"An Econometric Analysis of the price determination process in the Greek manufacturing industries, 1963 - 1977"

by Arakel Bedrossian

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CONTENTS

To my father's loving memory

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ABSTRACT

This thesis examines the determining factors of price changes in the two-digit SIC industrial sectors of Greece during the period 1963i - 1977iv. Altogether five pricing-hypotheses are formulated and subjected to empirical testing.

Short-run price models are examined first and include the neoclassical price determination and average cost models. The first is based on an explicit maximization of a profits function while the second is of the markup or cost-plus variety.

Long-run price models that are differentiated from the short-run by their use of "standard" rather than actual cost and output are discussed next. These models include the full-cost, target-rate of return and normal cost models all of which set prices as a markup on standard costs. Prior to this the calculation of standard costs is described, which involves formulation and empirical estimation of equations describing hours, earnings, employment and materials volume.

All five price-models are tested against the data of 21 two-digit industrial sectors that cover the whole spectrum of Greek manufacturing. A non-nested procedure is implemented to test for sectors in which the data generation process is described by more than one pricing hypotheses.

Results are produced for individual sectors. In general cost elements overwhelmingly outperform demand elements for the majority of the sectors examined. Furthermore short-run hypotheses and in particular average cost seem to perform better than long-run models during the period under examination.

INTRODUCTION

During the last 15 years inflation has been presented as a major if not the major of the problems facing the Greek Economy. Successive Governments have attempted to tackle inflation through macroeconomic policies of either Keynesian or monetarist spirit that have to a large extent been successful in Western Capitalist Economies but have as yet to be met with success in Greece. In this thesis inflation is examined in a more or less microeconomic perspective in view of our confinement of the explanation of the price determination process to the manufacturing sectors. Agricultural firms do not individually determine the price of their products; in the usual terminology they are price takers, not price makers. Prices in the services sector are by and large the prices of the firms in regulated industries that are determined by government agencies.

The fundamental question facing researchers in the area of inflation is whether price changes respond to changes in costs or changes in demand and if so to what extent. Indeed the question traces back as far as the publication of the "General Theory" where it is suggested that a capitalist economy in recession would show little price response to changes in aggregate demand. On the other hand monetarism argues that changes in aggregate demand lead rapidly to price changes. The methodology proposed in this study to explore these questions can be summarised as follows:

The basic assumption is that the pricing behaviour of the industrial frims in question is conducted within a non-competitive market structure that ranges from monopolistic competition to monopoly. By this we mean that in most if not all Greek manufacturing sectors the pricing decision is dominated by a few firms. Once this assumption is granted then a number of alternative models are explored in an attempt to search for the best representation of the pricing generation process in each of the industrial sectors involved. All these models can be described by the following statement

"In a single industry its particular price level depends partly on the rate of remuneration of the factors of production which enter into its marginal cost and partly on the scale of output. There is no reason to modify this conclusion when we pass to the industry as a whole"

J. M. Keynes (1936) p.294.

Five alternative price models are examined in this study all of which can be broadly described by the above statement. It is by no means asserted that these five models exhaust the spectrum of possible price determination theories. Nonetheless it is felt that given the assumption about the market structure within which Greek industrial firms operate, these five models, taken together, represent quite sufficiently the data generation process of industrial prices in Greece. Each of these models provides an operational framework for testing the above mentioned questions, whether that is (industrial) price changes respond to changes in costs or changes in demand and to what extent.

The first model to be examined is the neoclassical price determination model based on an explicit maximization of the profits function and resulting to an equation whereby the price is a function of the prices of factors of production, an income term and an index of "other prices". The second is the average cost model according to which price is determined as a markup upon unit factor costs which may or may not include capital costs and in any case are calculated at the actual output level. Markup is modelled to depend on an index of demand pressure variables, the expectation being that markup and hence prices respond positively to changes in demand.

The next category of models includes pricing hypotheses of the markup variety but calculations of costs are not based on the actual day to day output levels but on a notion of output that came to be known in the literature as standard or normal output. In all these equations the markup is again modelled as a function of demand the expectation however is that changes in demand do not play any role in the determination of the markup and hence prices. Pricing hypotheses in this category include the full-cost model whereby the price is determined by the standard unit factor costs including standard capital costs and the target rate of return model where price is set at such a level in order to achieve a target rate on capital (or on sales). Finally a test is also conducted of the recently proposed normal cost model which is similar in context with the full-cost model but examined as a special case since it provides the most analytic as yet treatment of the problem of cost and demand influences on prices.

On the basis of the empirical results obtained by the estimation of the above models a non-nested procedure is employed in choosing wherever possible, one model that is considered to describe the data generation process in the best possible way. On the basis of the results provided by this non-nested procedure it is then possible to (re)examine the original question of whether and how price changes respond to cost and demand changes by merit of the performance of the individual cost and demand coefficients, since by now each sector will be represented by one pricing model.

In summary our findings suggest that on the whole (ie. in most of the sectors examined) industrial price changes respond quite reasonably to changes in costs as these are measured either by factor prices or unit costs (calculated at either the actual or standard output level) but are impervious to changes in demand. This conclusion does not as such resolve the issue between "Keynesians" and "monetarists" ; In fact it indicates that if demand affects industrial prices it does so only through factor prices that is by influencing the cost of labour, materials (and to a relatively lesser extent) capital inputs.

The thesis contains six chapters. Chapter 1 presents a brief presentation of price form ation models by exploring the background and origins of pricing theories. Pricing behaviour in both competitive and non-competitive markets is examined, but special emphasis is attached on the markup price determination hypotheses. Each of the different five models is treated in a separate section and is accompanied by a brief survey of the existing literature particularly with respect to applied works.

Chapter 2 deals with a number of issues involving the data and also provides an explanation of the econometric methodology. The data considerations include a brief representation of the Greek industrial sectors and a description of the sources and existing relationships between the various variables. Furthermore the relationship between implicit sectoral deflators and (sectoral) wholesale prices is examined and the choice of the former as the dependent variable is warranted. Finally the last section of this chapter examines the procedure of setting testable hypotheses for the price models under consideration and describes our strategy for model selection.

Chapter 3 examines the short-run price models; the neoclassical and average cost equations. A brief description of the demand and production functions used for the derivation of the neo-classical price is followed by an examination of the character-istics of the neoclassical equation. A section describing the specification of the independent variables preceeds the estimation and testing of the neoclassical model. The average cost model is then examined. Special sections are devoted to the treatment of labour productivity and capital costs, to a comparison with the neoclassical model, to the role of demand and to the determinants of the markup prior to the derivation of the average cost model. Specification of the independent variables is followed by the presentation and discussion of the average cost model results.

Chapter 3 is supplemented by Appendix 3 where a detailed analysis of the procedure used for the generation of the independent variables in both short-run models can be found. These include wage rates, materials prices, "other prices", the generation of demand variables etc., but particular emphasis is given in the derivation of numerical estimates for the user-cost of capital.

Chapter 4 deals with the calculation of standard (normal) costs.

Each input on the standard unit normal costs is treated in a separate section involving the formulation and estimation of models of hours worked, earnings and employment for male and female manual and non-manual workers for each of the two digit SIC sectors. The estimation of a materials input equation is also examined and the chapter is concluded by a description of the procedure by which standard unit costs based on the estimates of of the above equations can be calculated.

Chapter 5 presents the long-run pricing theories: full-cost, target rate of return and normal cost models. A theoretical explanation of the markup or target rate determination is carried out through the apparatus of the limit-price theories and the kinked demand curve. The full-cost pricing model is then examined formulated and tested empirically. The discussion of the target rate model involves among others an examination of the features of the target rate model, the specification of the target rate and an estimation and discussion of the results of the target rate equation. The normal cost model is finally formulated, estimated and tested. Particular attention is devoted to the generation of "predicted" or normal prices by specifying the procedure by which prices respond to normal unit labour and normal unit materials costs.

Chapter 5 and in particular the last section devoted to normal cost is supplemented by Appendix 5, where a detailed analysis of the production period, the pricing policy and the pattern of lags and the derivation of normal unit labour and normal unit materials costs can be found.

Finally in chapter 6 the accepted models from chapters 3 and 5 are compared through a non-nested test procedure. On the basis of these results the evidence is recapitulated and the final conclusions are drawn.

CHAPTER 1 : Price Formation Theories

1.1. Introduction

This chapter serves as an introduction to the price theories that will be formulated and tested empirically in latter chapters. Broadly speaking, a distinction is made between theories that are based on short-run profit maximization and apply the marginalist principle (MR = MC) in determining price,and markup models. In Section 1.2 we discuss the background and origins of pricing theory. Section 1.3 is concerned with the various pricing responses; marginalist behaviour in competitive and non-competitive markets and markup models such as average cost, full-cost, target rate of return and normal-cost are discussed and surveyed. References are given throughout section 1.3, but the discussion of existing papers is rather selective, since the purpose of this chapter is the presentation rather than the surveying of price models.

1.2 Pricing theories: the background and origins.

Although the role of pricing has been a central feature of economic analysis for more than a century, there are still many unresolved issues concerning both the theory as well as the empirical verification of price mechanisms. A major source of confusion seems to arise from the fact that empirical evidence on pricing is to a lesser or higher degree at conflict with the established set of price theory.

Economists started to pay attention to business pricing practices during the mid-thirties and ever since there has been a flurry of published works referring to various topics of pricing literature. The starting point for the theory of price was a central proposition in the theory of imperfect competition put forward by J. Robinson (1933) and E. H. Chamberlin (1933) to the effect that the price of a product is so chosen that the firm's marginal revenue equals its marginal cost.[1] Before that the firm as a decision maker was completely ignored by classical economists because under perfect competition the price of a firm's product was given uniquely to it by its horizontal demand curve. The fundamental innovation effected by the theory of imperfect competition was that monopolistic elements became an integral part of price formation in most markets. The very fact however, that the firm became the focus of the pricing decision had another consequence; empirical researchers were now able to test the notion of equality between marginal revenue and marginal cost as the golden rule of price determination. Moreover, since the equality between marginal revenue and marginal cost has been stated by the theory of imperfect competition as nothing more and nothing less than a criterion for achieving maximum profit, empirical research went on to question the rationality of the objective of profit maximization. This was further reinforced by the fact that during the depression of the thirties, prices remained rigid in the face of a low and declining demand, whilst marginal analysis would forecast price reductions to achieve profit maximization. The great debate that followed - the marginalist versus full-cost debate[2] - never really questioned the validity of the marginal principle as a necessary condition for a maximum. What was at stake was either the objective of short-run profit maximization or the application of the marginal principle by the firm as a decision rule in its attempt to reach its objective.

The empirical research on price determination that was undertaken, originated with the article by R. L. Hall and C. J. Hitch (1939) and took either the form of questionnaire studies or econometric investigation. Pricing practices usually referred to in the literature as "rules of thumb" like average cost pricing, full-cost pricing, target rate of return pricing and nominal cost pricing - among others - emerged from that research as the true and only true pricing methodology that the firm followed under a set of conditions regarding the structure within which it operated. All these practices are common in the sense that they refute the marginal principle as either unknown or incomprehensible by the businessman and on the other hand agree on the fact that prices are calculated on the basis of some figure expressing average costs with a margin marked-up to account for profits. The common characteristics of the mark-up theories stop here. There is no consensus on what elements of costs should be marked-up or whether costs should be calculated at the actual or some other notion of output and on whether mark-up is affected by market conditions or not and, if so to what degree. In the next section all these matters will be clarified within the framework of presenting the pricing theories that dominate the current literature.

1.3. Pricing theories: an exposition.

1.3.1. Model classification.

Many theories exist on how firms determine their prices and consequently on how prices change. The preceding discussion offers a useful criterion for the classification of these theories into two broad categories. The first general class of theories are those assuming profit maximising behaviour on the part of the firm: perfect competition, monopolistic competition, classical monopoly and oligopoly models fall into this category. These models can further be classified into models where the firm is assumed to behave as a price-taker exercising no discretion over the price to be charged and models where the firm is to a lesser or higher degree responsible for setting its price. Everything, but perfect competition belongs to the second category of price making models. One of the characteristics that differentiate classical theories is the assumption used about the number of sellers in the market. This may range from a relatively large number, where some discretion is allowed over the price (monopolistic competition) to a simple seller (monopoly).

The second general class of theories are those assuming that firms are able to add a profit-increment to their estimated costs to derive their price. These are the mark-up or cost-plus models and the main part of this thesis is devoted in the formulation and the estimation of such models. A number of theories have appeared in the literature with regard to mark-up models depending on the determinants of the mark-up and on the way unit costs are calculated. Following only the last characteristic we can summarize these models without any significant omission into the following: average cost pricing, full-cost pricing, target rate of return pricing and normal cost pricing. Each of these models will be discussed briefly in the remaining part of the section. Latter chapters will be devoted in the empirical formulation and testing of these models. Before that, however, a brief exposition of profit maximising theories is necessary, since in many respects, mark-up models are directly related to the former.

1.3.2. Marginalist behaviour: competitive markets.

The first model to be examined is that of the perfectly competitive firm. Perfect competition is a very good description of many of the complicated markets of today despite views about the opposite. Financial markets, primary commodities markets, futures markets etc., are good examples of the realistic nature of the perfectly competitive model. For industrial markets however, there is an almost complete agreement among economists that monopolistic elements are their dominant characteristic. This does not necessarily render the perfectly competitive model useless in this analysis. What is going on in imperfect markets can only be examined in relation to the workings of perfect competition. The theory of perfect competition assumes, among other things, that (a) the firm is a profits maximizer,(b) there is free entry into the industry,(c) the product of the firm is homogeneous. The last two assumptions guarantee that neither the firm nor the industry has any discretion over the price to be charged.[3] Firms are the therefore price takers in the sense that they face a perfectly elastic horizontal demand curve and therefore the price that occurs is unaffected by their actions; the only possible way is to adjust output so that price equals marginal cost. This in turn, ensures short-run profit maximization. The question, however, that arises is how do prices ever change in such a situation. In a competitive environment prices respond to the difference between demand and supply, or formally

(1.1) $\frac{1}{P}\frac{dP}{dt} = K\ (Q^D - Q^S)$

The system was supposed to function through an external agent, the auctioneer, who declared prices, collected the demands and supplies at those prices and finally cleared the market by raising prices when demands were higher from supplies and lowering prices when supplies exceeded demands. Implicit in the workings of the system was that trading took place when and only when equilibrium prices were found. Disequilibrium trading was not allowed. This is the so called tâtonnement process and has been criticized mainly on three grounds:

(a) the ficticious nature of the auctioneer (b) the fact that disequilibrium trading is ruled out and (c) the assumption that all firms are price takers.

What happens with regard to price adjustments in the absence of the auctioneer, when the market is in a disequilibrium situation was the question to which K. J. Arrow (1959) addressed himself. The main issue developed in his paper is that in a competitive equilibrium firms are price takers, but in disequilibrium each producer is faced with a downward sloping demand curve. Since therefore in disequilibrium each producer becomes a monopolist, he can set his own price and, therefore, there is no reason to expect only one market price. K. J. Arrow's (1959) lead has been followed by a series of papers[4], each of which examined various aspects of the disequilibrium dynamic properties of the optimum price setting behaviour of the firm, departing however, from the assumptions of perfect competition.

Nonetheless there is a number of empirical works that are based on (1.1) and either implicitly or explicitly assume a perfectly competitive market. It is not the purpose of this section to produce a survey of all works since there are many published surveys that thoroughly discuss these papers.[5] As a point of reference however, we can classify papers that in one way or the other use an excess demand approach in the price determination equation into the following categories.
(a) "Friction models"[6] which include works by R.S. Barro (1972), E. S. Phelps and S. Winter (1971) and J.A. Carlson (1978) among others, but no empirical papers as yet.[7] (b) "Expectations models" where price changes are explained in terms of excess demand and expected changes in prices and costs,[8] and include papers by M. Parkin, M.T. Summer and R. Ward (1976), G.W. Smith (1978), P. Tomkinson (1981), and L.S. Maccini (1978). (c) "Pure excess demand models", such as those by B.T. McCallum (1970), F. Rushdy and P. Lund (1970), R.M. Solow (1969), F. Brechling (1972), A. Brownlie (1965), L.C. Andersen and F.M. Carlson (1972), B.T. McCallum (1974), N. Duck et al (1976) and J. Johnston et al (1964). Moreover pricing models distinguishing between production to order and production to stock also fall in this category. Papers by O. Eckstein (1964), G.A. Hay (1970), V. Zarnovitz (1962) and T. Courchere (1969) are important examples of this category.

Summarising the perfectly competitive model we note that (a) Perfect competition is not a good description of industrial markets and (b) In equilibrium price is determined by adjusting output so that price equals marginal cost, while in disequilibrium price is changed responding to the difference between demand and supply.

1.3.3. Marginalist behaviour: non-competitive markets.

In its most general form monopolistic pricing is characterised by three elements: (a) the assumption of profit maximization (b) the existence of a downward sloping demand curve for a single differentiated product and (c) the existence of an average cost curve that is traditionally U shaped to cover all possibilities of increasing decreasing and constant costs with respect to output. The essential difference from the perfectly competitive model is given by assumption (b) that includes a demand function which relates output inversely to price as in (1.2)

(1.2) $P = \alpha D(Q)\ ,\ \partial P/\partial Q = D' < 0$

where P= price, Q= output and α= a demand shift parameter.

The firm has a cost function that is the sum of variable costs ($\beta V(Q)$) and fixed costs (F) given by (1.3)

(1.3) $C = \beta V(Q) + F\ ,\ \partial C/\partial Q = C'(Q) = V' > 0$

where C= cost and β= factor price shift parameter

The firm is a short-run profit maximizer. The profit function (Π) is given by (1.4)

(1.4) $\Pi(Q) = P.Q - C(Q)$

Profit maximization occurs if and only if conditions (1.5) and (1.6) are satisfied

(1.5) $\Pi'(Q) = P + Q\frac{\partial P}{\partial Q} - C'(Q) = 0$

(1.6) $\Pi''(Q) = 2\frac{\partial P}{\partial Q} + Q\frac{\partial^2 P}{\partial Q^2} - C''(Q) < 0$

Since $P + Q\frac{\partial P}{\partial Q}$ is the first derivative of total revenue (PQ), ie MR, then equation (1.5), the first order condition, may be written as (1.5')

(1.5)' MR=MC

Since $2\frac{\partial P}{\partial Q} + Q\frac{\partial^2 P}{\partial Q^2}$ is the derivative of MR and C"(Q) is the derivative of MC, equation (1.6) may be written as

$$(1.6)' \qquad \frac{\partial MC}{\partial Q} > \frac{\partial MR}{\partial Q}$$

which states that the slope of the marginal cost curve must exceed the slope of the marginal revenue curve at the optimal profit maximising output. Equation (1.6)' is the sufficient condition for profit maximisation. If marginal costs are increasing with output, then (1.6)' will always hold, since by assumption marginal revenue is diminishing with output, ie [9]

$$(1.6)'' \qquad \frac{\partial MC}{\partial Q} > 0 > \frac{\partial MR}{\partial Q}$$

Equation (1.5) may be further written as

$$(1.5)'' \qquad MR = P\left(1 + \frac{Q}{P}\frac{\partial P}{\partial Q}\right) = MC$$

Since however the point elasticity of demand (η) is defined as

$$(1.7) \qquad \eta = -\frac{P}{Q}\frac{\partial Q}{\partial P}$$

equation (1.5)" may also be written as

$$(1.5)''' \qquad MR = P\left(1 - \frac{1}{\eta}\right) = MC$$

from which the pricing decision rule for monopolistic pricing can be defined as in (1.8)

$$(1.8) \qquad P = \left(\frac{\eta}{\eta - 1}\right) MC$$

The elasticity of demand can take any value between 0 and $-\infty$, or by omitting the negative sign

$$(1.9) \qquad 0 < \eta < \infty$$

if $\eta=0$, then demand is perfectly inelastic

$\eta=1$, demand has a unitary elasticity

$\eta=\infty$, demand is perfectly elastic

$0<\eta<1$, demand is inelastic

$1<\eta<\infty$, demand is elastic

Equation (1.8) establishes a price determination function in it's most general form. As it stands it depicts an equilibrium relationship between price, marginal cost and the elasticity of demand. As such it does not yield a form amenable to econometric verification not only because it represents an equilibrium situation, but also because the arguments on the right hand side are unobservable. Before however introducing specific demand and production functions that will render equation (1.8) a testable hypothesis, it is interesting to examine a number of points that can be directly deduced from (1.8) and are closely related to subsequent sections of this chapter.

1. The firm that exercises some degree of monopoly power will choose a price that will always be higher than the marginal cost. From price equation (1.8) this difference is equal to $\eta/\eta-1$. Since the elasticity of demand for the monopolist is finite, taking values up to infinity, but never infinity (the perfectly competitive case), $\eta/\eta-1$ guarantees that P will always be larger than MC in cases where monopolistic elements exist. In the perfectly competitive model on the other hand P=MC.

2. Because under perfect competition market price will be equal to each firm's marginal cost the extent of the divergence of price from marginal cost is regarded as a measure of the degree of monopoly power exercised by the firm. From (1.8) we have

$$(1.10) \qquad \frac{P-MC}{P} = \frac{1}{\eta}$$

Where the left hand side of (1.10) is A.P.Lerner's (1934) monopoly power index. As the demand curve becomes perfectly elastic, monopoly gains disappear (perfect competition).

3. The previous point brings the question of what is the plausible range of the elasticity of demand. By equation (1.9) η can take any value between 0 and ∞. However a profit maximising situation is attainable only with an elastic demand curve. From equation (1.8), since marginal cost is always positive, the optimal profit maximising output should always be at a point on the demand curve where $\eta>1$. Equation (1.9) can therefore be replaced by equation (1.9)' that guarantees profit maximization.

(1.9)' $1<\eta<\infty$

4. Since price is higher than marginal cost, many authors have viewed $\eta/\eta-1$ as the markup that the monopolist changes over his costs (in this case marginal costs) to arrive at a price that in this case maximizes profits. Under certain conditions that relate to the shape of the average cost curve (and hence the shape of the marginal cost curve) equation 1.8 can be seen as nothing less and nothing more than one of the decision rules that are applied on markup models.[10]

5. If we are to assume that $\eta/\eta-1$ accurately represents the markup factor of the cost-plus models an obvious question is how the markup, ie the elasticity fluctuates over the cycle. The expressed view in many papers[1], particularly the early works on markup models is that elasticity remains fairly constant over time. A possible justification for the perceived constancy of the elasticity over time could be the fact that the enterpreneur has no means of accurately forecasting the elasticity of demand for his products during the course of a trade cycle. However in terms of equation (1.8) this can only be true if the firm is faced with a demand function for which shifts (due to a change in α, equation (1.2)) are isoelastic with respect to price. Since this is an unlikely possibility, the elasticity of demand will fluctuate over time.

The movement of elasticity over the cycle is affected by the pressure of demand. The relationship between demand pressures and the elasticity of demand will be examined in chapter 3.

There is a number of studies testing empirically price determination equations that are based on an explicit profit maximization model of the type just discussed and which are commonly named neoclassical because of the assumptions used. Almost all of these papers have followed W. Nordhaus (1972) in deriving empirically testable equations by introducing specific demand and production functions. A typical neoclassical equation in a general functional form expressing price as a function of input prices and demand can be given by (1.11)

(1.11) $Pn = f(w,q,v,Y)$

where Pn = (neoclassical) price

w,q,v = factor prices for labour, capital and materials respectively.

Y = a measure of demand usually proxied by disposable income.

W.D. Nordhaus (1972) has investigated in detail a wide range of neoclassical price equations by specifying the production and demand functions facing the firm. First the profit function is maximized to find the optimum output flow and then, given the demand function, the profit maximizing price is derived. The assumption of long-run profit maximization coupled with the assumption of no intertemporal interdependencies guarantees profit maximization at every point in time. Furthermore, it offers a framework for comparing neoclassical with markup models since in the long-run all markup models implicitly or explicitly assume profit maximization.[12]

The models that are briefly discussed below are strictly neoclassical in the sense that all derive price based on short-run profit maximization as a function of factor prices and income. Models by J. Kwak (1974) and B. Laden (1972) found significant positive coefficients on the factor price variables and negative coefficients for demand. T.D. Sheriff (1979) compared a markup model of the average cost variety based on the R.Lipsey and M. Parkin (1972) model and a variant of the neoclassical price equation for five industrial sectors and the total U.K. manufacturing industry. Demand was proxied by industrial production index and produced a negative coefficient, while the coefficients of factor price variables were all positive. V.B. Hall (1977) tested various alternative neoclassical equations in an attempt to specify the "best" price equation for the Australian manufacturing sectors during the period 1955-1968. A Cobb-Douglas constant returns to scale production function was used to derive the price equations tested in the paper. Of the many alternatives only one equation was reported significant. L. Shahling (1977) used a neoclassical approach to analyse empirically the speed of price adjustment to changes in costs for the non-food U.S. manufacturing sectors during the period 1955-1971. The price equation is estimated in a manner similar to that of W. Nordhaus (1972) with the exception of the specification of the demand function. A partial adjustment mechanism ranging from full to zero adjustment is introduced resulting in a number of models, that are finally compared between them empirically.

W. Moffat (1970) went on to test if the introduction of taxes should be considered as an explanatory variable in a price determination equation by comparing models based on different assumptions, one of which is the neoclassical model. Finally there is a number of models that are based on neoclassical assumptions but do not test the price equations as such. Instead the neoclassical framework is used as a basis for testing various hypotheses; administered price inflation[13], profits bahaviour[14], performance of the price equation in large disaggregated economy models[15], etc Although this small survey is by no means exhaustive it concludes the discussion on theories that use marginal principles and are strictly based on short-run profit maximization. A neoclassical model will be formulated and tested in chapter 3. Until then however, markup models remain to be presented.

1.3.4. Markup models: general considerations.

Neoclassical hypotheses about price determination are centered around the proposition that the firm is a short-run profit maximizer and for that purpose a strict application of the rule

(1.12) $P= f(MC)$

where f is a function of demand elasticity, has to be applied. The criticism on the neoclassical theory was based among other things on the empirical observations that many researchers have reported to the effect that

1. The firm is not necessarily a profit maximizer in the short-run, although in the long-run profits are maximized.
2. Even if the firm is a short-run profit maximizer, it does not achieve its objective by applying rule (1.12) since (α) marginal costs are unobservable or impractical to use as a decision pricing rule, being extremely costly to calculate and (b) Demand pressure which is assumed to affect changes in the elasticity is not considered to be a determining factor of price, although the views on this particular point are by no means unique. Instead prices are set as a markup on average costs, that can be average variable or average total costs, which can be calculated at the actual output that the firm is producing, or at a notion of output that the firm regards as normal or standard, or any other combination, depending on the pricing rule used. Markup can be considered as never varying with demand, or being a function of demand. To cover all possibilities markup models can be summarized by (1.13) as

(1.13) $P= (1+m(Q))\ C(Q)$

where $m(Q)$ is the markup

Markup pricing first appeared in the literature with the R.L. Hall and

C.J. Hitch (1939) paper, whose findings were to a large extent divergent from what the classical theory was able to predict about price determination. Further evidence was offered by a series of studies, the early works being in a form of questionnaire and based on direct observation, while the latter works were based on econometric analysis. Generally speaking all these studies can be summarized with regard to (a) their treatment of the markup and (b) their treatment of costs on which the markup is based.

With regard to the markup the firm has three options: (α1) Never to vary the markup. (α2) To adopt a markup that remains fairly constant but changes only in unexpected demand conditions (α3) To adopt a markup that systematically varies with changes in demand. The first case involves a price determination equation that consists only of cost factors. The second case may or may not have demand elements, while the third case implies that both cost and demand factors affect price.

Turning to the cost side the firm has the following options: (α) To exercise a markup on average unit costs that may or may not include capital costs, calculated at the actual, day to day output rate, or (b) To exercise a markup on average total costs that are calculated at a rate of output that is different from actual output and is considered by the firm to be its "normal" operating output. Such a calculation ensures that fluctuations in demand will have a minimal effect on output and hence price.

A number of studies some of which are based on questionnaires and some of which are econometric models can be surveyed using the above classification as framework. Econometric models are discussed with reference to the particular form of markup practice used. Questionnaire studies usually touch on many aspects of firm's behaviour and include large and diversified numbers of issues. Studies by R. Heflebower (1955), M.A. Adelman (1949), P.W.S. Andrews (1949), D. Hague (1957), B. Fog (1960), P.J.D. Wiles (1961), J.M. Clark (1961), A.D.H. Kaplan et al (1955), R. Lanzilotti (1958), I.F. Pearce (1956), R. Robson (1957), A. Fitzpatrick (1964), R.C. Skinner (1970), R. Smyth (1967), W. Haynes (1964), R. Barback (1964), H.R. Edwards (1964), etc. provide supporting evidence for markup pricing on one form or the other and and are to a large extent surveyed by D.H. Hay and D.S. Morris (1979) and A.J. Silberston (1970).

What these studies fail to establish however is that markup pricing is a theory different from other theories of the firm, not only those discussed previously. The compatibility of markup pricing rules with various models of firm's behaviour as for example W. Baumol's (1967) sales maximization hypotheses or R.M. Cyert and S.G. March's (1963) satisfycing behavioural model have been shown in the recent study of M.C. Sawyer (1983)[16]. Furthermore the markup models discussed will be examined with reference to neoclassical profit maximizing assumptions. For example in chapter 3, it will be shown, that under certain conditions average cost pricing reduces to the profit maximizing price of a monopolist or a monopolistically competitive firm.

The question therefore that obviously arises is whether markup pricing models constitute an established part of a theory of firm's behaviour or whether they are simply pricing practices adopted by firms for various reasons. All theories of the firm are based implicitly or explicitly on a specified goal. A number of goals has been suggested, each of which is connected with a different model explaining firm's behaviour. Profit maximization, maximization of some managerial utility function (that can be either W. Baumol's (1967) sales maximization or R. Marris's (1963) balanced growth), satisfying behaviour, long-run survival and entry-prevention are some of the goals reported in the literature. However despite a small number of studies that have examined the relationship between firm's ownership and its performance,[17] in general there is no empirical evidence with regard to firm's objectives. Markup models on the other hand, do not specify the objectives of the firm whose pricing decision they describe, or if they do,[18] they implicitly or explicitly assume that these objectives serve the purpose of long-run profit maximization.

Given that none of the markup models that will be discussed in detail in subsequent chapters is based on optimising behaviour of any kind, it seems that markup models are rather pricing practices, not theories. Heuristic explanations, such as limit pricing theories used to explain the level of the markup or target rate in the full-cost and target rate of return pricing models respectively or P. Sweezy's (1939) kinked demand curve employed to explain the price stickiness observed by R.L. Hall and C.J. Hitch (1939) and others and used in association with the full-cost model, do not provide a theory of markup pricing but merely help in the description of the pricing procedure. This by no means invalidates the use of markup models. First it might be argued that if long-run profit maximization is the goal of the firm, then the pricing practice by which this goal is attained is one of the markup rules and not the application of the marginalist principle. Second, even if this is not the case, markup models provide pricing descriptions that are of significant use with regard to policy measures concerning inflation, particularly when compared to theories that explain firm's behaviour but do not yield forms amenable to empirical verification. The old but as yet unresolved issue about cost-push or demand-pull inflation with its consequent repercussions about policy perscriptions is far better explained in terms of a markup price equation, that is able to discriminate between cost and demand changes, than by any other price model.

Markup models should therefore be regarded as pricing practices that have been adopted by industrial firms as the most realistic way to arrive at long-run profit maximization. A variety of purposes can be said to be served by markup models in the short-run as for example reduction of uncertainty or market co-ordination,[19] none of which however explains the motivation and hence the decision making of firms. Markup models are rules of thumb providing a practical device for firms in the complex industrial world and leading to long-run profit maximization.

The implications of markup models are not confined only to prices, but extend to profits and real wages as well. If price is a markup on average costs, then the price-cost margin will be solely a function of markup M(=1+m(Q)) as in (1.14)

$$(1.14) \quad \frac{P-C(Q)}{P} = \frac{M-1}{M}$$

which, if we are to assume long-run profit maximization and constant average costs , reduces to

$$(1.15) \quad \frac{P-C(Q)}{P} = \frac{1}{\eta}$$

by equation (1.8).Furthermore assuming for convenience that total costs comprise only of labour costs, then equation (1.13) can be written as

$$(1.13)' \quad P= M.\frac{w.N.}{Q}$$

where w,N,Q are wage, employment and production value respectively Rearranging (1.13)' we have

$$(1.13)'' \quad \frac{W}{P} = \frac{1}{M}\left(\frac{Q}{N}\right) = \left(1-\frac{1}{\eta}\right)\frac{Q}{N}$$

which is a real wage equation. Similarly equation (1.13)′ can be written as an income distribution equation,[20] as

(1.13)''' $w.N = (1-\frac{1}{\eta})\ PQ$

where $MPQ = (1-\frac{1}{\eta})\ PQ$ is the share of wages in production.

In the following paragraphs we will examine markup models that have dominated the empirical literature based on econometric analysis: average cost, full-cost and target rate of return pricing models. Furthermore, special emphasis will be given in the estimation of the normal cost model, which is essentially similar to full-cost because of its relative significance in discriminating empirically between cost and demand influences on prices.

Markup models can be classified into short-run and long-run according to the time horizon within which the enterpreneur bases his cost calculations. Average cost model, together with the neoclassical model will be regarded as short-run, while all other markup hypotheses as long-run. The same distinction is applied in P.H. Earl's (1973) survey on prices and also in W.D. Nordhaus's (1974) study with reference to profit theories. Short-run models base the calculations of unit costs on actual output. Demand fluctuations affect price either through the markup or through their effects on unit costs. In the long-run theories on the other hand pricing policy has been connected with other decision objectives of the firm, such as investment policy. According to R.S. Ball (1974)

"Pricing and investment policies will not be determined directly by the current demand, but will be affected by it only to the extent that current movements in demand cause a reappraisal in the basic long-term forecast or expectation. The longer the horizon encompassing the expectation the smaller the effect is likely to be of a short-period shift in demand on current price and investment policies".

The long-term forecast or expectation that the enterpreneur forms about output by movements in demand that are regarded as permanent is the standard or normal output. Calculation of unit costs of long-run price models is based on that output.[21] In general standard output is a function of capacity output with actual output fluctuating around standard output.

All markup models have been summarized in equation (1.13). Anticipating following chapters, it is possible to distinguish all markup models on the basis of (1.13). Ignoring at the moment, the way markup is affected by demand, (1.13) can be written as (1.16)

$$(1.16) \quad P = (1+m)AC = (1+m)\frac{TC}{Q}$$

where AC, TC = average and total costs respectively

Define total costs as

$$(1.17) \quad TC = w.L + v.M + \tau K$$

where w, v, τ are the prices of labour, materials and capital respectively

L,M,K are employment, materials volume and stock of capital.

(1) If a strict application of average cost markup is in practice, then

$\tau = 0$, $m > 0$, and $Q = Q$ (actual output)

(2) If full cost pricing is the model actually applied, then

$\tau = 0$, $m \neq 0$ and $Q = QN$, where QN is standard output

(3) If target rate of return pricing is in order, then

$\tau > 0$ (τ is the rate of return on capital), $m = 0$, and $Q = QN$

The next subsections briefly discuss these markup pricing models.

1.3.5. Average Cost Pricing.

Average cost pricing sets the price as a markup over actual costs. The markup may enter either multiplicatively as a percentage over costs, or additively as a fixed absolute sum. In both cases the markup may or may not vary with demand conditions according to the classification presented in the previous subsection. The precise way by which the markup is influenced by demand conditions will be examined in chapter 3, where a testable hypothesis based on average cost pricing is formulated and estimated. Since the majority of studies following average cost pricing use the multiplicative markup version we will consider a typical model to be represented by (1.18)

$$(1.18) \qquad P_A = (1+\Pi)\, \frac{\beta V(Q)}{Q}$$

where all variables have been defined before and subscript A stands for average cost pricing. Before examining empirical studies that are based on average markup pricing, a number of issues that are directly related with equation (1.18) will be discussed.

First is the question of the elements that are included in the cost function. The literature suggests, following the lead of M. Kalecki (1939) that as a rule only average variable costs (prime costs in M. Kalecki's terminology) should be included, ie labour and material costs.[22] But then again part of labour cost consists of salaries that can be considered as part of fixed costs that the firm has to pay since they are not directly related with production. Although it is possible to give a precise definition of what is variable and what is fixed cost, in practice when estimating a pricing model, this may create a number of problems. Consider for example the identity expressing the value of output in terms of factor shares

$$(1.19) \qquad PQ \equiv wL + vM + \tau K + \Pi$$

Assuming that profits are a function-f-of output (PQ) then it is possible to express the above identity by dividing by Q and rearranging terms as in (1.20)

$$(1.20) \qquad P \equiv \frac{1}{1-f(Q)} [ULC + UMC + UCC]$$

where $\frac{1}{1-f(Q)}$ is the markup factor accounting for profits and ULC, UMC, UCC are unit labour, unit material and unit capital costs respectively.

Alternatively if we are to assume that capital costs are also a function of output, then equation (1.20) would become

(1.21) $$P \equiv \frac{1}{1-h(Q)} [ULC + UMC]$$

where now $\frac{1}{1-h(Q)}$ is the markup accounting for both capital input and profits.

Note that equations (1.20) and (1.21) are identities. A behavioural assumption is required on how the markup is determined, which is usually offered by introducing demand factors into the price equation. The markup however is supposed to account for profits and not for capital costs. A point therefore can be made that average cost pricing should include capital costs as an explanatory variable. W.D. Nordhaus (1972) makes a similar point when deriving a neoclassical price equation referring to the necessity of including capital cost variables in price determination equations.

On the other hand if we are to include capital costs, a question arises as to how these costs will be calculated. Recall that the average markup model is supposed to offer to the businessman a practical way of calculating his costs and arriving at a price that guarantees long-run profit maximization. Since capital costs remain constant in the short-run, but output flucutates, the calculation of the percentage of capital costs that would be included in the price of each and every output level is a particularly difficult task. The matter would have been easily resolved if we have considered that the businessman had based his calculations of unit costs not on actual output but on what he perceives to be his normal operating rate. This however will be left for the full-cost model. In practice we shall estimate the average cost model by including capital costs calculated at the current output rate. A strict application of the average cost model would imply that the coefficients on capital costs would be zero.

Second, from equation (1.18) we can see that all cost variables are expressed in terms of unit factor costs. Since unit factor costs are the ratios of unit factor prices to unit factor productivities a formulation such as (1.18) constrains the effect of factor prices and factor productivities over price to be equal (and opposite in sign). However, this may not be the case, particularly with respect to the labour input.[23]

Third, there is a number of issues left unresolved until chapter 3. These include
(1) the determinants of the markup and in particular the relationship between markup and demand conditions (ED) (2) the shape of the average cost curve and (3) the relationship between the average cost model and the neoclassical model. In a general form the average price equation to be estimated in chapter 3 will be

(1.22) $P_A = f(w, \frac{Q}{L}, \text{UMC}, \text{UCC}, \text{ED})$

The majority of the studies in price determination are reported to use some variant of average cost pricing. Studies by L.R. Klein and R.S. Ball (1959), J.C.R. Dow (1956), L.A. Dicks-Mireaux (1961) all use as explanatory variables wages, input prices and productivity explicitly or implicitly. Moreover they all assume that the share of profits in the value of output remains constant, thereby constraining the coefficient on ED (in terms of (1.22)) to be zero. Relaxing this assumption and allowing the markup to be a function of demand results in studies like those of R.G. Bodkin (1966), G.L. Perry (1966) where demand is proxied by a capacity utilization index, or G. De Menil (1974) where the ratio of unfilled orders to sales accounts for the demand pressure variable.

A number of studies have followed R. Lipsey and M. Parkin (1972) in a model where the rate of change of prices is a function of the rate of change of wages, productivity and materials and where no role is allowed for demand or any other variable in affecting the markup. L.G. Godfrey (1972), K.F. Wallis (1972) and P. Burrows and T. Hitiris (1972) are based on the R. Lipsey and M. Parkin (1972) model while F. Brechling (1972) includes demand with a number of lags. R.S. Ball and M. Duffy (1972) also use the Lipsey-Parkin model to examine price formulation in nine European countries. They show that if a distinction can be made between actual and normal output, then a further variable, the rate of change of the ratio of normal to actual labour cost per unit of output can be included in the explanation of price behaviour. The actual cost model augmented by this last variable yields good results for seven out of nine countries studied in the paper.

Large economy models by L.R. Klein and A.J. Goldberger (1955) and L.R. Klein and Y. Shinkai (1974) for the U.S.A. and Japanese economies respectively include price equations based on some average cost markup form with good empirical results. Y. Shinkai (1974) extended the price equation of the L.R. Klein and Y. Shinkai (1974) model to include capital costs (unit financial cost variable) as well as demand variable and applied his price equation to the Japanese manufacturing sector. He found that unit costs explain roughly half of the price variation. On the other hand, although demand variables were significant, added virtually nothing to the equation containing cost variables and also rendered labour cost variables insignificant.

Similar findings are reported in the models of M.E. Morkre (1970) and R.D. Rippe (1970), that used an average cost markup model to explain the behaviour of U.S. steel prices. Although they used different formulations in their demand variable they both agree on that steel prices are responsive to demand changes after account has been taken for the change in unit variable costs. Finally a study by F.C. Ripley and L. Segal (1973) employing average cost model in a cross-section estimation of 395 industrial sectors should be mentioned. Changes in unit labour costs, material costs and output are used to explain changes in prices yielding significant coefficients for all variables.

So far we have discussed various studies where price is seen as a function of short-run costs either expressed as factor prices or unit costs. The role played by demand factors was left vague since the examination of the relationship between demand and markup will be examined in chapter 3. A number of important studies like those by R.R. Neild (1963)(1973), F. Rushdy and P. Lund (1967) and B.T. McCallum (1970) have been omitted from this survey, since they will be examined in detail in connection with the role of demand in markup models.

1.3.6. Full-cost pricing

As a matter of definition full cost pricing has been presented in the literature in a somewhat dubious manner. Much of the confusion seems to arise from the fact that a number of authors have considered full-cost as comprising only of prime costs or have considered the calculation of costs, whether full or prime to be based not on standard but on actual output.[24]

All matters are probably cleared if we follow J.M. Clark (1961) in defining the full-cost price "....[as the] one that will cover costs under normal conditions of operations disregarding minor fluctuations. This means that it does not espouse the anomaly of raising the price if a downward fluctuation of demand reduces the operating rate and raises the unit cost by spreading the overhead over a smaller number of units. This anomaly is avoided if standard costs rather than actual costs are used".

J.M. Clark (1961) p.126.

Based on this definition full-cost pricing may be presented formally by (1.23)

$$(1.23) \qquad P_F = (1+\pi)\,\frac{C(QN)}{QN} = (1+\pi)\left[\frac{\beta V(QN) + F}{QN}\right]$$

where all variables have been defined previously and subscript F stands for full cost price.

A number of points that are relevant to full-cost pricing can be mentioned here. First is the question of whether full-cost is concerned with the level of prices or price changes. Sometimes this distinction is not made clearly as if it is unimportant. The full-cost model determines the level of price as that, that will earn a markup upon full-costs at the standard level of output. Furthermore, the markup will be influenced by many factors such as long-run profitability, structure of the market, including barriers to entry etc. and also demand conditions. The latter however are supposed to affect the markup only through their effect in changing the normal level of operation of the firm, and as such this affect on prices is likely to be small. This was further corroborated by the Hall and Hitch empirical findings to the effect that whenever full-cost pricing is applied, prices tend to remain sticky, despite fluctuations in demand. Whatever the underlying reason for price stickiness an expost justification is given to it by P. Sweezy's (1939) kinked demand curve. The basic assumption is that the businessman expects a reduction in his price to be followed by competitors in the market but not a price rise. This means that demand is inelastic with price decreases but elastic with price increases. The profit maximising price is therefore set at the full-cost price and thereafter does not change unless demand conditions change the businessman's view of normality, or unless standard unit costs change either because of a change in the input factor prices or a change in the standard output. Obviously the kinked demand curve does not explain the level of the full-cost price, instead it provides a justification of why prices remain sticky. Price stickiness however is far from well established empirically, particularly with regard to firms where the full-cost pricing is warranted, ie to firms enjoying some degree of market power. G.S. Stigler (1947) for example, based on a survey of approximately 100 firms has reported a negative correlation between the degree of concentration in an industry and the frequency of price change. In addition price rigidity was greater under monopoly where no kink could exist than under oligopoly, possibly suggesting that other explanations outside the kinked demand curve should be looked at, common to both market structures. J.L. Simon (1959) has also found no evidence for the kink since prices were as flexible in oligopolistic markets as they were in monopolistic ones.

A second question regards the market structure in which full-cost pricing firms operate. Although oligopoly has traditionally believed to be the appropriate market structure, full-cost pricing is applicable in any market where the firm is able to exercise some discretion in its pricing policy. R.L. Hall and C.J. Hitch (1939) inquiry that initiated full-cost pricing was based on 38 firms: 3 monopolists, 3 oligopolists and 32 monopolistically competitive firms. Later studies have examined larger numbers of firms, including small ones and all agree on the applicability of full-cost in markets where firms are to some extent price markers.

There is a number of studies employing econometric analysis in their determination of the full-cost price. One of the most important is that by C.L. Schultze and J.L. Tryon (1965) which is part of the large multiequation U.S. model, the Brookings model. Their price equation is presented as a three-part hypotheses: (1) Prices are set as a markup on standard costs (2) Temporary changes in costs, ie deviations of actual from standard costs also affect prices but to a lesser extent than permanent changes (3) The markup on standard costs is let to be influenced by excess or insufficient demand relative to available supply, which is proxied by the inventory-output ratio. Assymetry in price behaviour is tested by including as seperate variables both positive and negative deviations of actual from normal capacity utilization ratios. Price assymetry suggests that positive deviations are greater than the negative ones. Price equations are applied for aggregate manufacturing as well as other sectors. The regression results show that cost factors dominate the influences on prices. There is some evidence that the markups on normal costs are influenced by excess demand but in general the results show an insignificant role of capacity utilization in most of the equations. The hypothesis of assymetry is not generally confirmed. Nevertheless whenever the capacity utilization variable enters significantly, the positive deviations are greater than the negative ones.

D.G. McFetridge (1973) has used a variant of the full-cost model to show that demand factors are significant in determining prices even through a full-cost price equation. He first tested whether actual or standard unit costs are appropriate; the evidence was overwhelming in favour of the latter. Demand was either proxied by the deviation between the actual and the desired ratio of unfilled orders to sales and the deviation between the actual and the desired ratio of finished inventories to sales. Both variables generated significant and well behaved coefficients, suggesting a significant influence of demand factors in the full-cost price equation.

1.3.7. Target rate of return pricing.

The target rate of return pricing hypothesis asserts that the firm charges a price equal to average variable cost at standard output plus a margin designed to yield (at standard output) a certain rate of return on firms assets. Its main difference from the full-cost model is exactly on the treatment of capital costs. While the full-cost model determines price as a markup on total costs including capital expenditure costs at standard output, target rate of returns determines price as a markup that has to yield a sufficient return on firm's assets. More on that and the implications of the differences and similarities of these two pricing models with regard to price changes will be discussed in chapter 5. Formally target rate of return pricing may be written as

$$(1.24) \qquad P_T = \frac{\beta V(QN)}{QN} + \frac{(1+\tau)\ K}{QN}$$

where K is the firm's assets and subscript T refers to target rate of return pricing. How is the target rate determined, how does it behave cyclically and what kind of firms actually practice target rate pricing are some of the questions that need to be briefly mentioned here. In a line similar with previously discussed markup models, target rate of return does not specify a well-established theory able to determine the target rate. Nevertheless a number of authors have put forward a set of factors that can influence the target rate on capital. O. Eckstein and G. Fromm (1968) for example believe that

"The target rate of return is based on market structure and long-run economic conditions of the industry, including barriers to entry, international trade barriers, concentration, product differentiation, managerial talent, long-run demand elasticities, the degree of risk attached to profits and the valuation placed on the firm's equity and debt instruments in the capital market".

Most of these factors are able to explain why the target rate is different across industries, but not why the target rate differs (if it does) through time. Limit price theories[25] by focusing on the conditions of entry into an industry as the key determinant of the markup can indeed shed some light into the question. Under limit price theories, firms are preoccupied with long-run considerations and the prevention of entry is one of them. The price is therefore set at such a level that the potential entrant believes that entry will be unprofitable at the existing price and also will be unprofitable at the price that will exist after entry. So what is the existing price? It is the price that will deter entry and as such it will be less that the price that would have existed under short-run profit maximization and higher than the competitive price. Such a price will also serve the purpose of yielding a rate of return on capital invested. Broadly speaking therefore limit price theories are able to provide the upper limit of target rate of return price.

How the target rate behaves over the business cycle is another matter to be dealt with. A strict application of the target rate formula would require that demand elements play no role in target rate pricing. Such a formulation may be seen to imply that the target rate is constant through time and also that there is no deviation between actual and target rates of return. However both these implications are wrong as it will be seen in chapter 5. The difference between actual and target rates is explained by businessmen because of competition and market conditions.[26] Long-run demand considerations and not day to day changes in demand may affect the target rate in so far as the price charged corresponds to the price that prevents entry. It should be noted that none of the above arguments should be taken as introducing short-run demand changes as a factor affecting price changes. Such a hypothesis would clearly be irrefutable and thus devoid of operational meaningfulness. The target rate hypothesis states that short-run demand movements play no role in a target rate pricing formula. On the other hand target rate is affected by long-run demand considerations. Since we are only able to observe short-run changes in prices, costs and demand, the introduction of a demand pressure variable in a price equation such as (1.24) would serve the purpose of either verifying or refuting the target hypothesis depending (among other things) on the significance of the demand coefficients.

Full cost pricing was said to be applicable to firms with some discretion over the price they charge. As such any market structure other than perfect competition was considered to be relevant. Small firms were also found to practice full-cost pricing.[27] Empirical evidence on target rate of return pricing on the other hand was constrained on large corporations with multiple product chains as shown in the study by A.D.H. Kaplan etal (1955). Moreover target rate of return has been suggested as the appropriate pricing method in regulated monopolies. The very fact that the firm bases it's pricing decisions primarily on a desired return on capital invested thus ignoring to a large extent competitors reactions, indicates that a significant degree of market power is enjoyed by the firm. Evidence to that extent has been offered by O. Eckstein and D. Wyss (1979) and D. and M. Straszheim (1976) to the effect that industries with the highest concentration ratio have been found to be practicing target rate of return pricing. Econometric evidence on target rate is constrained to a limited number of studies probably due to the difficulties of measurement regarding capital costs. The best known paper is that by O. Eckstein and G. Fromm (1968) which is based on a model first discussed by O. Eckstein (1964). Price is a function of standard costs, deviation of actual from standard costs, the profit rate on capital and demand variables. Separate equations are estimated for price levels and price changes and are applied on the durable and non-durable U.S. manufacturing sectors. All variables are significant including demand. The same is not true in a latter study by O. Eckstein, that by O. Eckstein and D. Wyss (1972), where there are no demand variables in the target price equation. The profit-equity ratio that accounts for target rate on capital is significant and is used as an indication that the industry follows the target rate pricing rule. W. Moffat (1970) uses as a measure of target rate stockholders equity divided by unit output but does not find satisfactory evidence to suggest the use of target rate pricing. The same conclusion is also reached by D. Kamerschen (1975) in a study that does not test for target price equation as such, but attempts to provide an explanation of the target rate by correlating data on profits with a number of variables such as wholesale price index, production and stockholders investment.

1.3.8. Normal cost pricing

The last markup model to be examined is the normal cost model. It is a model that could be summarized under the full-cost heading, however it is treated seperatly due to the elaborate proce dure of estimating standard (=normal) costs and due to the framework that provides in distinguishing the influences of cost and demand changes on price changes. The model first appeared with the publication of the W. Godley and W. Nordhaus (1972) paper but was based on ideas initiated previously in R.R. Neild (1963) and W. Godley (1959-1976) and to some extent in W. Godley and C. Gillion (1965).

A monograph by K.J . Coutts, W. Godley and W. D. Nordhaus (1978) was produced six years latter that covered the main U.K. industrial sectors and explained many issues that were left unclear in the original paper. Ever since a number of studies have appeared either verifying and extending the normal cost hypothesis or providing evidence against it. The former include studies by J. Ros (1980), R. Dixon (1983), P.S.W.N.

Bird (1983), G. Tavlas (1984) and also W. Godley (1977) H. Pesaran (1972a)(1972b) , W.D. Nordhaus (1974), K.J. Coutts, R. Tarling and F. Wilkinson (1976), I.F. Pearce et al (1976) and P. Sylos Labini (1979) review article. The latter include studies by A.D. Bain and Evans (1973), M . Parkin (1977)(1978), G.W. Smith (1978)(1982) and R. Gordon (1975).

Briefly the normal cost hypothesis asserts that industrial firms charge prices based on normal costs. In particular the firms calculate the level of costs with reference to standard output and not to actual output. The price-normal cost relationship, ie the markup (on normal costs) is unaffected by demand. As such the normal cost model provides the strongest statement compared to the other markup models about the role of demand in pricing. The coefficient on normal costs in the price equation is expected to be unity and at the same time the coefficient on demand is expected to be zero. Formally the normal cost model can be written as the full-cost equation.

$$(1.25) \qquad P_N = (1+\pi)\,\frac{(\beta V(QN)+F)}{QN}$$

or, if we are to assume, as K.J. Coutts et al (1978) do, that capital cost plays no role, as

$$(1.26) \qquad P_N = (1+\pi)\,\frac{(\beta V(QN))}{QN}$$

A detailed exposition of the procedure for calculating standard costs relevant to the normal cost model is found in chapter 4. Section 5.5 deals with the normal price equation by deriving and testing the normal cost model based on the KJ. Coutts, W. Godley and W.D. Nordhaus (1978) methodology.

Thus far we have examined the various pricing practices that have been developed in the literature and are known as markup models. A distinctive feature of these models is the many common characteristics that they share. Later chapters will be devoted in the formulation and empirical testing of these models using data on the 2-digit SIC sectors of the Greek industry. Prior to these however a chapter that describes the data used as well as the methodology for estimating the markup models is required. This is chapter 2.

NOTES

1. "It is assumed to be the aim of the producer to fix that price at which the excess of gross receipts or revenue over costs will be at a maximum. He will achieve this if he regulates output in such a way that the addition to his total revenue from selling an additional unit is exactly equal to the addition to his costs caused by producing that unit. If he sold one unit less he would lose more of revenue than he saved of costs, and if he produced one unit more he would incur more of cost than he gained of revenue. The addition to total revenue produced by selling an additional unit is marginal revenue. The seller is assumed always to equate marginal revenue to marginal cost"

J. Robinson (1933) pp 51-52.

2. See papers by P.W.S. Andrews (1949), E.H. Chamberlin (1942), W. J. Eiteman (1949), R.A. Gordon (1948), R.F. Harrod (1952), F. Machlup (1946), H.M. Oliver (1947), E.A.G. Robinson (1950), (1951) most of which are surveyed in R.B. Heflebower (1955) and O. Langholm (1968).

3. See M. Sawyer (1983) p.12.

4. See for example R.S. Barro (1972), E.S. Phelps and N. Winter (1971) among others.

5. See for example survey articles by A.J. Silberston (1970), M. Parkin, M.T. Summer and R.A. Jones (1972), W.D. Nordhaus (1972), P.H. Earl (1973), P.H. Earl (1974), D.E.W. Laider and M. Parkin (1975), J.A. Trevithic and C. Mulvey (1975),M. Parkin (1978), D.H. Hay and D.S. Morris (1979), S. Domberger and G.W. Smith (1982) and M.C. Sawyer (1983).

6. See J.A. Trevithick and C. Mulvey (1975) p.81.

7. See D.E.W. Laidler and M. Parkin (1975) p.767.

8. See M.C. Sawyer (1983) pp9-22.

9. Note however that if MC is diminishing with output, then profits are maximized if the negative slope of MC is steeper than that of MR.

10. A detailed examination of the relationship between the elasticity and the markup is postponed until chapter 3.

11. See D.H. Hay and D.S. Morris (1979) p.120, for a number or references.

12. A similar more or less model to that of W. Nordhaus (1972) is presented in chapter 3. There it is shown that under certain conditions referring to the slope of the marginal cost curve, equation (1.11) may be expressed in terms of unit costs, thus resulting in a testable form that is similar to that of average-cost markup models.

13. See for example papers by R. Wilder, G. Williams and D. Singh (1977), K. Shinjo (1977), O. Eckstein and D. Wyss (1972) and D. Straszheim and M. Straszheim (1976).

14. See for example J. Beath (1978).

15. See for example D. Heien and J. Popkin (1972).

16. See M.C. Sawyer (1983) pp 31-32 and p.34.

17. See for example R.S. Monsen et al (1968) and D.R. Kamerschen (1968).

18. See for example R.L. Hall and C.S. Hitch (1939) and W. Haynes (1964).

19. See F.M. Scherer (1980) pp 183-187.

20. See L.R. Klein (1967).

21. A detailed exposition of the methodology of such a calculation is given in section 3.9.4.

22. For a similar discussion see P. Sylos Labini (1979).

23. See for example R.S. Ball and M. Duffy (1972).

24. A notable example of opposing definitions can be found in a number of papers by O. Eckstein. For example in O. Eckstein (1964): "Target return pricing differs from full-cost pricing by relating price not to actual costs but to standard costs".
definition which is repeated in O. Eckstein and R. Brinner (1972) but refuted in O. Eckstein and G. Fromm (1968), since
"Full cost pricing which is a variant of target return pricing is based on the principle that price equals standard unit variable cost multiplied by a markup".

CHAPTER 2 : Data Considerations and methodological issues

2.1. Introduction

The aim of this chapter is twofold; on the one hand to present in a most concise way information about the Greek industrial sectors that form the basis of the empirical application of price determination theories and on the other to present the methodology that is followed for the estimation of the price equations.

The chapter contains six sections. Section 2.2 sets the framework of analysis by explaining the reasons for choosing the time series and cross-section coverage used. Section 2.3 contains information on the performance of the Greek industries that is relevant to the study of price determination. The goal is not to present a complete picture of Greek manufacturing but merely to provide an indication of the relative movements with regard to the variables used in the estimation of price equations. Interelationships between these variables are discussed in section 2.4 together with the presentation of the main statistical sources. Section 2.5 is concerned with the choice of the dependent variable. For reasons explained in this section there is a departure from the practice of testing price models by using wholesale price indices; instead implicit gross output deflators are used. The relationship between the two price variables is examined and analyzed. Finally section 2.6 presents the methodological issues that clarify the procedure used for the estimation, testing and evaluation of the price models. The procedures examined in this section are invariably followed in the next chapters, since each price model is estimated and tested with the same method. Great importance is attached in performing tests in batteries not only across theories but across sectors as well, since it reduces the possibility of data mining and subjectivity in favour of one model vis-a-vis the other.

2.2. Time series and cross-section coverage of the study.

The estimation and formulation of the pricing models discussed in chapter 1 will be applied to all two-digit Standard Industrial Classification (SIC) sectors of the Greek industry. This makes a total of 21 sectors for each pricing model; 20 industrial sectors (SIC 20 - SIC 39) plus the total manufacturing sector. Therefore each sector will be referred to by its code SIC number and the correspondence between code numbers and industry names is given in table (2.1).

Data unavailability in the Greek industry permits the examination of economic relationships only on what is called by the National Statistical Service of Greece (NSSG) "major" or "large scale" manufacturing. Large scale industry comprises of firms that employ 10 persons or more. The rest, ie "small" scale industry contains family type companies with almost no capital installed, occupied in handicraft or seasonal activities and employing a limited number of workers. Out of a total of 123000 enterprises that existed in Greek manufacturing during 1970, large scale industry accounted only for 4.9% of the establishments but for 81.3% of the total of employees, 77.7% of the total value added and almost 90% of total investment during that year.

Estimation of price equations requires information on a number or variables, such as prices, employment, productivity, wages, materials, prices and volume, capital stock, profits, investment, output etc. The problems faced in obtaining and employing such an information body in a consistent manner are greatly enhanced by the two-digit disaggregation adopted.

Table 2.1 Greek industry: Two digit standard industrial classification. Correspondence between codes and names

SIC code	Industrial name
(20-39) TOT	Total manufacturing sector
20	Food preparation industries
21	Beverage industries
22	Tobacco manufactures
23	Manufacture of textiles
24	Footware and clothing industries
25	Wood and cork industries
26	Furniture and fixture industries
27	Paper and pulp industries
28	Printing and publishing industries
29	Leather and fur products industries
30	Rubber and plastic products industries
31	Chemical industries
32	Petroleum and coal refining industries
33	Non-metallic mineral products industries
34	Basic metal industries
35	Fabricated metal product industries except machinery
36	Machinery and appliances industries except electrical
37	Electrical machinery and electrical appliances
38	Transport equipment industries
39	Miscellaneous manufacturing industries

The main difficulty that had to be overcome however was how to increase the number of time series observations for each sector, since most published sources contained information on a yearly basis that included only 15 years (1963-1977) at the time that this study was undertaken. The lack of degrees of freedom for an efficient estimation of price equations dictated the generation of quarterly figures for the same period (1963i - 1977iv), thus making a total of 60 observations.

Since data on most variables are available only yearly, a number of assumptions is required for the generation of quarterly figures. In such a procedure great care is taken in order to secure

(a) the consistency of the generated data. As it will be shown there is a number of identities that are observable with yearly data. Quarterly figures are generated in such a way that (1) the same identities hold on a quarterly basis and (2) by adding-up the quarterly figures we are able to observe the same identities on a yearly basis.

(b) the reliability of the generated data. Quarterly figures do not originate from published sources. Nonetheless they are publishable in the sense that, following the assumptions used, we can create quarterly data from yearly figures and also from the quarterly generated data, by adding up, the original yearly figures.

2.3. The Greek industrial sectors: the facts to be explained.

This section is concerned with the presentation of a number of indicators that are relevant to the understanding of industrial price formation in Greece. A discussion on the morphology of the Greek industry, the origins of its development, the financial and capital structure, the institutional background as well as the prospects for its future growth pattern is outside the scope of this section which is mainly to present in a most concise way the necessary quantitative information on the majority of variables used in the price determination equations.[1] Such variables are the prices of factors of production, ie wages (Pw), materials prices (Pm) and the price of capital services (Pc) and also labour productivity (Q/L), unit labour (ULC), unit materials (UMC) and unit capital costs (UCC). Since the analysis of price determination is conducted at a relatively disaggregated level, indices that describe structural characteristics of the sectors discussed are also presented. Such indices are market concentration, the share of value added in output, export performance, the share of inputs and also output, investment, employment and profit rates. Furthermore and in connection to the analysis of chapter 4, a picture of the labour market is also drawn in terms of relative employment shares and wage rates of each employment category. The indices mentioned above are themselves self-explanatory and so the analysis of the tables presented below is constrained to the minimum.

During the period under examination the Greek industry has experienced rates of inflation significantly higher that the relative rates of OECD countries.[2] Implicit deflators for Gross Production Value are used as a measure of price rather than wholesale price indices.[3] For the total manufacturing sector the average quarterly rate of increase between 1963i and 1977iv was 2.48%. This inflation rate was distributed unevenly throughout the period. The signal for explosive inflation rates that exceeded 25% on a yearly basis was given with the oil-crisis of 1973.

There after industrial prices persisted at a rate of increase of about 20% or more per year. An indication of the distribution of price increases is given in table (2.2) where the period is divided into 3 equidistant periods; 1963i - 1967iv, 1968iv-1972iv,1973i 1977iv. Quarterly inflation rates are given for each sector and subperiod. With the exception of sector 32 that has almost absorbed the quadrupling of oil prices in 1973, the rest of sectoral inflation rates are rather close to the average rate as that is given by the manufacturing total. Sectors with inflation rates relatively lower than the total are SIC: 30,31,33,34,39 while sectors with higher inflation rates are SIC: 28,32,38.

The pattern of modest increases during the first two thirds of the period and high rates during the last third was also observed by the prices of factors of production. Table (2.3) presents average quarterly rates of change for wages (Pw) materials prices (Pm) and price of capital services (Pc). The figures in parentheses show the relative increase in factor prices to the price output (PG). These ratios show that average quarterly rates for wages and capital are twice as much as that of prices while the ratios for materials prices are around unity. Obviously increases in labour and capital productivity are absorbed by prices of labour and capital while the "productivity" of materials (the reciprocal of materials-output ratio) has remained constant across sectors and approximately equal to unity. Indeed industries with higher wage price ratios are for example the industries where productivity has increased more than average, ie sectors 30,31,33,34,35 and 39 as can be seen from table (2.4), where productivity is defined as the ratio of gross production over the number of people employed.

Table 2.2 Implicit deflators for gross production value (PG) average quarterly rates, two digit SIC sectors, large scale manufacturing

Sector	Period 1963_i-1977_{iv}	Period 1963_i-1967_{iv}	Period 1968_i-1972_{iv}	Period 1973_i-1977_{iv}
TOT	2.48	0.36	0.92	6.17
20	2.76	0.22	0.86	7.21
21	2.15	0.11	0.69	5.65
22	2.15	0.33	0.41	5.70
23	2.26	0.43	0.75	5.62
24	2.09	0.66	0.48	5.14
25	2.58	0.23	0.96	6.55
26	2.42	0.44	0.79	6.02
27	2.23	0.16	0.44	6.10
28	2.95	0.16	1.58	7.13
29	2.31	0.75	0.62	5.74
30	1.76	0.30	0.30	4.68
31	1.71	0.28	0.65	4.21
32	7.74	-0.23	1.53	21.93
33	1.87	0.26	0.31	5.05
34	1.72	-0.01	0.65	4.51
35	2.23	-0.04	0.84	5.90
36	2.49	0.37	1.08	6.02
37	2.28	0.39	0.70	5.76
38	3.20	0.64	0.75	8.20
39	1.64	0.00	0.42	4.51

Table 2.3 Wage rates (Pw), Materials prices (P_M), Price of capital services (Pc); average quarterly rates 1963_i-1977_{iv}. Two digit SIC sectors; large scale manufacturing

Sector	Pw	(Pw/PG)	P_M	(PM/PG)	Pc	(Pc/PG)
TOT	4.81	(1.94)	2.38	(0.96)	5.14	(2.07)
20	4.98	(1.80)	2.97	(1.08)	4.91	(1.78)
21	4.46	(2.07)	2.32	(1.08)	4.86	(2.26)
22	4.69	(2.18)	2.47	(1.15)	4.75	(2.21)
23	4.75	(2.10)	2.32	(1.03)	5.08	(2.25)
24	4.40	(2.10)	2.33	(1.11)	5.44	(2.60)
25	4.97	(1.93)	2.40	(0.93)	6.39	(2.48)
26	4.51	(1.86)	2.57	(1.06)	5.25	(2.17)
27	5.20	(2.33)	2.23	(1.00)	3.95	(1.77)
28	5.22	(1.76)	2.27	(0.77)	4.56	(1.54)
29	4.31	(1.87)	2.24	(0.97)	4.76	(2.06)
30	4.23	(2.40)	2.03	(1.15)	3.94	(2.24)
31	4.33	(2.53)	1.95	(1.14)	4.18	(2.44)
32	4.24	(0.55)	9.06	(1.17)	4.00	(0.52)
33	5.11	(2.73)	1.86	(0.99)	5.02	(2.68)
34	4.39	(2.55)	1.71	(0.99)	4.65	(2.70)
35	5.24	(2.35)	2.12	(0.95)	4.99	(2.24)
36	4.95	(1.99)	2.29	(0.91)	5.48	(2.20)
37	5.07	(2.22)	2.65	(1.16)	5.08	(2.23)
38	5.12	(1.60)	2.47	(0.77)	5.08	(1.59)
39	4.40	(2.68)	2.17	(1.32)	4.69	(2.86)

Table 2.4 Unit labour cost (ULC), Labour productivity (Q/L) Unit material cost (UMC), Unit capital cost (UCC), average quarterly rates 1963_{i}-1977_{iv}. Two digit SIC sectors, large scale manufacturing

Sector	ULC	Q/L	UMC	UCC
TOT	2.98	1.14	2.68	2.10
20	3.48	0.80	2.71	2.85
21	2.56	0.75	2.14	1.63
22	1.15	1.73	3.16	1.66
23	2.47	1.41	2.34	2.23
24	2.76	0.96	1.90	2.83
25	2.42	1.50	2.63	3.66
26	3.11	0.95	2.74	1.96
27	3.47	1.09	2.03	1.12
28	3.85	0.72	3.47	3.17
29	2.43	1.23	2.35	2.97
30	2.13	1.32	1.93	1.41
31	1.58	1.85	1.99	0.86
32	4.94	0.30	10.14	2.38
33	1.47	2.22	2.48	1.30
34	1.52	1.75	2.30	0.30
35	2.28	1.65	2.24	1.37
36	2.76	1.25	2.76	2.26
37	3.70	0.90	2.51	2.21
38	4.10	0.67	2.85	3.13
39	1.94	1.69	2.27	1.55

The differences between the prices of factors of production and output price are mitigated if one considers unit factor costs that take into account factor productivities. Average quarterly rates for ULC, UMC and UCC are given in table (2.4).

Materials prices and unit material cost rates of change are more or less equal thus giving credit to the hypothesis that materials/ output ratio has remained almost constant (around unity). Unit capital cost rate of change is rather similar to that of output price rates. Unit labour cost rates, despite taking account of productivity are in most sectors (15 of 21) higher than the corresponding output price rates. In general average wage rates followed movements in minimum wages that increased significantly during the period, particularly women's wages. This is due to the fact that minimum wage policy was directed to pay equalization between males and females. Given that in the early sixties women's wage levels were significantly lower than those of men, this resulted to considerably higher wage rate increases for women workers. Table (2.5) gives a good indication of the structure of labour pay per sector. The first five columns present employment shares for each employment category namely, employers and other family members (EF), male salaried employees (SM) female salaried employees (SF), male wage earners (WM) and female wage earners (WF). The last four columns of table (2.5) present the average quarterly rates of change for the prices paid to each of the four categories of employees. It is apparent that wage earners and in particular female wage earners enjoyed higher rates of wage increases.

The period under study was characterized not only by high inflation rates, but by equally high growth rates. Industry output as

Table 2.5 Percentage shares of employment categories for 1970. Average quarterly rates, wages and salaries, males and females 1963_i-1977_{iv}. Two digit SIC sectors, large scale manufacturing

Sector	Employment shares					Average rates of pay			
	EF	SM	SF	WM	WF	SM	SF	WM	WF
TOT	3.48	16.53	4.46	49.22	26.31	4.26	4.19	5.41	5.50
20	3.61	18.95	5.03	42.30	30.11	4.55	4.94	5.44	6.38
21	2.60	35.04	4.24	41.13	16.99	4.41	4.45	4.97	5.48
22	0.91	11.21	1.69	33.04	53.16	3.33	3.50	5.06	5.94
23	2.25	13.19	9.57	26.67	57.90	3.96	4.66	5.04	5.47
24	6.97	4.82	4.25	33.76	50.20	4.43	4.98	5.10	5.67
25	6.43	6.50	1.82	62.25	19.64	3.89	3.72	4.76	5.55
26	8.19	5.63	4.13	76.50	5.55	4.46	5.19	4.47	5.65
27	1.94	21.43	3.85	47.31	25.46	4.15	4.23	5.77	6.19
28	4.04	23.98	8.19	46.38	17.41	4.76	5.02	5.51	5.87
29	8.59	8.22	2.48	64.53	18.18	4.00	4.21	4.67	5.00
30	3.05	15.02	5.32	48.50	28.11	3.56	3.70	4.94	4.87
31	0.96	32.33	11.99	29.14	25.57	3.77	3.67	5.32	5.47
32	0.85	56.51	7.08	34.90	0.66	3.56	2.59	5.38	5.29
33	4.63	17.98	4.04	60.63	12.72	4.24	3.96	5.45	6.61
34	0.17	29.31	2.27	67.80	0.45	3.99	4.90	5.35	6.59
35	3.46	12.24	3.58	62.68	18.03	3.90	3.72	5.70	6.03
36	5.67	12.47	2.50	77.72	1.64	5.01	4.72	4.80	6.04
37	1.72	20.24	6.75	55.34	15.95	4.38	4.20	5.71	6.22
38	1.89	20.14	2.50	74.58	0.89	4.76	4.51	5.82	5.51
39	6.56	8.09	4.70	50.93	29.73	4.27	3.89	4.58	5.19

measured by gross production value at constant 1970 prices increased at an average rate of 2.11% per quarter for the period 1963-1977. Such a growth rate has increased the share of manufacturing sector in Gross Domestic Product from 14.23% in 1963 to 21.33% in 1977. Greece is not any longer an agricultural economy, although the share of manufacture is still relatively low when compared with countries with approximately the same GDP per capita.[4]

The pattern of growth rates achieved by the Greek industry was not evenly distributed through the years. In table (2.6), the growth rates of each industrial sector are presented for the three equidistant periods 1963i - 1967iv, 1968i - 1972iv, 1973i - 1977iv. Inspection of table (2.6) indicates that higher growth rates were achieved during the second (9 out of 21) and third (12 out of 21) periods. Sectors with growth rates less than the average are the traditional sectors such as SIC: 22,26, 27,28,29 while SIC: 20,23 increased with rates similar to that of total manufacturing. The dynamic sectors are the heavy industry sectors (SIC:33,34,35) and also SIC:30,31,39. The highest growth rate though was achieved by footwear and clothing industries (24) that was able to capitalize on the expansion of the home and to a large extent of the international markets.

The major share in the expansion of industry has to be attributed to the high rates of investment carried out through the period rather than the increase in employment. Tables (2.7) and (2.8) present the average quarterly rates for gross investment in buildings and machinery and employment for the period 1963-1977 and the three subperiods. Referring to table (2.7) the higher rate of increase in investment was observed in the second subperiod

Table 2.6 Output growth rates, average quarterly values. Two digit SIC sectors, large scale manufacturing

Sector	Period $1963_{i}-1977_{iv}$	Period $1963_{i}-1967_{iv}$	Period $1968_{i}-1972_{iv}$	Period $1973_{i}-1977_{iv}$
TOT	2.11	0.96	2.53	2.83
20	1.92	0.79	1.90	3.07
21	2.34	1.43	3.26	2.35
22	0.68	0.38	-0.47	2.13
23	2.39	0.81	2.68	3.66
24	3.92	1.13	3.39	7.24
25	2.40	1.37	3.39	2.44
26	1.69	0.85	2.26	1.95
27	1.47	1.19	2.06	1.15
28	1.04	0.62	1.85	0.66
29	1.25	0.17	1.34	2.24
30	3.35	1.51	3.41	5.13
31	3.25	1.68	3.07	1.67
32	1.70	1.25	1.64	2.22
33	3.03	1.45	2.75	4.89
34	2.74	1.10	3.76	3.36
35	2.71	1.50	2.97	3.68
36	2.18	0.93	2.02	3.59
37	1.89	1.48	4.25	-0.07
38	1.83	0.13	3.31	2.03
39	3.52	0.96	3.70	5.89

Table 2.7 Gross Investment in buildings and machinery, constant 1970 prices, growth rates, average quarterly values, two digit SIC sector large scale manufacturing

Sector	Period 1963_i-1977_{iv}	Period 1963_i-1967_{iv}	Period 1968_i-1972_{iv}	Period 1973_i-1977_{iv}
TOT	1.571	1.016	5.160	-1.464
20	1.588	0.161	2.181	1.588
21	1.499	1.632	4.525	-1.660
22	-1.066	2.033	-1.380	-1.700
23	2.060	-0.710	6.895	-0.005
24	5.293	1.665	8.740	1.886
25	7.944	2.085	7.840	13.906
26	0.617	-0.056	6.008	-4.100
27	-0.577	-1.842	0.345	0.921
28	0.454	0.363	4.766	-3.766
29	2.415	-1.916	3.318	5.843
30	2.458	-0.310	5.617	2.067
31	2.440	10.081	6.739	-9.500
32	2.059			
33	3.567	-0.022	10.912	-0.188
34	1.548	1.808	-0.995	0.736
35	1.652	1.365	4.269	-0.678
36	2.936	0.416	6.887	1.505
37	0.908	1.180	6.720	-5.176
38	1.190	-0.159	5.545	-1.816
39	4.025	-0.297	7.450	4.907

Table 2.8 Total employment growth rates, average quarterly figures, two digit SIC sectors, large scale Greek manufacturing

Sector	1963_i-1977_{iv}	1963_i-1967_{iv}	1968_i-1972_{iv}	1973_i-1977_{iv}
TOT	1.04	0.45	1.06	1.62
20	0.89	0.53	0.92	1.21
21	1.41	1.45	1.43	1.36
22	-0.87	-1.42	-1.77	0.56
23	0.78	0.07	0.63	1.63
24	2.64	0.64	1.83	5.45
25	0.94	0.67	1.51	0.64
26	0.87	0.21	0.99	1.41
27	0.66	0.98	0.19	0.80
28	0.39	0.22	0.55	0.41
29	-0.68	-0.84	-0.90	1.06
30	1.80	1.12	1.41	2.89
31	1.33	1.09	1.06	1.83
32	1.83	0.32	2.17	3.01
33	0.59	0.48	0.47	0.83
34	1.81	1.29	2.25	1.88
35	0.94	-0.17	1.27	1.37
36	0.85	0.69	0.65	1.22
37	1.30	0.83	2.56	0.51
38	1.74	0.51	2.60	2.01
39	1.72	0.95	1.99	1.97

for the majority of industrial sectors (13 out of 21). A significant portion of that increase is due to the fact that a large number of enterprises were established at that period. Despite the high investment rates the share of investment in manufacturing remained at a level around 12-15% of total investment in the economy which is rather low when compared to the corresponding shares in the EEC countries. Referring to 1970 data the share of manufacturing investment was 21.5% in Great Britain and Italy, 24.7% in Belgium, 20.1% in France and only 14.1% in Greece. The fact that the Greek industrial sector was unable to absorb capital should probably be attributed to the ineffective banking system that has been the main obstacle to industry growth by allocating funds to non-productive sectors. This was further reinforced by the lack of an organized capital market that could raise capital for industry. As a result the largest share of national savings was invested outside manufacturing and in particular to construction.

Turning to table (2.8) it is obvious that the growth in employment was smaller or significantly smaller in some sectors than investment growth. Expansion of average quarterly rates of 2.11% in output rate was able to absorb only 1.04% in employment. In 13 out of 21 sectors the largest employment growth was observed during the last period. Traditional labour intensive industries like SIC:20,22,23,28,29,33 have either decreased their employment or increased with rates significantly smaller than the average. Notable exceptions of labour intensive industries, where employment increased with larger than average rates are SIC:24 and 38. Higher employment rates were observed in capital intensive industries like SIC:30,32,34 and also in SIC:39.

Table (2.9) presents the profit rates for each sector and sub-period. Profit rates are defined as profit over sales and are yearly averages for each period considered. Two points are worth noting; First intersectoral differences are quite large; the maximum sectoral rate is five times the minimum. Second higher profit rates are observed during the period 1968-1972 (13 of 21 sectors). This should be attributed to the fact that for almost all sectors the years 1970-1972 were expansionary years. This can be seen in the 5th and 6th columns of table (2.9), where the expansionary and contractionary periods are presented. Expansions and contractions are defined by the ratio of actual to potential output. Whenever this ratio is less than unity, supply exceeds demand and consequently a contractionary period is in order. The opposite is true for expansions. Generally speaking the period between 1968-1972 is characterized by excess demand while the years after 1974 by excess supply.

In the last two tables of this section, (2.10) and (2.11) we present a number of structural indicators for the industries under study. In table (2.10) the shares of output, investment and employment of each two digit industrial sector to the total of manufacturing are given for the years 1963, 1970 and 1977. Sectors with declining shares are on the whole the consumer-industries like SIC:20,22,26,28,29 and also SIC:23,27,36, while expanding sectors are usually intermediate and capital goods industries like SIC:25,30,31,34,35,37 and from the consumer industries sector SIC:24.

In table (2.11) the first two columns present the share of value added in gross production value and the share of labour expenditure in value added for each industrial sector. All data refer to 1970.

Table 2.9 Average yearly profit rates, profits over sales, two digit SIC sectors large scale manufacturing Expansion and contraction periods per sector

Sector	Profit rates 1963-77	1963-67	1968-72	1973-77	Expansionary Periods	Contractionary Periods
TOT	0.0936	0.0735	0.1129	0.0946	69-74	75-77
20	0.0567	0.0382	0.0659	0.0660	70-74	67-69/75-77
21	0.0904	0.0790	0.1106	0.0814	70-74	67-69/75-77
22	0.0699	0.0738	0.0930	0.0431	65-71	72-76
23	0.1076	0.0820	0.1165	0.1242	63-55/71-73/75-77	67-69
24	0.0761	0.0522	0.0876	0.0886	63-65/74-76	66-73
25	0.0845	0.0499	0.1230	0.0807	67-73	63-66/74-77
26	0.0595	0.0534	0.0847	0.0406	70-73	63-69/74-77
27	0.0534	0.0262	0.0500	0.0342	68-74	63-66/75-77
28	0.0928	0.1364	0.1091	0.0328	66-74	63-65/75-77
29	0.0720	0.0741	0.0851	0.0570	-	73-75
30	0.1540	0.1373	0.1869	0.1376	67-74	63-66/75-77
31	0.1070	0.0560	0.1374	0.1276	66-73	63-65/74-77
32	0.1103	0.1337	0.1269	0.0702	69-71/73-75	65-68
33	0.1435	0.1098	0.1805	0.1401	69-71	66-68/74-77
34	0.1315	0.0412	0.1951	0.1581	66-74	63-65/75-77
35	0.0658	0.0440	0.0672	0.0715	65-69	74-77
36	0.0368	0.0364	0.0425	0.0314	64-66/73-76	70-72
37	0.0698	0.0717	0.0969	0.0408	70-73	74-77
38	0.0701	0.0456	0.0719	0.0929	70-73	66-69
39	0.1614	0.1991	0.1600	0.1251	-	64-69

Table 2.10 Sectoral shares of output, investment, employment in total manufacturing, years 1963, 1970, 1977. Two digit SIC sectors, large scale manufacturing

Sector	Output			Investment			Employment		
	1963	1970	1977	1963	1970	1977	1963	1970	1977
TOT	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
20	20.65	16.93	15.91	14.45	11.52	11.90	13.50	14.34	12.93
21	3.18	3.58	3.54	1.89	3.75	2.56	1.94	2.66	2.66
22	9.26	4.39	3.37	4.97	1.83	1.07	7.13	3.85	2.63
23	17.15	13.41	14.83	19.95	14.55	18.48	20.95	17.28	17.44
24	2.92	3.18	4.80	1.44	1.41	2.92	5.63	6.56	10.39
25	1.45	1.87	1.83	1.27	1.96	7.14	2.55	2.82	2.55
26	1.16	1.09	0.90	1.08	0.91	0.54	2.25	2.27	2.10
27	2.51	2.75	1.96	8.31	2.98	2.00	2.56	2.60	2.16
28	2.93	2.08	1.46	1.77	1.81	0.84	3.53	3.19	2.52
29	1.79	1.05	0.89	0.68	0.39	0.60	2.27	1.51	1.14
30	2.13	2.70	3.49	4.74	3.70	5.26	2.73	3.26	3.99
31	4.83	6.85	8.47	2.12	4.63	5.50	4.79	5.59	5.80
32	3.33	4.16	3.17	1.09	0.84	1.05	0.61	0.82	0.97
33	5.12	5.19	6.42	13.97	8.32	16.73	7.93	7.50	6.34
34	2.77	8.04	7.86	8.96	21.85	7.35	1.39	2.56	2.69
35	6.73	6.96	7.87	3.99	5.74	5.22	6.66	6.47	6.29
36	3.07	2.59	2.63	1.83	1.14	1.96	3.36	3.50	3.14
37	4.99	8.14	6.28	3.34	4.34	2.62	3.94	5.46	5.18
38	3.67	4.58	3.66	3.66	8.01	5.15	5.56	6.69	7.90
39	0.37	0.47	0.63	0.50	0.32	0.70	0.72	1.07	1.17

Table 2.11 Structural characteristics of the Greek industry (1) Share of value added to Gross production value (VA/GPV) (2) Share of labour bill to value added (LB/VA) (3) Share of imports (IMP) (4) Share of exports (EXP) (5) Concentration ratios 4-firm (CON)

Sector	VA/GPV	LB/VA	IMP	EXP	CON
TOT	38.64	33.36	19.84	8.77	
20	25.63	34.57	12.59	10.00	6.89
21	37.54	27.83	4.82	17.49	37.31
22	26.79	34.92	0.21	24.52	42.31
23	39.29	35.98	12.20	9.04	15.77
24	38.80	43.74	0.85	2.23	15.50
25	42.27	33.23	19.36	0.53	36.19
26	49.30	37.87	2.06	0.17	24.07
27	31.43	36.42	25.56	1.31	51.58
28	58.14	39.51	5.21	1.27	15.49
29	33.08	43.23	18.73	13.88	18.18
30	48.53	31.83	16.50	3.26	21.93
31	45.49	30.71	34.07	11.69	49.62
32	26.95	15.54	15.22	2.88	62.72(71)
33	34.35	31.42	9.61	4.39	30.47
34	45.83	15.95	32.57	29.46	84.14
35	37.13	39.72	26.10	6.06	25.22
36	47.46	46.63	65.31	0.81	19.26
37	35.55	33.36	26.69	1.55	27.34
38	44.47	50.29	38.08	2.10	59.75
39	52.07	44.13	40.33	4.38	33.15

The value-added content seems to be rather low indicating that the manufacturing process in the Greek industry is limited to a smaller number of stages. This is particularly true for heavy industrial sectors where one would expect longer lines of industrial process. The absence of establishments specialising in the processing of by-products coupled with the lack of the relevant technology is the basic reason for low value-added shares.

Columns (3) and (4) of table (2.11) show the degree of international exposure for each two-digit industry. Import share is defined as the ratio of imported final products to total consumption (home demand plus imports minus exports). The share of exports is the ratio of exports to home demand. The dependence of the Greek economy on industrial imports is very high particularly on the heavy and intermediate goods industries, where despite the industrialization that has taken place a significant amount of goods is still imported. This has to be assessed together with the fact that the direction of industrial policy was towards import substitution coupled with heavy protection of the Greek industry.

Finally the last column gives an indication of the degree of market concentration per sector by using 4-firm concentration ratios. With the exception of sectors 20,23,24,28,29 and 36 that have rather low concentration ratios, the rest of the Greek industry seems to be very concentrated.

The information given in the tables of this section provides a broad outline of the tendencies observed in the Greek industry during the period 1963 to 1977. The majority of the data used are not published but are generated from information taken from various published sources. The next section describes these sources and examines the relationships between the variables used.

2.4. Data Description: Sources and Relationships.

A number of data sources have been employed for the data collection and generation of the variables used in this study. The main body of information is obtained from the Annual Industrial Surveys (AIS) published by the National Statistical Service of Greece (NSSG) from 1963 to 1977. AIS provide data on a list of variables that can be used to set up a number of identities referring to various aspects of the firm's accounting balance such as gross production value, value added, sales, stocks, materials consumption, energy bill, labour bill, profits, investment, capital stock and employment, with regard to each two-digit sector. Moreover the sampling coverage of the large-scale industry in the AIS is by far more complete compared to any other source of information, since it covers approximately 75% of the population of the major industry, thus making AIS the most reliable source of information.

Labour Statistics (LS) published quarterly by the NSSG since 1962, provide the main bulk of information on variables related to employment, wages and salaries. Employment series is provided on a monthly basis further disaggregated into male and female employment both in wage and salaried earners. Average weekly hours worked by wage earners both males and females is further analyzed into the following categories: normal (standard hours) and overtime hours. Information on labour remuneration is provided with regard to (α) Average monthly earnings on male and female salaried employees which is further disaggregated into normal earnings, overtime earnings and other payments including fringe benefits, bonuses etc. and (b) Average weekly earnings and average hourly earnings on male and female wage earners further disaggregated in a similar manner to that of monthly earnings of salaried employees.

Monthly Statistical Bulletin (MSB) published by NSSG is used for information that is provided for various indices as for example consumers price index, wholesale price indices referring to the 21 sectors used, indices of prices of agricultural products and various material price indices, unit value and quantum indices of imports and exports, etc.

The Confederation of Greek Industries yearly bulletin (CGI) , provides information on fixed and circulating capital, depreciation, borrowing etc, structured in the form of consolidated balance sheets for each two-digit sectors used. CGI coverage includes companies that have the legal form of limited liability or sociètè anonyme and as such it is different from the AIS. CGI information is used to supplement information from the AIS, mainly in the construction of the user cost of capital variable.

Finally information from Input-Output Tables (IOT) which is available from 1958 to 1977 is used for the construction of material price indices and also for the construction of an index of prices of "other" commodities ((P_B),see chapter 3) that will be used in the neoclassical price equation.

The data sources described above present a number of relationships between variables used in this study. These relationships are useful in understanding the methodology by which the quarterly data used, are generated. As an example it will be shown how by using AIS data as the basis and utilizing additional information from other sources it is possible to construct quarterly figures on output at current and constant 1970 prices.

The main source of information is obtained from AIS, where all variables are expressed yearly and in current prices. For the purpose of this section, let

subscripts q,y, denote quarterly and yearly figures respectively

n,τ denote constant 1970 prices and current prices respectively. Gross production value is defined as the sum of value added and materials consumption, as

(2.1) $GPV_{y\tau} \equiv VA_{y\tau} + CON_{y\tau}$

where GPV = gross production value

VA = value added

CON = materials consumption.

Value added, accounting for the remuneration of the factors of production (labour and capital) can be defined as

(2.2) $$VA_{y\tau} \equiv LB_{y\tau} + (0.175 \times LB)_{y\tau} + EMREM_{y\tau} + DEP_{y\tau} + INS_{y\tau} + INT_{y\tau} + RENT_{y\tau} + ADV_{y\tau} + (LAW + AGENT + TRANS + PTT)_{y\tau} \pm PROF_{y\tau}$$

where LB = employees remuneration (wage and salary bill)

0.175 = a percentage added to labour bill to account for employers contributions to social securities organizations

EMREM = remuneration of personal services of proprietors and family members provided that they are not considered as employees

DEP = depreciation of all kinds

INS = insurance expenditure

INT = interest bill plus commission of banks

RENT = expenditure on rent

ADV = advertising expenditure

LAW + AGENT + TRANS + PTT= general expenditures rendered such as legal advice, agent's commission, storage and transport, postage and telecommunications

PROF = profits or losses derived as a residual.

Information on the elements of (2.2) is provided only for VA, LB, EMREM. The method by which data are generated for the rest of the variables of the above identity is described in Appendix 3. These variables are important in determining the level of profits which in turn is used for the estimation of the user cost of capital, employed as an argument in the neoclassical price determination equation.

AIS also provides information on sales (X) from which we are able to calculate stocks per year (change in stocks (ΔS)) and sector based on (2.3). Data on stocks are also employed in the calculation of the production lag, further used in the estimation of the normal cost model.

$$(2.3) \qquad \Delta S_{y\tau} \equiv GPV_{y\tau} - X_{y\tau}$$

Materials consumption (CON) is the sum of materials bill (MAT), spare parts and packing materials bill (SPARE) fuel and energy bill (FUEL), all of which are provided by the AIS as

$$(2.4) \qquad CON_{y\tau} \equiv MAT_{y\tau} + SPARE_{y\tau} + FUEL_{y\tau}$$

Data on gross investment are also provided by the AIS based on the following information: (1) Machinery and other mechanical equipment (2) Buildings (3) Transport means (4) Furniture and fixtures (5) Lots and sites and (6) Other fixed assets. On each of the above six categories we have data on (a) new items bought

(b) used items bought and (c) destructions. For reasons of convenience gross investment is condensed into two categories: gross investment on machinery ($GINV_M$) and gross investment on buildings ($GINV_B$) as follows

$$(2.5) \qquad GINV_M = (1+3)_a + (1+3)_b - (1+3)_c \text{ , and}$$

$$(2.6) \qquad GINV_B = (2+4+5+6)_a + (2+4+5+6)_b - (2+4+5+6)_c$$

where numbers and letters correspond to the above classification of investment. Data on employment remununeration are disaggregated in the AIS into wage bill (LBW), salary bill (LBS) and remuneration of employers and working family members (EMREM) as in (2.7)

$$(2.7) \qquad LB_{y\tau} \equiv LBS_{y\tau} + LBW_{y\tau} + EMREM_{y\tau}$$

Finally data on total employment (LT) are disaggregated in the AIS into employment of salaried (LS) and wage earners (LW) and proprietors and family members (LR) as

$$(2.8) \qquad LT_y \equiv LS_y + LW_y + LR_y$$

Labour statistics (LS) provide (quarterly) information on employment, wages, salaries and hours worked. The following relationships hold (2.9)(2.10)(2.11)

$$(2.9) \qquad LT_q \equiv LSM_q + LSF_q + LWM_q + LWF_q$$

ie total employment (LT) is the sum of male (LSM) and female (LSF) salaried employees and male (LWM) and female (LWF) wage earners. Note that total employment (LT_q) in (2.9) is not the same as that in (2.8) even if deduce LR_y from LT_y. The reason is that the two sources have different sampling coverages despite the fact that they both refer to major industry. Referring to the people employed the coverage of LS is about 20% of the population while that of AIS is approximately 75%. This is the reason that all data on labour employment and remuneration taken from LS are "corrected" to correspond to the AIS data, or in other words identities (2.7) and (2.8) are observed even if expressed in quarterly figures. The methodology is explained in Appendix 3.

Labour remuneration data in LS refer to average monthly salaries and average hourly rates for male and female salary and wage earners respectively and are further disaggregated into regular (R), overtime (OV) and other earnings (OTH). As an example consider average monthly salary for male employees; all data are quarterly averages, ie the sum of three monthly remunerations divided by three

$$(2.10) \qquad S(T)_{mq} \equiv S(R)_{mq} + S(OV)_{mq} + S(OTH)_{mq}$$

Finally LS provide data on weekly hours worked on male and female manuals, further disaggregated into regular (R) and overtime (OV) hours as in (2.11)

$$(2.11) \qquad H(T)_{mq} \equiv H(R)_{mq} + H(OV)_{mq} \text{ , and } H(T)_{fq} \equiv H(R)_{fq} + H(OV)_{fq}$$

The GCI bulletin provides information based on the balance sheet and operating results accounts that are published for all companies having the legal-form of limited liability company or société anonyme. A typical asset liabilities account includes information on the following items

$$(2.12) \quad \text{Fixed assets} + \text{Circulating Capital and Reserves} \equiv$$
$$\equiv \text{Depreciation} + \text{Own Funds} + \text{Borrowed Funds}$$

Fixed assets are further decomposed into

(2.13) Fixed assets≡Land and Buildings + Machinery Equipment + + Vehicles + Other Fixed Assets

while data for borrowed funds are expressed as

(2.14) Borrowed funds≡Short-term borrowing + Long-term borrowing.

A typical operating results account includes

(2.15) Gross profits≡Financing, Marketing and General Administrative expenses + Annual Depreciation + Net Profits.

Finally the distribution of net profits is given by

(2.16) Net Profits≡Reserves, deductions carried forward + dividents + + Taxes

Identities (2.12) to (2.16) are used mainly to generate various ratios that are useful in approximating variables in reference to AIS. For example AIS do not provide information on working capital. Assuming for example that the ratio between fixed and working capital in the CGI is the same with that of AIS it is possible to deduce data for working capital for AIS firms using the information provided by (2.12)[5]. The main bulk of information given in the CGI is used for the construction of capital and user-cost of capital series.

The above relationships do not exhaust the various data combinations that can be generated from the data sources described in the beginning of the section. A good example of the data generating methodology used in this study is the construction of quarterly figures both in current and constant 1970 prices for GPV for which the only information is provided in (2.1) expressed in yearly current prices.

In Appendix 3 we describe the method by which we construct quarterly data on salaries for males ($\hat{SMq}$) and females ($\hat{SFq}$), wages for males ($\hat{WMq}$) and females ($\hat{WFq}$) on labour bill ($\hat{LBq}$) and on total employment ($\hat{LTq}$), employment on salaried earners, males ($\hat{LSMq}$) and females ($\hat{LSFq}$) and employment on wage earners, males ($\hat{LWMq}$) and females ($\hat{LSFq}$). Carrets on all generated variables denote that the data are "corrected" so that they observe the two conditions set out in section (2.2).

It is possible to express wages and salaries on males and females in an index form, where the average quarterly value for 1970 is taken as the base, ie.

$$100 = \frac{(1970i + 1970ii + 1970iii + 1970iv)}{4}$$

so that

$\hat{SMq}$ corresponds to PSM(q)

$\hat{SFq}$ corresponds to PSF(q)

$\hat{WMq}$ corresponds to PWM(q)

$\hat{WFq}$ corresponds to PWF(q)

Total labour bill ($\hat{LBq}$) can now be expressed in an index form in constant 1970 prices as

$$(2.17)\quad \overline{\hat{LBq}} = \alpha_1 \, PSM(q) + \alpha_2 \, PSF(q) + \alpha_3 \, PWM(q) + \alpha_4 \, PWF(q)$$

where $\alpha_1 = (3.525 * \hat{LSMq}) / \hat{LTq}$

$\alpha_2 = (3.525 * \hat{LSFq}) / \hat{LTq}$

$\alpha_3 = (14.39375 * HMq * \hat{LWMq}) / \hat{LTq}$

$\alpha_4 = (14.39375 * HFq * \hat{LWFq}) / \hat{LTq}$

All variables have been defined before and the numbers are explained in Appendix 3. Define variable LABSq as the share of each of four quarterly values of $\overline{\hat{LBq}}$ to the sum of four quarterly values of $\overline{\hat{LBq}}$ for every year y as

$$(2.18) \quad LABSq = \frac{\overline{\hat{LB}}_{qi(y)}}{\sum_{i=1}^{4} \overline{\hat{LB}}_{qi(y)}}$$

MSB provides data on industrial production index (IND) for each two digit SIC sector. Aggregating monthly into quarterly data, it is possible to express $INDS_q$ as the share of each of the four quarterly values of IND_q to the sum of four quarters of $INDS_q$ for every year y as in (2.19)

$$(2.19) \quad INDSq = \frac{IND_{qi(y)}}{\sum_{i=1}^{4} IND_{qi(y)}}$$

In Appendix 3, it was made possible to derive a materials price index for each two-digit SIC sector in both yearly (Pm) and quarterly figures (Pm_q) by using information from input-output Tables. In equation (2.1) we can deflate CONyτ by Pm and obtain CON_{yn} as in (2.20)

$$(2.20) \quad CON_{yn} \equiv \frac{1}{Pm_y} CON_{y\tau}$$

Quarterly data on materials consumption in constant 1970 prices can be generated by

$$(2.21) \quad CON_{qn} \equiv INDS_q * CON_{yn}$$

Quarterly data on materials consumption in current prices can be generated as

$$(2.22) \quad CON_{q\tau} \equiv CON_{qn} * Pm_q$$

Yearly implicit deflators for value added (PVA_y) are not published, but are provided upon request by the Ministry of National Economy. It is possible to deflate $VA_{y\tau}$ in equation (2.1) by using PVA_y as in (2.23)

$$(2.23) \quad VA_{yn} \equiv \frac{1}{PVA_y} * VA_{y\tau}$$

Quarterly data on value added in constant 1970 prices can be generated by using $LABS_q$ index as in (2.24)

$$(2.24) \quad VA_{qn} \equiv VA_{yn} * LABS_q$$

Assuming that the quarterly pattern of PVAy is the same as that of wholesale price indices, then it is possible to generate quarterly figures of VA in current prices as

$$(2.25) \quad VA_{q\tau} = VA_{qn} * PVA_y * \frac{P_{\tau q}}{P_{\tau y}}$$

where $P_{\tau q}$ = quarterly wholesale price index

$P_{\tau y}$ = yearly wholesale price index

Equations (2.21) and (2.22) provide information for materials consumption in constant 1970 and current prices quarterly data, while equations (2.24) and (2.25) provide the same information for value added. Gross production value at constant 1970 prices and current prices in quarterly figures can now be defined as (2.26) and (2.27)

$$(2.26) \quad GPV_{qn} \equiv VA_{qn} + CON_{qn}$$

$$(2.27) \quad GPV_{q\tau} \equiv VA_{q\tau} + CON_{q\tau}$$

Equations (2.26) and (2.27) will be used for the construction of implicit deflator indices for gross output that is employed as the dependent variable in the price equations. The relationships between these indices and wholesale price indices is the subject matter of the next section.

2.5. Specification of the dependent variable; What price index?

The majority of the papers surveyed in chapter 1 employ the wholesale price index, P_T, as the dependent variable in industrial price equations. The reason is that the published data on P_T, are readily available in the form of monthly observations for considerable time lengths and in a disaggregated form that in most of the cases corresponds to the classification of industries used. Despite that, there is a number of problems created by the use of wholesale price indices in industrial price equations most of which have to do with the method with which P_T's are constructed.

Firstly, it is quite possible that since P_T is based on information collected on a sample of products, the basket of which remains the same over a considerable time length, changes in the quality of products over time are obscurred in the sense that they are not reflected in P_T. As the "hedonic" price literature points, such changes are likely to affect the cost of the products, other things being equal.

Secondly and perhaps more important is the fact that wholesale price indices do not measure prices at which actual trading takes place. This issue has been examined in connection with the administered price inflation hypothesis according to which prices in administered markets remained fairly rigid in the face of changing demand conditions. The main contribution on the subject is by G.S. Stigler and J.K. Kindahl (1970) who were able to construct price indices based on reports by buyers (transaction prices) and compare them with the official wholesale price indices (list prices). The two indices were found sufficiently dissimilar and G.S. Stigler and J.K. Kindahl went on to test whether their transactions price index had a procyclical or anticyclical behaviour, whether that is, it is in accordance or at odds with the administered price inflation thesis. On the basis of their results with the constructed data G.S. Stigler and J.K. Kindahl were able to conclude ..."[that there was no evidence] to suggest that price rigidity or administration is a significant phenomenon".

G.S. Stigler and J.K. Kindahl (1970) p.9

Their work on the list-transactions price relationship was attacked by G.C. Means (1972) and the issue was recapitulated by L.W. Weiss (1977) who found that the two indices had almost similar pattern in their movements.

Even in the face of the above problems, P_T would have been used as the dependent variable in the price equation, had the published information with regard to the Greek wholesale prices been reliable, consistent and complete. Unfortunately in addition to the above problems there are two more reasons for which it is not advisable to use P_T .

Firstly, MSB publishe information on wholesale price indices that covers only a number of sectors, ie SIC:20,23,27,30,31,32,33. The rest are aggregated so that one wholesale price index corresponds to sectors 21 and 22, one to sectors 34 and 35, one to sectors 36 and 37 and one to sectors 24,25,26,38 and 39. Moreover there are no published indices for sectors 28 and 29. Although it has been possible to disaggregate the aggregate indices and obtain wholesale indices for sectors 28 and 29,[6] there are reasons to doubt the reliability of such constructed wholesale data. Finally there is no guarantee that there is one to one correspondence between wholesale prices and sectoral data on output cost and demand.

Secondly wholesale price indices, published or generated capture the effects of incomes policy. With regard to prices, incomes policy in Greece is conducted by the Ministry of Commerce that plays the role of a Price Board. Industrial prices are classified for that purpose into 3 categories: (a) Necessities in "scarce" for which prices or percentage markups on costs are determined by the Ministry of Commerce (b) Necessities in "abundance" for which the Ministry of Commerce defines the maximum percentage profit allowed and (c) All other goods apart from those classified as necessities for which there is no intervention. The majority of items falls into the third category, but nonetheless a significant amount of goods is subject to price controls of either case (α) or case (b). The time interval according to which an item is subjected to price control is determined by the Ministry. It is not possible to classify what products per each sector are subject to price controls at a given time and furthermore it is not possible to measure the effects of such controls on prices, since the periods in which the price control is "on" or "off" are not regular.

The above arguments are strong enough to preclude the use of wholesale price indices as the dependent variable in the price equation. An obvious alternative is to construct a unit value index for output that will represent the price index. Such an exercise requires data on the value and volume of output. In section 2.4 we described the methodology by which data on the value of output (GPV_{q_T}) and the volume of output (GPV_{qn}) were generated. The definition of such an index, which is essentially an implicit deflator for output is given in (2.28)

$$(2.28) \quad PG_{(q)} = \frac{GPV_{q\tau}}{GPV_{qn}}$$

Implicit deflators, P_G, are free from most of the disadvantages that characterize wholesale price indices as dependent variables in industry price equations. First, although they are not an accurate reflection of transactions prices, they are more closely related to actual trading prices than wholesale price indices, since by definition $GPV_{q\tau}$ includes all elements that make up sales. If for example the discrepancy between list prices and actual transactions prices is the amount of reductions offered by producers when business is slack, then the P_G index would correspond to the transaction price more closely than the wholesale index, since such reductions would appear in sales or output value. Output value (GPV) and sales (X) are different by the change in stocks (ΔS) as that is given by equation (2.3). However the difference between the two is rather small as can be seen in table (2.12) which provides data for gross production values and sales for 1970. Second the affect of price controls which is manifested on the wholesale price indices is irrelevant with regard to implicit deflators. Furthermore P_G indices are more reliable to use since they are based on published information provided by AIS, and also the working assumptions used for the generation of quarterly from yearly data are set out explicitly in section 2.4.

Even if wholesale indices are not used as dependent variables in the price equations, they are still useful in the sense that they offer a measure of comparison with the constructed implicit deflators.

Table 2.12 Gross Production value and Sales in 1970
Two digit SIC sectors, large scale manufacturing

Sector	Gross Production Value	Sales	Change in Stocks
TOT	98,575,554	87,925,246	10,650,308
20	17,654,180	16,573,570	1,080,610
21	3,732,339	3,526,213	206,126
22	4,573,214	4,449,131	124,083
23	13,985,116	12,077,036	1,908,080
24	3,317,013	2,998,881	318,132
25	1,949,008	1,817,354	131,654
26	1,137,111	1,075,517	61,594
27	2,872,540	2,623,924	248,616
28	2,165,809	1,391,337	774,472
29	1,097,512	967,276	130,236
30	2,814,439	2,663,070	151,369
31	7,139,069	6,933,717	205,352
32	4,340,026	4,636,519	-296,493
33	5,861,933	5,375,069	486,864
34	8,377,740	7,508,556	869,184
35	5,290,991	4,822,379	468,612
36	1,833,794	1,271,538	562,256
37	6,266,131	5,153,622	1,112,509
38	3,677,638	1,631,395	2,046,243
39	489,951	429,142	60,809

Such a comparison would serve two purposes. First, since the two price indices originate from completely different data sources, a significant discrepancy between the two that can not be attributed to specific factors would cast doubt on the procedure for generating P_G. Second if we are to assume as K. Coutts, W. Godley and W. Nordhaus (1978) do, that wholesale indices (P_T) represent the official list prices, while P_G's represent the transactions prices, then a comparison between the two would offers a framework for testing whether the discrepancies can be attributed to cyclical or other elements. This is an important issue to the administered inflation theory, since critics of the theory claim that predictions of economic theory relate specifically to transactions prices, which being unobservable and unrecorded can not be captured by the official price indices in which the verification of the administered inflation theory is based. In such a way administered inflation theory is nothing more than a reflection of the measurement error in the published wholesale price indices. It is quite possible therefore that list prices are the veil behind which secret price shading takes place.

The procedure to be followed in this section is to test whether or not significant differences exist between the two indices and then to examine whether these differences can be attributed to cyclical or other factors.

At first as a measure of comparison between the two indices we examined their secular trends. Yearly data for both indices were used to avoid fluctuations due to seasonal factors that would not necessarily be the same for both indices. With regard to P_T yearly data were obtained as quarterly sums, while for P_G yearly data generated as

(2.29) $P_G(y) = \frac{GPV_{yT}}{GPV_{yn}} = \frac{GPV_{yT}}{CON_{yn} + VA_{yn}}$

As measure of the trend of the two indices was obtained by running the following regressions for the period 1963-1977.

(2.30) $\ln P_T = \alpha_0 + \alpha_1 t + u$

(2.31) $\ln PG = b_0 + b_1 t + u \quad , u \sim NID(0, 6^2 u)$

Furthermore in order to test whether there was a differential trend pattern in the two halfs of the period 1963-1977 that are characterized by different inflation rates, equations (2.30) and (2.31) were also run for these two subsamples. Table (2.13) presents the values of the α_1 and b_1 coefficients of equations (2.30) and (2.31) and for the sample periods 1963-1977, 1963-1970, 1970-1977 respectively. The values on the third, sixth and ninth columns of table (2.13) correspond to the Z statistic, that tests for equality between the two coefficients[7]

(2.32) $Z = \frac{\hat{\alpha}_1 - \hat{b}_1}{\sqrt{(6\hat{\alpha}_1^2 + 6\hat{b}_1^2)}}$

If the values on the Z statistic are less than the 5% significance level, then the null hypothesis that the difference between the two coefficients is not significantly different from zero is not rejected. The Z values indicate that for the period 1963-1977 only sector 39 exhibited significant differences between the two coefficients, a pattern that was repeated in the second part of the period, characterized by high inflation. For the period 1963-1970, 7 sectors showed a different coefficient between wholesale and implicit deflators indices; SIC:20,21,22,32,33,38 and 39. The results of table (2.13) indicate that in general the difference

Table 2.13 Comparison between trend coefficients on P_r, P_G

$\ln P_r = ao + a_1 t$

$\ln P_G = \beta o + \beta_1 t$

Two digit SIC sectors, large scale manufacturing

Sector	1963-1977			1963-1970			1970-1977		
	$\hat{\alpha}_1$	$\hat{\beta}_1$	Z	$\hat{\alpha}_1$	$\hat{\beta}_1$	Z	$\hat{\alpha}_1$	$\hat{\beta}_1$	Z
TOT	0.071	0.075	0.28	0.015	0.021	1.46	0.144	0.142	0.09
20	0.052	0.066	1.06	0.007	0.020	3.94*	0.117	0.136	0.97
21	0.052	0.058	0.48	0.009	0.014	2.19*	0.117	0.122	0.31
22	0.044	0.063	1.63	0.042	0.021	2.79*	0.090	0.130	1.83
23	0.068	0.064	0.34	0.022	0.022	0.08	0.131	0.125	0.46
24	0.067	0.060	0.70	0.024	0.023	0.23	0.117	0.113	0.23
25	0.079	0.072	0.55	0.020	0.017	0.57	0.134	0.137	0.16
26	0.050	0.067	1.34	0.026	0.021	0.74	0.119	0.128	0.51
27	0.078	0.065	0.77	0.014	0.003	1.76	0.155	0.143	0.36
28	0.095	0.088	0.47	0.001	0.015	1.36	0.151	0.146	0.22
29	0.073	0.065	0.76	0.055	0.035	1.43	0.123	0.123	0.06
30	0.052	0.051	0.08	0.010	0.012	0.50	0.124	0.111	0.68
31	0.053	0.053	0.03	0.010	0.007	0.94	0.109	0.112	0.17
32	0.143	0.122	0.59	-0.020	-0.004	2.36*	0.325	0.287	0.68
33	0.058	0.055	0.26	0.029	0.018	3.10*	0.114	0.111	0.16
34	0.073	0.057	1.16	0.002	0.004	0.34	0.140	0.114	1.16
35	0.085	0.072	0.98	0.018	0.010	1.54	0.139	0.129	0.42
36	0.079	0.069	0.48	0.019	0.017	0.09	0.119	0.110	0.73
37	0.057	0.060	0.28	0.023	0.019	1.02	0.111	0.115	0.24
38	0.072	0.085	0.93	0.012	0.030	4.59*	0.145	0.154	0.49
39	0.019	0.050	4.02*	-0.001	0.019	4.79*	0.042	0.099	4.64*

as measured by the trend coefficients of the two price indices is not significant. What they do not show however is the direction and the magnitude of discrepancies between P_T and P_G. This is given in table (2.14).

The mean discrepancy is defined as the difference between P_T and P_G summed up for the 15 yearly observations and divided by 15. In 13 out of 21 sectors P_G was higher on average than P_T. Perhaps a better measure in order to compare the two price indices is to use percentage mean discrepancies, where the differences in the latter years of the period which had to be large due to high inflation rates are weighted as in (2.33)

$$(2.33) \qquad \% \text{ Mean Discrepancy} = \frac{1}{15} \sum_{y=1}^{15} \frac{P_{Ty} - P_{Gy}}{P_{Ty}}$$

P_G was higher in two thirds of the sectors but the difference was relatively small, approximately 2% or less in 17 sectors. Significant differences were observed in sectors 22,28,32 and 39. With regard to sectors 22 and 28 the main reason for which P_G was higher than P_T was that for most of the period the prices of the products of these sectors (Tobacco manufactures (22) and Printing and Publishing (28)) were kept artificially low by price controls. This is not the case though with the rest of the sectors. The differences although small, indicate a specific pattern. The question that arises is whether we can attribute these differences to cyclical elements or are there other factors working to that effect as well.

Such a factor accounting for differences in the two price indices may well be the fact that P_T is a Laspeyres index[8], while P_G is in principle a Paasche index since it is the value of output divided by a Laspeyres quantity index.[9] In continuous inflationary

Table 2.14 Discrepancies between P_r and P_G; Yearly observations 1963-1977; Two digit SIC sectors, large scale manufacturing

Sector	Mean Discrepancy	Maximum Discrepancy	Minimum Discrepancy	% Mean Discrepancy
TOT	-0.0074	0.0917	-0.1828	0.39%
20	-0.0515	0.0652	-0.2520	-2.69%
21	-0.0116	0.0333	-0.1269	-0.43%
22	-0.1315	0.0421	-0.4505	-10.20%
23	0.0288	0.1373	0.0003	1.69%
24	-0.0030	0.1396	-0.0588	-1.21%
25	0.0032	0.0888	-0.0548	-0.62%
26	-0.0031	0.1389	-0.1694	0.65%
27	0.0604	0.3775	-0.0629	2.04%
28	-0.0395	0.1710	-0.1945	-5.51%
29	-0.0081	0.0812	-0.0797	-1.77%
30	0.0338	0.1475	-0.0229	2.24%
31	-0.0290	0.0425	-0.0969	-1.80%
32	0.3981	2.1757	-0.0372	7.80%
33	-0.0040	0.0694	-0.0603	-0.62%
34	0.0431	0.3069	-0.0731	0.61%
35	0.0112	0.1765	-0.0682	-1.33%
36	0.0241	0.1951	-0.0725	-1.50%
37	-0.0280	0.0380	-0.1264	-2.14%
38	-0.0292	0.0851	-0.3024	-0.89%
39	-0.0952	0.1451	-0.4730	-7.39%

periods it is known that if the goods that expand relatively fast in volume are those for which prices rise relatively slowly, then a Paasche index will be slower to adjust than a Laspeyres index in periods after the base year.[10] We would expect therefore that other things being equal the Paasche index P_G to rise relatively faster than the Laspeyres index P_T for the period 1963-1970 ($P_T/P_G<1$) and the opposite for the period 1970-1977 ($P_T/P_G>1$).

A test to determine the extent to which the two price indices diverge because of index number differences can be achieved by examining the coefficient C_2 in equation (2.34)

$$(2.34) \qquad \frac{P_T}{P_G} = C_0 + C_1 t + C_2\, DUM + u \qquad u \sim NID\,(0, \sigma^2 u)$$

Where DUM = a dummy variable with zeros until 1970, the base year, and rising linearly thereon.

Table (2.15) presents the results on the coefficient on C_2. In 13 out of 21 sectors, C_2 took the positive expected sign of which 11 were significant. Of the 8 remaining sectors where C_2 had a negative sign, 5 were significant.

A new set of discrepancies can now be defined between P_T and P_G after the removal of the trend effect and the effect attributed to index number problems. Table (2.16) presents the results on a new set of discrepancies between P_T and P_G, defined as

$$(2.35) \qquad \left(\frac{P_T}{P_G}\right)^* \equiv \frac{P_T}{P_G} - \hat{C}_0 - \hat{C}_1 t - \hat{C}_2\, DUM$$

As expected the discrepancies appear to be very small, indeed much smaller than the corresponding figures of table (2.14). The mean discrepancy for all sectors has been reduced significantly and the

Table 2.15 Results on c_2 coefficient on equation

$$\frac{P_r}{P_G} = c_o + c_1 t + c_2 \text{ DUM}$$

Two digit SIC sectors, large scale manufacturing

Sector	c_2	Sector	c_2	Sector	c_2
TOT	0.0023 (1.78)	26	-0.003 (3.52)	33	-0.0015 (1.15)
20	-0.0028 (3.84)	27	0.011 (6.60)	34	0.0076 (4.95)
21	-0.007 (0.96)	28	0.0051 (3.45)	35	0.0042 (3.11)
22	-0.0126 (1.82)	29	0.0046 (5.19)	36	0.0021 (2.47)
23	0.0014 (1.14)	30	-0.0054 (6.18)	37	0.0037 (4.10)
24	0.0044 (4.25)	31	0.0059 (7.50)	38	-0.0014 (2.82)
25	0.0047 (3.59)	32	0.0127 (18.31)	39	-0.011 (9.72)

Table 2.16 Discrepancies between P_T and P_G after the removal of trend and the effect of index number differences; yearly observations. Two digit SIC sectors, large scale manufacturing

Sector	Mean Discrepancy	Maximum Discrepancy	Minimum Discrepancy
TOT	0.0021	0.0134	-0.0028
20	-0.0127	0.0013	-0.0086
21	0.0071	0.0104	-0.0036
22	-0.0409	0.0044	-0.0581
23	0.0096	0.0186	0.0001
24	-0.0019	0.0205	-0.0019
25	0.0008	0.0285	-0.0099
26	-0.0003	0.0444	-0.0299
27	0.0167	0.0390	-0.0151
28	-0.0201	0.0253	-0.0122
29	-0.0049	0.0035	-0.0120
30	0.0143	0.0168	-0.0125
31	-0.0069	0.0056	-0.0166
32	0.0508	0.0867	-0.0214
33	-0.0019	0.0103	-0.0004
34	0.0183	0.0485	-0.0241
35	0.0065	0.0059	-0.0135
36	0.0117	0.0293	-0.0217
37	-0.0104	0.0035	-0.0057
38	-0.0208	0.0146	-0.0068
39	-0.0437	0.0074	-0.0812

same is true for the maximum and minimum values.

The final question that has to be answered is whether the discrepancies that are still observed can be attributed to cyclical factors. If we are to accept that during contractions there is a significant amount of price reduction and the reverse takes place during expansions, then the ratio of list to transactions prices, or for our purposes the ratio between wholesale price and sectoral implicit deflators would behave in an anticyclical manner. Note again that there are differences in the very notion of price that the two measures attempt to capture. MSB treats prices as unique in the sense that it does not report any dispertion of prices at a given point in time:

"To secure comparability of the collected prices the market conditions prevailing for each product, otherwise, the "terms of trade" are taken into consideration. The terms of trade refer (a) to the "usual" wholesale quantity of merchandise. The "usual" quantity varies among products and enterprise, according to the prevailing terms of trade. Thus collection of prices formulated from transactions of extreme quantities is avoided. (b)the "payment method ". It's already known that for each product different prices are formulated according to the payment method adopted. In this case the "payment method" which has been adopted is the one correponding to the greatest part of transactions of the corresponding goods".

National Statistical Service of Greece (1967) p.12

On the other hand, the transaction price for a product at a given place and time can be influenced by many factors. G.S. Stigler and J.K. Kindahl (1970) for example mention as such factors the credit worthiness of the buyer, services supplied to the user of the product, trade relations, ties in sales, introductory offers, the speed of delivery, guarantees of supplies in periods of shortage etc.

To test the hypothesis of anticyclical behaviour of the ratio between P_T and P_G consider equation (2.36)

$$(2.36) \quad \frac{P_T}{P_G} = C_0 + C_1 t + C_2\ DUM + C_3 \frac{Q}{QN} + u \qquad u \sim NID(0, 6^2 u)$$

where Q/QN is a measure of capacity utilization (See equation 3.107).

Evidence of anticyclical behaviour in the ratio P_T/P_G would require a negative coefficient on C_3. The results of equation (2.36) with regard to C_3 are given in table (2.17). Evidence of anticyclical behaviour is found in 9 sectors where C_3 is negative and significant. In 6 sectors the P_T/P_G ratio moves procyclically since C_3 is positive and significant. If a tentative conclusion can be drawn from such mixed results, that is that on the whole the evidence is in favour of anticyclical behaviour and this in contradiction with similar findings by K. Coutts et al (1978) and G.S. Stigler and S.K. Kindahl (1970).

In summary the discussion of this section was able to show that (1) it is inappropriate to use wholesale price indices as dependent variables in sectoral price equations for the Greek industry and (2) that there is some degree of discrepancy between P_T and P_G that can be attributed apart from measurement errors to the effect of price controls in wholesale prices and to the fact that there are index number differences. Taking these factors into account it was further shown (3) that the remaining differences can be partly explained by the anticyclical behaviour of the P_T/P_G ratio.

Table 2.17 Results on c_3 coefficient on equation

$$\frac{P_r}{P_G} = c_o + c_1 t + c_2 \text{ DUM} + c_3 \frac{Q}{QN}$$

Two digit SIC sectors, large scale manufacturing

Sector	c_3	Sector	c_3	Sector	c_3
TOT	-0.0048 (2.96)	26	-0.0146 (4.44)	33	0.0050 (2.33)
20	0.0015 (1.08)	27	0.0205 (11.09)	34	-0.0091 (2.00)
21	0.009 (1.23)	28	-0.0098 (7.06)	35	-0.0167 (2.25)
22	0.0112 (6.58)	29	-0.0011 (0.93)	36	-0.0018 (1.25)
23	0.0053 (2.66)	30	-0.0079 (3.42)	37	-0.0066 (3.12)
24	-0.0080 (3.07)	31	0.0026 (0.48)	38	0.0040 (1.57)
25	0.0073 (4.08)	32	0.0191 (9.11)	39	-0.0219 (3.73)

The next and final section of this chapter deals with a brief discussion of the econometric methodology that is followed in the estimation of the price equations to be examined in the next chapters.

2.6. The Econometric Methodology.

The econometric research carried out in this study consists of the following stages; First, the formulation of empirically testable hypotheses corresponding to each of the five pricing models discussed in chapter one. Second the estimation of the above hypotheses for each two-digit SIC industrial sector and third the evaluation of the five estimated models with the purpose of choosing the theory that most adequately describes the data generation process.[12]

2.6.1. Formulation of testable hypotheses.

According to conventional usage a hypothesis is in a testable form when it is possible to infer something about the truth of the hypothesis on the basis of evidence from observed data. The transformation of economic theory requires first the mapping of theoretical variables into actual observations and second the transformation of the theoretical model into an econometric specification. The first stage has been dealt with, in previous sections. The second stage is closely related with the scope of the investigation. Explanation of industrial price inflation is centered on the effects of demand and cost changes on price changes. Examination of these effects can be achieved by a variety of models that are differentiated with respect to the definition of costs and the way demand enters the pricing process. Yet there is a common characteristic in that all models refer to non-competitive markets.

Price inflation theories therefore can be typically considered to represent a relationship whereby the rate of change of prices (dlny) is a function of the rate of change of costs and demand (dlnxj) as in (2.37)

(2.37) $d\ln y = f\ (d\ln x_j)$

Equation (2.37) represents a state of nature between price inflation and its determinants whereby it is assumed that the response of price changes to cost and demand changes is instantaneous. Real world phenomena however are characterized by long-run contracts, by rigidities in deliveries of goods produced and also by frictions and uncertainties with regard to labour pay, purchases of inputs etc. Moreover investment goods take a considerable time to be incorporated into the production process and consequently investment goods prices into the pricing process, due to gestation lags. In the presence of such complications, the adjustment of price changes to its determinants is not expected to be completed within one quarter. Hence a plausible specification of the price equation mechanism requires the introduction of dynamic elements into equation (2.37)

Since economic theory is rather reticent about the nature of the dynamic aspects of the data generation process, a procedure for deciding on the appropriate lag pattern has to be selected. Such a procedure involves (α) the specification of the maximum number of lags that will be used on the variables of (2.37) and (b) the determination of a method by which it will be possible to select the "best" model among the various combinations that will result after introducing dynamics on equation (2.37).The maximum number of lags is chosen on the basis of apriori information about the mechanisms of the markets under study and is constrained by data availability. The selection procedure of the best dynamic form is conditional on the criteria set forth to characterize what is best. Such criteria are discussed in connection with the estimation procedure.

On the basis of the above considerations the estimation procedure is based on a general model of the following form

$$(2.38) \quad dlny_t = \alpha_0 + \sum_{j=1}^{n} \sum_{i=0}^{4} \alpha_{ji} \, dln \, x_{jt-i} + u_t$$

where u_t is assumed to be independently and identically distributed normal error term (with zero mean and constant variance) $u_t \sim NID(0,\sigma^2 u)$

2.6.2. Estimation and testing.

The second stage of the econometric exercise requires the estimation of models which are typically depicted by equation (2.38). All explanatory variables are considered exogenous and are distributed independently of the error term. Exogeneity, apart from being an econometric condition for the estimation of the price models is also an economic characteristic of these models.[13] The above assumptions guarantee the optimal properties of the coefficients when estimated by ordinary least squares. This however does not necessarily mean that the estimated model is "correctly" specified. A number of criteria should be set in advance that determine what is a "correctly" specified model.

In a real world context the process by which data are generated has a high degree of complexity. A model that purports to depict reality in every detail is useless as a tool of analysis. An operationally useful model should abstract from reality and as such will differ significantly from the data generation process but at the same time should possess high prodictive power. The principles of parsimony and ability to predict form the framework against which the selection procedure of the best model together with tests of the various hypotheses must be judged. Both these principles are stressed by M. Friedman (1953) as necessary requirements for testing economic hypotheses, since [14]

"A hypothesis is important if it explains much by little....." and "....the only relevant test of the validity of a hypothesis is comparisons of its predictions with experience"

The analysis of estimation carried out in the next chapters, rests on two distinct but interrelated issues; hypotheses testing and model selection.

The use of tests such as likelihood ratio (LR) tests forms the basis of hypotheses testing, while measures of goodness of fit and parsimony form the criteria for model selection. Under hypotheses testing framework, the maintained hypothesis (or null hypothesis or H_0) is treated differently from the other hypothesis (or alternative hypothesis or H_1) since it is believed that H_0 provides a good representation of the data generation process. Usually H_0 is based on theoretical predictions about the value of parameters in question and is rejected only if an unlikely event were to occur. Even then this does not necessarily mean that H_1 is accepted. In contrast, in model selection framework, both models (the null and the alternative) are considered as equal in the sense that there is no commitment in favour of one model against the other. Furthermore this means that under model selection one model is always preferred, while this is not always the case in hypotheses testing, where all models under consideration may be rejected.

2.6.2. (1) Hypotheses testing Hypotheses testing in this study is based on classical procedures (Neyman - Pearson criteria). It is concerned with the problem of whether a coefficient based on sample information is consistent with the hypothesis in question.

A critical value is assigned to assess the results, this critical value differing between tests. Tests are based on sample data and so inferences about the population are not said to be conclusive in the sense that it is not possible to verify the proposition unless the whole population is observed. A hypothesis therefore is either consistent or inconsistent with the data, but it never verifies or falsifies a theory.

The study proceeds by distinguishing between two types of tests: specification tests and mispecification tests, usually termed diagnostic tests. Specification tests are carried out within a framework of well specified null and and alternative hypotheses, where one or more restrictions on the coefficients are imposed. They are used mainly in the model selection procedure for the purpose of choosing a final equation that describes in the best possible way the data generation process.

Mispecification tests are usually associated with the null hypothesis against an unspecified alternative hypothesis. They are also used in conjunction with the search procedure for diagnostic purposes. Although the alternative hypothesis is not precisely specified, a mispecification test statistic is chosen on the basis of a suspected departure from the maintained hypothesis in some particular direction. Such a test for example is the test against serial correlation.

Three different types of tests usually serve the above purposes of specification and mispecification tests; likelihood ratio (LR) tests, Wald (W)tests and Langranze multiplier (LM) tests. A treatment of the properties of these tests can be found in A.C. Harvey (1981). LR is used mainly as a specification test for the purposes of testing restrictions, while LM is used as a mispecification test as for example to test against serial correlation.

2.6.2. (2) Model Selection. The second issue in estimating price equations is to use a strategy for model selection. Once economic theory is transformed into an econometric specification the question that remains is to discriminate between models. The question is generated because economic theory does not specify the nature of the dynamic process and so models with different variables (lagged variables) can be considered to present an adequate representation of the data generation process. The method advocated in this study is to start with a general model and proceed by sequential downward testing by means of likelihood ratio tests until a restricted model is reached that satisfies the criteria of parsimony and predictive power. Such a method is chosen on the grounds of computational ease, since the opposite approach (from specific to the general) might involve endless procedures and on the grounds that mispecification that is due to overparameterization presents a less serious problem than mispecification due to underparameterization.[15]

The strategy adopted for the search procedure has been described by G.E. Mizon (1977) and is based on sequentially testing more restrictive models. The strategy is given structure by dividing tests into two separate stages, that of choosing the maximum lag length for each variable and that of decomposing the dynamics into systematic dynamics (the lag pattern of the explanatory variables) and error dynamics (the length (order) of autocorrelation in the residuals). G.E. Mizon (1977) argued that this decomposition is a reasonable and logical way to approach the problem since it is not possible to find a uniformly most powerful testing procedure which would be the best approach due to lack of unique ordering of tests. Even with the procedure suggested by G.E. Mizon (1977) there are still a number of paths to be chosen from and this constitutes the main disadvantage of this approach; one is never certain that the path chosen is the best.

The testing procedure consists of the following steps. First assign the maximum number of lags n for the systematic dynamics of the models. In most of the cases explanatory variables are treated identically in that respect but there are cases where some variables (capital cost variables) are allowed greater lag lengths than other explanatory variables. The order of error dynamics τ is set equal to zero. Estimate the general model by ordinary least squares and test the assumption of zero error dynamcis by means of LM test.[16]

Second after estimating the general model proceed to contracting sequential search for the specific models. E.E. Leamer (1978) suggests a number of rules by which contractual search can be achieved. The rule adopted here is to drop all variables that posses a t-statistic with less than some cut-off point. Reestimate the restricted model and test the number of restrictions by means of likelihood ratio tests against the general model (specification test). Also test for the assumption of zero order of dynamics (mispecification test).

Third, proceed in the same way as before by increasing the value of the cut-off point on t-statistics until the final model that is selected is parsimonious and possesses good predictive power. Test by means of likelihood ratio statistics the number of restrictions against the general model and the assumption of no autocorrelation of τth order by means of a Langranze multiplier test. The first test is also a test against overparameterization. Finally test for predictive power by post sample goodness of fit test.[17] Provided that mispecification tests are not rejected select the final restricted model as the best representation of the data generation process.

In general the sequential testing procedure forms the essence of the model selection strategy. Schematically the procedure looks like (2.39)

$$
\begin{aligned}
&H_1: \Theta n = 0 \\
(2.39)\quad &H_2: \Theta n = \Theta n_{-1} = 0 \\
&H_3: \Theta n = \Theta n_{-1} = \Theta n_{-2} = 0 \\
&\vdots \\
&\vdots \\
&Hn\text{-}n: \Theta n = \Theta n_{-1} = \Theta n_{-2} = \ldots = \Theta n\text{-}n = 0
\end{aligned}
$$

Hypothesis H_1 is tested against the general model and if H_1 is not rejected, we proceed to the H_2 versus H_1 , if H_2 is not rejected to H_3 against H_2 and so on until one rejects the more restricted model. Obviously each hypothesis is tested against the immediately preceeding hypothesis and not against the general model, although tests against the maintained hypothesis are implicit in this procedure.

Two important considerations of this testing procedure are worth mentioning: (a) the rule or size of the test used to select between models at each step of the procedure and (b) the overall significance level of the sequential testing procedure.

The first point pertains to balancing the costs of accepting a higher order or dynamics with that of lower order dynamics. Earlier it was noted that the consequences of accepting an underparameterized specification are more severe than those of accepting an over-parameterized one. Consequently since the null hypothesis corresponds to the restricted model more weight is attached to commiting a type II error than a type I error.

In classical testing procedures there are two hypotheses: the null and the alternative. The parameter space, Θ, is divided between these two exclusive hypotheses, the null (W) and the alternative (Θ-W).

A statistical test of W against Θ-W partitions of the sample space into regions of acceptance; one area consistent with W and another area inconsistent with W. The region where W is inconsistent or "rejected" is referred to as the "critical region". The essence of a "good" test procedure is the choice of a critical region which is in some sense optimal. In a test procedure of this form two types of errors can be commited

(i) Type I error : reject H_0, when H_0 is true

(ii) Type II error : accept H_0 when H_0 is false

Generally the probability of a type II error is determined only with respect to a specific alternative hypothesis. Given this alternative hypothesis, a good test should, other things being equal, minimize the probability of commiting a type II error. In order for other things to be equal, the maximum probability of commiting a type I error should be fixed. This probability is the significance level or size of the test. An optimal test statistic is that which minimizes the probability of a type II error over the complete set of parameter values associated with the alternative hypothesis. This test is termed uniformly most powerful test (UMP).

In implementing the test statistics of the sequential search the significance level (probability of commiting type I error) is fixed at a fairly high level, thus increasing the critical region, while reducing the probability of accepting the null.

If ε_i is the significance level of the i^{th} test in the sequence, then if the number of sequential models in the selection procedure is S, then a test of the most restricted model against the general model at a significance level of α requires the satisfaction of (2.40)

(2.40) $$(1-\varepsilon)^S = 1-\alpha$$

provided that $\varepsilon_i = \varepsilon$ for all i sequential models (i= 1...S). Of course one might object to $\varepsilon_i = \varepsilon$ for all i, which means that all models in the sequential search are treated symmetrically and adopt a procedure where upon ε_i increases with i as

$$(2.41) \qquad \varepsilon_i = i.\varepsilon/_S \text{ for } i= 1...S$$

Since the general model is always overparameterized, such a procedure with different significance levels for each sequence is adopted for our own search strategy. This means that as the sequential testing reache more and more restricted models the significance levels of the implicit tests (tests of each restricted model against the general) form a monotonically nondecreasing sequence.

The success of the model selection procedure is conditional on the adoption of the original general model. If this is chosen badly, no matter how efficient the specification search is, the final model would be inappropriate. Of course a guard against this possibility is the number of diagnostic (mispecification) tests conducted at each stage of the procedure. A possible further disadvantage that is particular to the problem examined in this study is the fact that due to an extensive number of models (this specification search is applied to 21 sectors and five different pricing models) all tests are conducted in batteries. The principle of testing in batteries is necessary in order to analyze and present such a large amount of material in an orderly way. Moreover such an approach serves the purpose of making impractical and almost impossible the mining of the data for congenial results.

2.6.3. Model Selection.

The second stage of the estimation procedure involved the estimation of models for each two digit SIC sector and pricing theory. The criteria set out for the estimation procedure were defined in the previous paragraphs as passimony and predictive power. A procedure was defined by which a model for each sector and price theory is chosen that is supposed to describe in the best possible way the data generation process. Nonetheless the pricing theories themselves form non-nested hypotheses since each is differentiated from the others on the definition and treatment of the explanatory variables. Although in principle it is possible that all five models examined are able to explain the data generation process for each industrial sector in question, in practice such a possibility is a rare case.

Model evaluation is viewed in this study as setting another criterion to be added to those of parsimony and predictive power, that of theoretical consistency. The introductory chapter set out the goal of this study as the estimation and testing of markup pricing models for the two-digit SIC sectors of the Greek industry and the evaluation of these models between them.

There are various means by which one can test the validity of a theory. For the purpose of this study each model selected on the basis of the previous dicussion will be regarded as consistent with the theory, provided that theoretical assumptions about the coefficients are met. If for example a theory assumes that

$$(2.42) \qquad \frac{\vartheta d\ln y}{\vartheta d\ln x_1}, \quad \frac{\vartheta d\ln y}{\vartheta d\ln x_2}, \quad \frac{\vartheta d\ln y}{\vartheta d\ln x_3} > 0,$$

then if one of the coefficients on the x_j's is negative then the theory will be rejected (in the sense that it will not be considered as describing adequately the data generation process). Similarly the theory will also be rejected if one of the coefficients on the x_j's is not statistically different from zero.

The criterion of theoretical consistency is applied to specific models that pass through the filters of econometric criteria. A mispecified model due to autocorrelation for example is not considered for theoretical consistency in none of the models.

Since in the short-run the coefficients of the explanatory variables can assume values different from those expected in theory the criterion of theoretical consistency is applied to the sums of the coefficients for each explanatory variable, that are regarded to represent long-run values.

The following possibilities may arise

(1) None of the five pricing models satisfies the econometric and economic criteria and consequently the data generation process can not be considered to be represented adequately by any of the models examined.

(2) Only one of the models satisfies the economic and econometric criteria. Therefore the model is considered to represent the "best" pricing method.

(3) More than one pricing models are able to satisfy the criteria set out. In such a case and since pricing hypotheses are non-nested a test between non-nested hypotheses is used to determine which model performs better. Non-nested hypotheses are tested in pairs, ie the test is between the null and the alternative. In cases where three or more theories pass the criterion of theoretical consistency the non-nested test is conducted in pairs.

There are two main approaches for testing non-nested hypotheses. The first is based on the idea to set-up a comprehensive model which includes both the competing models as special cases and then apply a likelihood ratio test. Practical ways of applying this procedure are the tests suggested by A.C. Atkinson (1970) and by R.E. Quandt (1974).

The second approach was first suggested by D.R. Cox (1961)(1962) and has been developed by M.H. Pesaran (1974) who derived the asymptotic distribution of a test-statistic based on the Neyman-Pearson likelihood ratio.

As R.E. Quandt (1974) points out however, there appears to be no best procedure either on theoretical or empirical grounds. In fact all three mentioned tests have yielded qualitively similar results in cases considered by Quandt. The Pesaran test is chosen in this study for reasons of computational convenience. Without getting into details on the statistical issues, the summary of the testing procedure can be described as follows:

Let the maintained hypothesis be H_0 and the alternative H_1

$$(2.43)\qquad H_0 : Y = Xb_0 + u_0$$
$$H_1 : Y = Zb_1 + u_1$$

where Y is the vector of observations on the dependent variable, u_0 and u_1 are the vectors of the error terms, X and Z are the matrices of observations on the independent variables and b_0 and b_1 vectors of the parameters to be estimated. Furthermore define

$\hat{6}^2_0$ and $\hat{6}^2_1$ the estimated residual variances from H_0 and H_1 respectively

e_{10} the vector of OLS residuals in the regression of Xb_0 on Z

e_{010} the vector of OLS residuals in the regression of e_{10} on X, and finally

$$(2.44)\qquad 6^2_{10} = \hat{6}^2_0 + \frac{1}{n} e'_{10}e_{10}$$

Then defining

$$(2.45)\qquad T_0 = \frac{n}{2} \log \frac{\hat{6}^2_1}{6^2_{10}} \quad \text{and,}$$

$$V_0 = \frac{\hat{\sigma}_0^2}{\hat{\sigma}_{10}^4} e_{010}\, e'_{010} \qquad (2.46)$$

It can be shown that the quantity

$$N_0 = T_0 / V_0^{1/2} \qquad (2.47)$$

is asymptotically distributed as N(0,1) on the assumption that H_0 is true.

A significant negative value of N_0 implies the rejection of the null in favour of the alternative, while a significant positive value of N_0 can be interpreted as strong evidence against H_0 in favour of the alternative which differs from H_0 in a way opposite to H_1 model. The same holds for N_1 which can be obtained by the same procedure, but this time testing the H_1 model against the H_0. When both statistics are computed the possible outcomes can be classified as follows (at the 5% significance level)

(a) Accept H_0 and reject H_1, when $|N_0| < 1.96$ and $|N_1| \geq 1.96$

(b) Reject H_0 and accept H_1 when $|N_0| \geq 1.96$ and $|N_1| < 1.96$

(c) Reject both H_0 and H_1 when $|N_0| \geq 1.96$ and $|N_1| \geq 1.96$

(d) Accept both H_0 and H_1 when $|N_0| < 1.96$ and $|N_1| < 1.96$

On the basis of the above test we are able to choose the price model that most accurately represents the data generation process of each two digit SIC sector under examination. The results of the application of the Pesaran test are discussed in the concluding chapter. The formulation estimation and testing of the price models is discussed in the next 3 chapters.

NOTES

1. A description of the various characteristics of the Greek industry can be found among others in G. Koutsoumaris (1967), A. Kintis (1973) and K. Nicolaou (1978).

2. See for example International Monetary Fund "Financial Statistics", various issues.

3. See sections (2.4) and (2.5).

4. Evidence is provided in the Yearbook of National Accounts, United Nations, 1979.

5. See section 5.4.4.

6. Information is provided by the Center of Planning and Economic Research.

7. See J. Kmenta pp 136-137.

8. See National Statistical Service of Greece (1967) p.14.

9. See K. Coutts, W. Godley and W. Nordhaus (1978) p.9.

10. A proof of this can be found in R.G.D. Allen (1975).

11. See K. Coutts, W. Godley and W. Nordhaus (1978) p.10.

12. Most of the material covered in this section can be found in A.C. Harvey (1981), particularly chapter 5. References are not cited throughout this section since they can be traced in the reference section of A.C. Harvey's book. Moreover, useful information is also available in E.F. Leamer (1978) chapter 1 a nd G.G. Judge et al (1980), particularly chapter 18.

13. More on that can be found in section 5.3.5.

14. See M. Friedman (1953) pp.3-43.

15. Overparameterization may result in inefficient estimators while

underparameterization may result in biased estimates, see A.C. Harvey (1981) p.145.

16. See R.S. Breusch and L.G. Godfrey (1981).

17. See A.C. Harvey (1981) p.180.

CHAPTER 3 : Short-run pricing theories : the neoclassical and average-cost models

3.1 Introduction.

This chapter is concerned with the formulation and empirical testing of two short run pricing models; the neoclassical theory and the average cost model. Generally the literature has focused on the distinction between long-run and short-run as the key characteristic used by an industry in defining costs; standard costs involve long-run considerations while actual costs are short-run measures. The means of representing long-run influences in price equations is to assume that prices are based on costs that are invariant to cyclical fluctuations in output. These are the standard or normal costs discussed in chapter 4 while the pricing models based on these costs are presented in chapter 5. This chapter is based on actual costs.

The neoclassical theory is the only model in this study that is based on explicit short-run profit maximising behaviour on the part of the firm. In section 3.2 we discuss the production and demand functions to be used in the derivation of the neoclassical price. In section 3.3 the neoclassical price equation is derived, while in section 3.4 we discuss some of the characteris tics of the neoclassical behaviour. Variable specification is the subject matter of 3.5 and section 3.6 is concerned with the derivation of a testable form for the neoclassical model together with the presentation and discussion of the results.

The average cost model is the only short-run markup model to be examined. Section 3.7 sets the framework for the average cost model by discussing the main findings of the R.L. Hall and C.S. Hitch (1939) study. Section 3.8 describes the derivation of the average cost model by paying particular attention to issues like the treatment of capital cost and labour productivity and the role of demand in the price equation. Section 3.9 is concerned with the specification of the variables that enter the average cost model. Finally in section 3.10 the results of the econometric application of the average cost model are presented and discussed.

3.2 Neoclassical price equation: the demand and production functions

Assuming that a production function exists, then the problem of the firm consists in the technological transformation of inputs into output. If for reasons of simplicity we assume that the firm produces on only one product, y and utilisesn inputs (X_i), then a production function may be written as[1].

(3.1) $$y = f(X_1 \dots X_n)$$

Equation (3.1) expresses all possible combinations of inputs for the production of y. From these combinations only the optimum one is of interest for the theory of production. To define the optimum combination and give the production set an economic content in the theory of the firm we have to accept one of the following assumptions[2] that lead to two equivalent definitions of the production function:

a) the firm maximises output with given amounts of inputs

b) the firm produces a given amount of output using the minimum amount of inputs.

There is a number of questions relating to the production function as for example the level of aggregation to which the function refers or the dimentionality of the y and x variables (stocks rather than flows at a point of time), measurement problems, etc. However what we are interested in is not the production function or its estimation but the derivation of a price equation from the production function. Therefore the basic assumptions and the properties of the production function will not be discussed. Instead we will deal with the algebraic specification of the production function which is necessary for the derivation of the neoclassical model.

Among the various forms used in the literature the Cobb-Douglas specification is chosen mainly because of the ease in the calculations required and despite its drawbacks compared to the C.E.S. specification[3]. It is useful to note however, that as it will be shown later, the various price equations resulting from different production functions are to a large extent similar.

The production function to be used is given in equation (3.2). Three factor inputs are employed; labour, materials and capital. Technological change is assumed to be Hicks-neutral at a constant rate δ. There is no constraint on the returns to scale parameter ($\alpha + \beta + \gamma \gtrless 1$)

(3.2) $$Q = A e^{\delta t} L^{\alpha} M^{\beta} K^{\gamma}$$

where Q = homogenous product measured in physical units.

L = labour input measured either in manhours or as the number of people employed.

M = material inputs measured in physical units.

K = capital stock measured in physical units.

A = efficiency parameter.

δ = rate of technological change.

t = time.

α, β, γ = elasticity of output with respect to labour, materials and capital respectively. The usual[4] properties are assumed to hold and furthermore,

(3.3) $$A > 0, \quad 0 < \alpha, \beta, \gamma < 1, \quad \delta > 0$$

Referring to the demand function, standard utility theory is used to derive a demand equation of the form (3.4)

(3.4) $Q = f(P, Y, P_B)$

where Q = quantity demanded for the firm's product measured physical units.

P = price of the product.

P_B = prices of other goods, substitutes or complements that can be purchased.

Y = money income of the demanders.

The following points may be considered regarding equation (3.4):
(a) Homogeneity. Equation (3.4) is assumed to be homogenous of degree zero, ie. if we increase all prices and income by the same proportion, then the quantity demanded will not change. In terms of elasticities, this implies that for a given product, the sum of price elasticities and income elasticity is zero. (b) Income term. Nothing can be said about the sign of the income term. It can be positive or negative but for normal goods it has to be positive. There is no apriori information about the magnitude of the income term, apart from the fact that for necessities it is expected to be less than one, while for luxuries higher than one. (c) Other prices. In general if a good is a substitute we would expect a possitive coefficient in (3.4) while if it is a complement, a negative one. Unless we know whether a good is a substitute or a complement, we can not determine the sign of P_B in (3.4). However if we can combine all other goods into one composite commodity (Q_B) with one composite price (P_B), then by definition (Q_B) will be a complementary good to Q. A specific Cobb-Douglas representative form will be assumed for the demand equation such as (3.5)

(3.5) $Q = \Gamma_0 \, P^{c_0} \, Y^{b} \, P_B^{d}$

where Γ_0 is a scale perameter

c_o is own price elasticity of demand

b is income elasticity of demand

d is cross price elasticity

Combining the assumptions of a negative own price elasticity ($c_o<0$) and positive income elasticity ($b>0$) with the assumption of homogeneity of degree zero, that guarantees no money illusion, then d will be

(3.6) $$d = -(b + c_o)$$

This being so, then changing Y, P, P_B proportionately leaves the amount demanded unchanged. Equation (3.6) does not specify the sign of d, but it shows how it depends on b and c_o. The derivation of neoclassical price equation is presented in the next section and is based on equations (3.2) and (3.5).

3.3 Derivation of the neoclassical price equation.

The neoclassical price equation is derived by explicitly maximising a profit function based on the production and demand equations (3.2) and (3.5). The price equation will be derived as a long-run equilibrium model. As such the optimal neoclassical price offers the framework for comparison with other pricing models to be examined later. Lags will be introduced in section (3.6) to show how prices adjust to their equilibrium levels. At the moment we will assume that there are no lags in the production process so that demand and production respond instantaneously to changes in income and factor prices.

The firm is assumed to have a production function described by (3.2) and faces a demand function described by (3.5). The firm sets it price so as to maximise the expected value of its discounted profits. This criterion coupled with the assumption of no intertemporal interdependencies guarantees that the profit flow is maximised at every point in time.

The profit function may be written as

(3.7) $\Pi = PQ - C$

where Π = profits

C = total costs that can be further defined as (3.8)

(3.8) $C = Pw.L + Pm.M + Pc.K$

where Pw = wage rate index

Pm = materials price index

Pc = cost of capital services index

Demand function (3.5) can be written as a function of price, as

(3.9) $$P = Q^{1/co} \Gamma_o^{-1/co} Y^{-b/co} P_B^{(b+co)/co}$$

and therefore the profit function may be written as

(3.10) $$\Pi = Q^{1+1/co} \Gamma_o^{-1/co} Y^{-b/co} P_B^{(b+co)/co} - Pw.L - Pm.M - Pc.K$$

or if we introduce the production function (3.2) as

(3.11) $$\Pi = [Ae^{\delta t} L^{\alpha} M^{\beta} K^{\gamma}]^{1+1/co} \Gamma_o^{-1/co} Y^{-b/co} P_B^{(b+co)/co}$$

$$-Pw.L - Pm.M - Pc.K$$

Maximization of (3.11) with respect to L,M,K yields the following first order conditions[5]

(3.12)

$$\frac{\vartheta\Pi}{\vartheta L} = (1 + \frac{1}{co}) P.\frac{Q}{L} \alpha - Pw = 0$$

$$\frac{\vartheta\Pi}{\vartheta M} = (1 + \frac{1}{co}) P.\frac{Q}{M} \beta - Pm = 0$$

$$\frac{\vartheta\Pi}{\vartheta K} = (1 + \frac{1}{co}) P.\frac{Q}{K} \gamma - Pc = 0$$

Equations (3.12) may be transformed to yield[6]

$$(3.13)\qquad \begin{aligned} L &= P.Q.Pw^{-1}\alpha(1 + 1/c_o) \\ M &= P.Q.Pm^{-1}\beta(1 + 1/c_o) \\ K &= P.Q.Pc^{-1}\gamma(1 + 1/c_o) \end{aligned}$$

Introducing the demand function (3.5) in (3.13) yields[7]

$$(3.14)\qquad \begin{aligned} L &= P^{(1 + c_o)} \Gamma_o Y^{b} P_B^{-(b+c_o)} Pw^{-1} \alpha (1 + 1/c_o) \\ M &= P^{(1+c_o)} \Gamma_o Y^{b} P_B^{-(b+c_o)} P_m^{-1} \beta (1 + 1/c_o) \\ K &= P^{(1+c_o)} \Gamma_o Y^{b} P_B^{-(b+c_o)} Pc^{-1} \gamma (1 + 1/c_o) \end{aligned}$$

Letting

$$(3.15)\qquad Z = P^{(1 + c_o)} \Gamma_o Y^{b} P_B^{-(b + c_o)} (1 + 1/c_o)$$

equations (3.14) become

$$(3.16)\qquad \begin{aligned} L &= Z\ Pw^{-1}\alpha \\ M &= Z\ Pm^{-1}\beta \\ K &= Z\ Pc^{-1}\gamma \end{aligned}$$

By introducing (3.16) into the production function (3.2) we have

$$(3.17)\qquad Q = Ae^{\delta t} (Z\ Pw^{-1}\alpha)^{\alpha} (Z\ Pm^{-1}\beta)^{\beta} (Z\ Pc^{-1}\gamma)^{\gamma}$$

which can be written in view of (3.5) as

(3.18) $$\Gamma_0 Y^b P^{c_0} P_B^{-(b+c_0)} = Ae^{\delta t}\left[\frac{\alpha}{Pw}\right]^{\alpha}\left[\frac{\beta}{Pm}\right]^{\beta}\left[\frac{\gamma}{Pc}\right]^{\gamma} Z^{\alpha+\beta+\gamma}$$

Let the returns to scale parameter be $\sigma=\alpha+\beta+\gamma$. If we substitute (3.15) into (3.18) we have after some rearrangement[8]

(3.19) $$P^{c_0-\sigma(1+c_0)} = Ae^{\delta t}\left[\frac{\alpha}{Pw}\right]^{\alpha}\left[\frac{\beta}{Pm}\right]^{\beta}\left[\frac{\gamma}{Pc}\right]^{\gamma}\Gamma_0^{\sigma-1} Y^{b(\sigma-1)}$$

$$\cdot P_B^{-(\sigma-1)(b+c_0)}\left(1+\frac{1}{c_0}\right)^{\sigma}$$

Setting

(3.20) $$\Theta = \left[c_0-\sigma(1+c_0)\right]^{-1}$$

equation (3.19) becomes

(3.21) $$P = A^{\Theta}e^{\delta\Theta t}\left[\frac{\alpha}{Pw}\right]^{\alpha\Theta}\left[\frac{\beta}{Pm}\right]^{\beta\Theta}\left[\frac{\gamma}{Pc}\right]^{\gamma\Theta}\Gamma_0^{\Theta(\sigma-1)} Y^{\Theta b(\sigma-1)}$$

$$\cdot P_B^{-\Theta(b+c_0)(\sigma-1)}\left[1+\frac{1}{c_0}\right]^{\sigma\Theta}$$

Further manipulation on (3.21) gives[9]

(3.22) $$P = \left[A\Gamma_0^{(\sigma-1)}(1+{}^1\!/c_0)^{\sigma}\alpha^{\alpha}\beta^{\beta}\gamma^{\gamma}\right]^{\Theta}e^{\delta\Theta t}\, Y^{\Theta b(\sigma-1)}$$
$$\cdot P_B^{-\Theta(b+c_0)(\sigma-1)} P_w^{-\alpha\Theta} P_m^{-\beta\Theta} P_c^{-\gamma\Theta}$$

which can be conveniently written as

(3.23) $$P = \pi_0 e^{\pi_1 t} Pw^{\pi_2} Pm^{\pi_3} Pc^{\pi_4} Y^{\pi_5} P_B^{\pi_6}$$

where

$\pi_0 = [A\ \Gamma_0^{(\sigma-1)}(1+1/c_0)\ \sigma_\alpha{}^\alpha{}_\beta{}^\beta{}_\gamma{}^\gamma\ ]^\Theta$

$\pi_1 = \delta\Theta$

$\pi_2 = -\alpha\Theta$

$\pi_3 = -\beta\Theta$

$\pi_4 = -\gamma\Theta$

$\pi_5 = \Theta b(\sigma-1)$

$\pi_6 = -\Theta(b+c_0)\ (\sigma-1)$

3.4 Characteristics and implications of the neoclassical equation.

Equation (3.23) represents an optimal equilibrium relationship for the neoclassical price whereby the prices of factors of production income and other prices are the explanatory variables of the neoclassical price. Before proceeding to the derivation of a testable hypothesis for equation (3.23) it is useful to consider a number of points that are directly related to the neoclassical price.

(1) The derivation of (3.23) implicitly rested on the assumption that perfect competition exists in all factor markets. This is quite a reasonable assumption because most firms can purchase any amount of factors in the market at the prevailing price. Perfect competition certainly exists in the labour and capital markets where the firm's purchases of labour and capital services are very small to affect the price of these services. With regard to material input markets however it is possible to visualize situations where the firm may be considered to operate in conditions that are far from perfectly competitive. In any case to cover the possibility of imperfections in factor markets define the demand for labour, materials and capital as

(3.24)
$$L = \Gamma_1 \; Pw^{c_1}$$
$$M = \Gamma_2 \; Pm^{c_2}$$
$$K = \Gamma_3 \; Pc^{c_3}$$

where $\Gamma_1, \Gamma_2, \Gamma_3$ are scale parameters

c_1, c_2, c_3 are elasticities

Maximization of the profit function will yield the following first order conditions

(3.25)
$$\frac{\partial \Pi}{\partial L} = (1 + \frac{1}{c_o}) \, P \frac{Q}{L} \alpha - Pw \, (1 + \frac{1}{c_1}) = 0$$
$$\frac{\partial \Pi}{\partial M} = (1 + \frac{1}{c_o}) \, P \frac{Q}{M} \beta - Pm \, (1 + \frac{1}{c_2}) = 0$$
$$\frac{\partial \Pi}{\partial K} = (1 + \frac{1}{c_o}) \, P \frac{Q}{K} \gamma - Pc \, (1 + \frac{1}{c_3}) = 0$$

Repeating the procedure for the derivation of the neoclassical price outlined in section (3.3) the resulting price equation will be in the form of (3.23) where the parameters are now

(3.26)
$$\pi_o = \left[A\Gamma_o^{(\sigma-1)} (1 + \frac{1}{c_o})^{\sigma} (\frac{\alpha c_1}{1+c_1})^{\alpha} (\frac{\beta c_2}{1+c_2})^{\beta} (\frac{\gamma c_3}{1+c_3})^{\gamma} \right]^{\Theta}$$
$$\pi_1 = \delta\Theta, \; \pi_2 = -\alpha\Theta, \; \pi_3 = -\beta\Theta, \; \pi_4 = -\gamma\Theta \; ,$$
$$\pi_5 = \Theta b(\sigma-1) \quad \pi_6 = -\Theta(b+c_o)(\sigma-1)$$

Obviously comparing the parameters (3.26) with those of (3.23) we can see that the only effect the introduction of imperfection in the factor markets has on the neoclassical price is through constant term.

(2) It was mentioned before that the choice of the Cobb-Douglas functional form may be considered rather restrictive. Table 3.1 shows the resulting price equations for different assumptions about the production function. The choice of the C.E.S. function differentiates the price equation resulting from the Cobb-Douglas production function only to the parameters to be estimated. Furthermore the assumption about the constancy or not of the returns to scale parameter differentiate further the price equation.

(3) The neoclassical price equation (3.23) has been derived without making any explicit assumptions about the returns to scale. Assuming constant returns to scale $\sigma=1$, then by (3.20), $\Theta=-1$, which results, as can be seen in table 3.1 in

(3.27) $$\pi_0 = [A\alpha(1+\frac{1}{c_0})\,\alpha^{\alpha}\beta^{\beta}\gamma^{\gamma}]^{-1}$$

$$\pi_1 = \delta,\ \pi_2 = \alpha,\ \pi_3 = \beta\ \ \pi_4 = \gamma$$

$$\pi_5 = \pi_6 = 0$$

Therefore equation (3.23) can be written as

(3.28) $$P = \pi_0\ e^{\pi_1 t}\ Pw^{\pi_2}\ Pm^{\pi_3}\ Pc^{\pi_4}$$

which implies that when constant returns to scale are assumed, demand elements disappear from the neoclassical price equation.

(4) The parameter c_0 measures the elasticity of demand with respect to its price. c_0, together with σ determine the value of the parameter Θ which in turn is crucial for all the parameters appearing in the price equation as can be seen from (3.23). Assuming that c_0 refers to a normal good, we can examine the values of Θ when

Table 3.1 Production functions and Neoclassical price Equations

1. Cobb Douglas

$Q = Ae^{\delta t} L^{\alpha} M^{\beta} K^{\gamma}$ $\qquad P = \Pi o e^{\Pi 1 t} Pw^{\Pi 2} PM^{\Pi 3} PC^{\Pi 4} Y^{\Pi 5} PB^{\Pi 6}$

$\sigma = \alpha+\beta+\gamma \neq 1$ $\qquad$ where $\Pi_o = \left[A\Gamma_o^{6-1} (1+{}^1/co)^6 \alpha^{\alpha} \beta^{\beta} \gamma^{\gamma}\right]^{\Theta}$

$\Pi_1 = \delta\Theta,\ \Pi_2 = -\alpha\Theta,\ \Pi_3 = -\beta\Theta$

$\Pi_4 = -\gamma\Theta,\ \Pi_5 = \Theta b(6-1)\ \Pi_6 = -\Theta(b+co)(6-1)$

$Q = Ae^{\delta t} L^{\alpha} M^{\beta} K^{\gamma}$ $\qquad P = \Pi o e^{\Pi 1 . t} Pw^{\Pi 2} PM^{\Pi 3} PC^{\Pi 4} Y^{\Pi 5} PB^{\Pi 6}$

$\sigma = \alpha+\beta+\gamma = 1$ $\qquad$ where $\Pi o = \left[A(1+{}^1/co)\alpha^{\alpha} \beta^{\beta} \gamma^{\gamma}\right]^{-1}$

$\Pi_1 = -\delta,\ \Pi_2=\alpha,\ \Pi_3=\beta,\ \Pi_4=\gamma,\ \Pi_5=\Pi_6=o$

2. C.E.S.

$Q = Ae^{\delta t}\left[h_1 L^{-\rho} + h_2 M^{-\rho} + h_3 K^{-\rho}\right]^{\frac{-6}{\rho}}$ $\qquad P = \Pi o e^{\Pi 1 . t}\left[h_1 Pw^{\Pi 2} + h_2 PM^{\Pi 3} + h_3 PC^{\Pi 4}\right]^{\frac{\Theta}{\rho}} Y^{\Pi 5} PB^{\Pi 6}$

$\sigma = a + b + \gamma \neq 1$

where

$\Pi_o = \left[A\Gamma_o^{6-1} (1+{}^1/co)^6 (h_1+h_2+h_3)\right]^{\Theta}$

$\Pi_1 = \delta\Theta,\ \Pi_2 = \theta\rho, \Pi_3 = \theta\rho, \Pi_4 = \theta\rho$

$\Pi_5 = \Theta b(6-1),\ \Pi_6 = -\Theta(b+co)(6-1)$

$Q = Ae^{\delta t}\left[h_1 L^{-\rho} + h_2 M^{-\rho} + h_3 K^{-\rho}\right]^{\frac{-1}{\rho}}$ $\qquad P = \Pi o e^{\Pi_1 t}\left[h_1 Pw^{\Pi_2} + h_2 PM^{\Pi_3} + h_3 PC^{\Pi_4}\right]^{\frac{1}{\rho}} Y^{\Pi_5} PB^{\Pi_6}$

$\sigma = a + b + \gamma = 1$

where

$\Pi_o = \left[A/(1+{}^1/co)\ (h_1+h_2+h_3)\right]^{-1}$

$\Pi_1 = -\delta,\ \Pi_2 = \rho\ \ \Pi_3 = \rho\ \ \Pi_4 = \rho$

$\Pi_5 = o,\ \Pi_6 = o$

demand is perfectly inelastic	$c_o = 0$
demand has a unitary elasticity	$c_o = -1$
demand is perfectly elastic	$c_o = -\infty$
demand is inelastic	$-1 < c_o < 0$
demand is elastic	$-\infty < c_o < -1$

For all the above cases we will also consider alternative assumptions about the returns to scale parameter σ, ie $\sigma = 1$, $\sigma < 1$ and $\sigma > 1$. All possibilities except for the perfectly elastic demand curve ($c_o = -\infty$) which is treated seperately in the next paragraph are given in table 3.2.

(5) The optimal neoclassical price (3.23) is closely related to average and marginal cost. In fact it equals average and marginal cost in the perfectly competitive case, where

(3.29) $$c_o = -\infty$$

Total cost was defined in (3.8) as C=Pw.L + Pm.M + Pc.K

In view of equations (3.13), total cost may be written as

(3.30) $$C = P.Q\,\alpha\left(1+\frac{1}{c_o}\right) + PQ\,\beta\left(1+\frac{1}{c_o}\right) + PQ\gamma\left(1+\frac{1}{c_o}\right) = PQ\left(1+\frac{1}{c_o}\right)(\alpha+\beta+\gamma)$$

From which marginal cost may be written as

(3.31) $$MC = \frac{\partial C}{\partial Q} = P\left(1+\frac{1}{c_o}\right)(\alpha+\beta+\gamma)$$

The assumption of constant returns to scale reduces (3.31) in

(3.32) $$MC = P\left(1+\frac{1}{c_o}\right)$$

which for the perfectly competitive case becomes

(3.33) $$MC = P$$

Table 3.2 Values of Θ for different values of co and 6

$$\Theta = \left[co - 6(1+co)\right]^{-1}$$

1)	$C_o = o \rightarrow \Theta = -6^{-1}$ and for	$6=1$	$\Theta = -1$
		$6>1$	$-1 < \Theta < o$
		$6<1$	$-\infty < \Theta < -1$
2)	$C_o = 1 \rightarrow \Theta = -1$		
3)	$-1 < C_o < o$ and for	$6=1$	$\Theta = -1$
		$6>1$	$-1 < \Theta < o$
		$6<1$	$-\infty < \Theta < -1$
4)	$-\infty < C_o < -1$ and for	$6=1$	$\Theta = -1$
		$6>1$	$\Theta \lessgtr o$
		$6<1$	$\Theta < o$

Following the same exercise for average cost we have

(3.34) $$AC=CQ^{-1}=P.Q\ (1+\frac{1}{c_0})(\alpha+\beta+\gamma)\ Q^{-1} = (\text{with } \alpha+\beta+\gamma=1 \text{ and } c_0=-\infty)=P$$

Therefore under competitive conditions and assuming constant returns to scale we get the familiar long-run condition

(3.35) $$P=AC=MC$$

Under non-competitive conditions the ratio of marginal cost to price equals the ratio of average cost to price which is further equal to $(1+1/c_0)$ which in turn can be regarded as the markup factor of the average cost model to be developed later in the chapter.

(6) Equation (3.23) is non-linear in the parameters to be estimated but linear in variables. Taking logarithms on both sides of (3.23) we have

(3.36) $$\ln P= \pi_0' + \pi_1 t + \pi_2 \ln Pw + \pi_3 \ln Pm + \pi_4 \ln Pc + \pi_5 \ln Y + \pi_6 \ln P_B$$

From (3.36) it can be seen that the effects of factor prices on product prices are the elasticities of product price with respect to factor prices. An increase for example of 1% in the price of labour services (Pw) will increase the product price by π_2%

Another distinctive feature of the neoclassical price is that productivity does not appear explicitly among the terms of equation (3.23). Instead it is assumed to grow smoothly over time and is represented by the time trend. However it is possible to model the neoclassical price in another form where productivity may appear explicitly.

(7) Such a form requires that unit factor costs instead of factor prices are the elements of the price equation. From equation (3.2)

we can write the production function as

$$(3.37) \qquad Ae^{\delta t} = QL^{-\alpha}M^{-\beta}K^{-\gamma}$$

and from (3.5) we can write the demand function as

$$(3.38) \qquad \Gamma_0^{(\sigma-1)} Y^{b(\sigma-1)} P_B^{-(\sigma-1)(b+c_0)} = Q^{(\sigma-1)} P^{-c_0(\sigma-1)}$$

By introducing equations (3.37) and (3.38) into equation (3.19) we have

$$(3.39) \qquad P^{c_0-\sigma(1+c_0)+c_0(\sigma-1)} = Q^{\sigma} L^{-\alpha} M^{-\beta} K^{-\gamma} (1+\frac{1}{c_0})^{\sigma} (\frac{\alpha}{Pw})^{\alpha} (\frac{\beta}{Pm})^{\beta} (\frac{\gamma}{Pc})^{\gamma}$$

which is equivalent to

$$(3.40) \qquad P^{-\sigma} = \frac{Q^{\sigma}}{(Pw.L)^{\alpha}(Pm.M)^{\beta}(Pc.K)^{\gamma}} (1+\frac{1}{c_0})^{\sigma} \alpha^{\alpha} \beta^{\beta} \gamma^{\gamma}$$

which by rearranging becomes

$$(3.41) \qquad P^{\sigma} = \left[\frac{Pw.L}{Q}\right]^{\alpha} \left[\frac{Pm.M}{Q}\right]^{\beta} \left[\frac{Pc.K}{Q}\right]^{\gamma} \left[1+\frac{1}{c_0}\right]^{-\sigma} \alpha^{-\alpha} \beta^{-\beta} \gamma^{-\gamma}$$

Raising both sides of (3.41) to the power $\frac{1}{\sigma}$ and taking logarithms we have

$$(3.42) \qquad \ln P = \tau_0 + \tau_1 \ln \left[\frac{Pw.L}{Q}\right] + \tau_2 \ln \left[\frac{Pm.M}{Q}\right] + \tau_3 \ln \left[\frac{Pc.K}{Q}\right]$$

where $\tau_0 = \frac{1}{\sigma} \left[\sigma \ln(1+\frac{1}{c_0}) - \alpha \ln\alpha - \beta \ln\beta - \gamma \ln\gamma\right]$

$\tau_1 = \frac{\alpha}{\sigma}$, $\tau_2 = \frac{\beta}{\sigma}$, $\tau_3 = \frac{\gamma}{\sigma}$

Clearly therefore the neoclassical price can be expressed in terms of unit costs. As such it bears a close relationship with average cost theory developed in the next sections of this chapter. It is important to note that the elasticity of demand (c_o) is still an argument of the neoclassical equation expressed in factor costs. It is further assumed that the effects of factor prices and productivities (for each factor input) are equal and opposite in sign. However there might be reasons for which this assumption is not valid particularly with regard to unit labour cost. A test of the differential effect between the price of labour and labour productivity on product price is carried out in the average cost model.

(8) The variables that appear in the neoclassical price equation are the prices of the factor inputs that appear in the production function and the arguments of the demand function. A question may arise as to whether we should reduce the variables that appear in the price equation by representing production as a function of labour and capital thereby excluding materials input, or represent demand as a function of its own price and income thereby excluding other prices.

The exclusion of materials input from the production function would be permissible if material inputs are a stable function of output which means that the elasticity of materials inputs with respect to output is unity.

By letting

Q = represent gross production value at current prices.

M = consumption expenditure at current prices (CON by equation (2.1)

it is then possible to estimate the following equation

(3.43) $$Q_t = AM_t^b u_t$$

for each two digit industrial sector for the period 1963i — 1977iv.

where u_t is the error term

b is the elasticity of materials inputs with respect to output

To avoid problems of heteroscedasticity we divide both sides of (3.43) by M and take logarithms so that (3.43) becomes

$$(3.44) \quad \ln\left[\frac{Q_t}{M_t}\right] = \ln A + (b-1)\ln M_t + v_t \quad v_t \sim NID\ (0, 6^2 v)$$

The exclusion of materials input from the production function would be justified if b-1 is not significantly different from zero. If this is the case then b=1, which means that materials inputs are a stable function of output. In such a case it would be preferable to work with labour and capital inputs only and as a consequence, output (Q) would account not for gross production value, but for value added. The values of the t-statistic on the b-1 coefficient are given in table 3.3. We can see that the assumption of b=1 holds in 4 out of 21 sectors (SIC: 21,29,30 and 39). For reasons of uniformity between sectors however and since all tests in this study are conducted in batteries, materials prices will be included in the four sectors where the assumption of b=1 was verified.

Sectoral demand equations have traditionally been modelled as a function of the (own) price and income. A variable measuring "other prices" usually does not appear in industry demand equations possibly because of the extensive amount of calculations required to generate such a variable. The argument for the exclusion of P_B is only statistical; it is highly collinear with the dependent variable of the price equation. It is decided therefore that the significance or not of P_B will be determined by the data in the price equations to be estimated. Assume for example that the ratio between P and P_B is constant

$$(3.45) \quad P/P_B = K$$

In such a case the demand function can be written as

$$(3.46) \quad Q = \Gamma_0 P^{c_0} Y^b \frac{P}{K}^{-(c_0+b)} = \Gamma_0 * P^{-b} Y^b$$

Table (3.3): Values of t-statistic on b-1 coefficient on equation (3.44) Two digit SIC sectors, 1963i - 1977iv.

Sector	t (b-1)	Sector	t (b-1)	Sector	t (b-1)
TOT	2.111	26	4.218	33	3.059
20	6.172	27	3.516	34	2.894
21	1.217	28	2.017	35	3.721
22	7.803	29	1.173	36	2.567
23	2.717	30	1.429	37	2.671
24	2.639	31	3.009	38	6.219
25	3.560	32	2.778	39	0.895

In such a situation the "other prices" would disappear from the demand function and consequently from the price equation. Note that assumption of zero homogeneity in the new price equation still holds. It is possible to test whether or not P_B should be included in the price equation by performing a likelihood ratio between a price equation that contains P_B and a price equation from which P_B is excluded. Such a test however does not necessarily imply that the coefficient of P_B in the demand function, $-(c_0 + b)$ is zero. The reason is that the coefficient of P_B is the price equation, π_6, cannot be identified, since it contains other parameters as well.

Equation (3.23) is represented as an optimum long-run relationship. As such it is not amenable to empirical verification. Before introducing short-run adjustments into (3.23) we should describe the method by which a precise measurement of the dependent variables that appear in the neoclassical price equation is possible. This is the subject matter of section 3.5.

3.5 Neoclassical equation: variable specification.

In this section we deal with the specification of the variables that enter the neoclassical price equation. Great importance is attached to the fact that all elements and in particular factor prices should bear a one to one correspondence to the sectoral prices (PG) as these are determined in sections (2.4) and (2.5). This involves extensive calculations in order to secure data coverage compatibility of all variables within each sector, since in most of the cases published price indices do not have a one to one correspondence with the coverage of the two digit SIC sectors. On the other hand such calculations secure the compatibility of results of neoclassical equation with those of markup equations in which the majority of variables is based on industry specific information. In what follows we will give a brief description of the methodology used for the construction of each of the five variables appearing in equation (3.23), suppressing the details into Appendix 3.

3.5.1. The wage-rate index (Pw)

Published information on wage rates that corresponds to the coverage provided by the diseggregation of the two digit SIC sectors is not available for Greek manufacturing. Labour input is a heterogeneous variable comprising of a number of labour categories. Available data permit the classification into salaried earners, males and females and wage earners, males and females. Assuming that total labour is measured by the number of people employed then,

$$(3.47) \qquad LT = LSM + LSF + LWM + LWF$$

Where definition of the variables is given in equation (2.9).

Had information about the remuneration of each of the above labour categories been available, then a composite wage rate would have been defined as the weighted sum of the four different wage and salary rates, the weights being the shares of each labour category to total employment.

What is available however, is data on yearly wage and salary bills. The methodology by which we are able to construct quarterly data on salaries for males and females and weekly earnings for male and female wage earners is described in Appendix 3. The generated variables permit the definition of the wage rate as the ratio of total labour bill over total employment as

$$(3.48) \qquad Pw = \frac{LB}{LT}$$

which is equivalent to the definition of the price labour as the weighted sum of wage and salary rates for each labour category, ie

$$(3.48)' \qquad Pw = PSM\left(\frac{LSM}{LT}\right) + PSF\left(\frac{LSF}{LT}\right) + PWM\left(\frac{LWM}{LT}\right) + PWF\left(\frac{LWF}{LT}\right)$$

Where PSM, PSF, PWM, PWF, are defined by equations (A3.8)(A3.9)(A3.10) (A3.11) respectively.

Price of labour Pw is expressed in index form, the base being the average quarterly value of the year 1970, ie (1970i + 1970ii + 1970iii + 1970iv)/4.

3.5.2. Materials price index (Pm)

The difficulty in constructing input-price indices that would directly correspond to the products produced by each sector has forced many authors to bypass the problem either by using proxies with regard to material prices or excluding them from the price equation.[10] Estimation of the price equations at the aggregate national economy level often employs a measure of farm price index to account for intermediate inputs. In the case of sectoral price equations however, such a treatment would be inadequate since it would fail to capture all the intermediate inputs required for the production of this sector's output, most of which is bought by other industrial sectors as well as from sectors such as agriculture, mining etc.

For the purpose of this study the construction of 20 sectoral input price indices was based on information provided by the input-output tables which are available for the period 1958 - 1977.

Let subscripts y,q, denote yearly and quarterly data as before. Also let the subscript i denote 2 digit SIC sectors (20-39), so that i=1...20 and subscript j denote an input-output sector, so that j=1...35.

Material prices can be defined as the weighted average of j sectoral output prices, the weights being the share of an intermediate purchase of sector i from sector j to the total of intermediate purchases of sector i (from sectors j). Formally we have

$$(3.49) \qquad Pmqi = \sum_{j=1}^{34} \frac{Qijy}{\sum_{j=1}^{34} Qijy} * Pqj \qquad \text{for } i = 1...20 \quad \text{for } j = 1...34$$

and where Pmqi = materials price index

Qij = intermediate purchase by sector i from sector j

Pjq = output price of each j sector

The procedure for the derivation of materials price is discussed in Appendix 3.

3.5.3. The price of capital services (Pc)

A notable characteristic of most price determination studies is the omission of capital costs. In equation (3.23) Pc is interpreted as the price of capital services which has become common in the literature by the term user cost of capital. This subsection outlines the methodology for the calculation of the user cost. A detailed procedure is described in Appendix 3.

In well behaved capital markets user-cost of capital can be defined as

(3.50) $$Pc = Pk(\delta + \tau)$$

where Pc = price of capital services

Pk = price of capital goods

δ = depreciation rate

τ = cost of capital or discount rate

Equation (3.50) is derived as the first order condition of a maximising behaviour according to which in the absence of taxes, investment will carry to the point where gross rate of return equals the cost of borrowing and the stream of depreciation needed to recover capital. The introduction of taxes reduces the expected rate of return from one hand but on the other the various tax allowances such as accelerated depreciation, investment allowances, interest rate subsidies etc, reduce the cost.

A specific tax equation, together with the assumptions required for the conditions of the maximization of the model are discussed in detail in Appendix 3. Suffice to mention here that the tax-factors transform equation (3.50) as

(3.51) $$Pc = Pk\left[\left(\frac{1-u.v}{1-u}\right)\delta + \left(\frac{1-u.w}{1-u}\right)\tau\right]$$

where u = tax rate

v = the proportion of depreciation that is charged against revenue less outlay on the current account in measuring income for tax purposes.

w = the proportion of cost of capital deduced from profits (revenue less outlay on current account) for tax purposes.

The user cost of capital as expressed in equation (3.51) may be considered as a shadow price for capital services stemming from the fact that the firm owns capital stock from which it derives services. A further reformulation of equation (3.51) is required to take account of the complicated structure of allowances that the Greek authorities have granted throughout the period under study to manufacturing firms. Let

λ= the percentage of capital stock that may be charged against revenue less outlay on current account to cover the value of investment, future losses etc. A number of legal decrees have been passed on, providing allowances described by λ for which we are able to collect the relevant information.

ρ= the percentage of investment cost that is granted in the form of tax and duties excemptions since most of capital investment in machinery is imported.

The user cost of capital equation may now be written as (3.52)

$$Pc = Pk\left[\left(\frac{1-\rho-uv}{1-u}\right)\delta + \left(\frac{1-\rho-uw}{1-u}\right)\tau - \left(\frac{u}{1-u}\right)\lambda\right] \qquad (3.52)$$

Equation (3.52) forms the basis for calculations of user cost extensively described in Appendix 3. Prior to these calculations however, data for capital stock, net profits, tax rate, investment implicit deflators, etc are calculated in a manner that corresponds directly to the identities described in section (2.4). Finally since data on user cost are all expressed in yearly figures, the methodology by which quarterly figures are generated is also discussed.

3.5.4. The income variable (Y)

The income variable is required in order to reflect the level of aggregate demand. Demand for final goods and services comes from all classes of income earners, households, business and government. Therefore Gross National Product, the total flow of earnings to all income recipients is used. GNP data are collected yearly from National Accounts. Quarterly figures are obtained by assuming that the quarterly pattern of GNP is the same with that of Money Supply (MS) defined as the sum of currency circulation and sight deposits. Figures of MS are collected monthly by the Monthly Statistical Bulletin of the Bank of Greece, from which quarterly data can be generated. Employing the usual notation we have

$$Y_q = Y_y * \frac{MS_{qj(y)}}{\sum^4 MS_{qj(y)}} \tag{3.53}$$

where j = a quarter of year y.

3.5.5 "Other prices" index (P_B)

The construction of the price index for "other prices" (P_B) is based on information provided by the input-output tables available yearly 1958 to 1977. The formula is given by equation (3.54).

$$P_{Bit} = \frac{Y_t - Y_{it}}{\frac{Y_t}{PY_t} - \frac{Y_{it}}{PG_{it}}} \tag{3.54}$$

where Y_t is total demand proxied by GNP

Y_{it} is sector's i own demand

PY_t is the GNP implicit deflator provided by National Accounts

PG_{it} is the output price of sector i (see section 2.5)

Equation (3.54) essentially presents an implicit deflator for GNP with the exclusion of the part of sales that each sector sells to itself. Since information obtained from input-output tables is expressed yearly, a number of assumptions are used for the construction of P_B in quarterly figures. The details of these calculations are given in Appendix 3.

The next and final section of the neoclassical model is concerned with the derivation of a testable form for equation (3.23) together with the presentation and discussion of the results.

3.6. Neoclassical price equation: A testable form.

The neoclassical price was derived in (3.23) as an optimal relationship between price and the prices of factors of production and the arguments of the demand function. As such it does not yield a testable hypothesis because not only is it expressed in levels form, but also it assumes that the adjustment of prices is instantaneous. This section presents an econometric specification for the neoclassical price.

3.6.1. An econometric specification.

Introducing a time subscript in (3.23) and lagging by one quarter we have

(3.23)' $$P_{t-1} = \pi_0 \, e^{\pi_1 t-1} Pw_{t-1}^{\pi 2} \, Pm_{t-1}^{\pi 3} \, Pc_{t-1}^{\pi 4} \, Y_{t-1}^{\pi 5} \, \dot{P}_{B\,t-1}^{\pi 6}$$

which upon dividing by (3.23) and taking logs becomes

(3.55)
$$\ln(P_t/P_{t-1}) = \pi_1 + \pi_2 \ln(Pw_t/Pw_{t-1}) + \pi_3 \ln(Pm_t/Pm_{t-1}) +$$
$$+ \pi_4 \ln(Pc_t/Pc_{t-1}) + \pi_5 \ln(Y_t/Y_{t-1}) + \pi_6(P_{B_t}/P_{B_{t-1}})$$

which can be further written as

(3.56)
$$\ln P_t - \ln P_{t-1} = \pi_1 + \pi_2(\ln Pw_t - \ln Pw_{t-1}) + \pi_3 (\ln Pm_t - \ln Pm_{t-1}) +$$
$$+ \pi_4(\ln Pc_t - \ln Pc_{t-1}) + \pi_5(\ln Y_t - \ln Y_{t-1}) + \pi_6(\ln P_{Bt} - \ln P_{Bt-1})$$

Since the aim of this investigation is to examine the influence of demand and cost changes on price changes, rates of change of the variables should be introduced. The rate of change of a variable X_t is defined as

$$\frac{X_t - X_{t-1}}{X_{t-1}}$$

which is equal to

(3.57) $$\frac{X_t - X_{t-1}}{X_{t-1}} = \frac{X_t}{X_{t-1}} - 1 \simeq \ln\left[1 + \frac{X_t - X_{t-1}}{X_{t-1}}\right] = \ln X_t - \ln X_{t-1} = d\ln X_t$$

Consequently equation (3.56) can be written in a rate of change form as in (3.58)

(3.58) $$d\ln P_t = \pi_1 + \pi_2 d\ln P_{W_t} + \pi_3 d\ln Pm_t + \pi_4 d\ln Pc_t + \pi_5 d\ln Y_t + \pi_6 d\ln P_{B_t}$$

3.6.2. Dynamic specification

Equation (3.58) still assumes that the impact between price change and its determinants is completed within one quarter. However there are various reasons to suggest that the adjustment of prices may take more than that. Generally there is no consensus among authors with regard to the dynamic response of price changes to cost changes.[12] The evidence does not suggest that there is a systematic sequence of events but rather that several elements move at their own pace, much of it determined by institutional factors.

Among the various factors traditionally recognised as affecting the speed of adjustment of price changes to cost changes is the influence of market structure. A common occurence in industries with a small number of firms is the announcement of a price increase by a single firm following an increase in costs. The other firms in the industry may go along with the change but in a different magnitude (usually in the same direction).The firm thinking of initiating the price change will consider the possibility of losing goodwill and customers in case its competitors do not follow its lead. Although the issue between adjustment speed and market structure has not yet been resolved,[13] the fact is that normally there may be a delay before any firm would start the process as it must be convinced that rivals would follow suit. The argument is more forceful in concentrated industries where large firms with significant amounts of liquid capital are better equipped to vary output and inventories as adjustment is delayed.

The stage of the business cycle also has an important role to play in the speed of the adjustment process. When firms are working at capacity levels the fear of losing custom to competitors is diminished compared to the situation where business conditions are slack.

The adjustment of prices can be further delayed due to a number of reasons that either have to do either with the internal workings of the firm or institutional factors. A change in costs or demand may not be immediately perceivable by the firm since data on sales, productivity, material costs etc. are usually available after a time. Moreover the observation that costs or demand have changed may not cause prices to change instantaneously or by the full amound indicated, if there is doubt on the permanency of the change. Temporary factors such as weather, strikes, seasonal factors, inefficiencies in theinstallation of new equipment all affect costs. Firms which fear competition may avoid reacting to these fluctuations until thepermanency of the change is asserted. In perfect competition there is no discretion over price, no fear of losing customers loyalty and these factors are not important. In addition to the time elapsing until the signal of the change is taken by the firm and examined, there is also a lag due to the decision process required by corporate officials to implement a price change. Even so, after a precise change is decided the new price may not take effect until old orders are filled or until a specific date is set upon by the firm. These considerations will of course, differ depending on whether the firm produces to order or to stock. In general, high backlogs of orders would cause the adjustment speed to be slow.

Institutional factors may influence the adjustment speed in a number of ways. The process of wage negotiations usually starts in the beginning of the year with an agreement that covers minimum wages and salaries for the total of the economy. Thereafter sectoral negotiations take place followed by negotiations on the firm level. Some of the agreements have retroactive effect with the result that the labour bill at the time immediately following the negotiations period can be artificially high. Although materials prices fluctuate more smoothly than wages, they are also characterized by long-term contracts which involve rigidities with regard to cost changes effective to the firms. Spot prices may be quite different from future prices, thus involving different costs to each firm depending on its choice and ability to purchase spot or on long-term contracts. Finally investment goods require considerable lapse of time to be completed from the time the investment decision is taken and even more time to be incorporated into the productive process. Investment costs incurred as far as three years from the time of the pricing decision is taken may have a significant impact on prices. On the other hand, the investment decision is strongly related to the pricing policy of today which, to a considerable extent influences the investment growth of the company in the future.[14]

In summary, a distributed lag adjustment model is required to take account of the fact that adjustment to long-term levels is impeded by factors such as administrative delays of various sorts, long-term contracts, rigidities in the pricing process etc. Also market structure and price administration can lead to decisions taken in the short-run that are different or inconsistent with long-run decisions. The discussion establishes the need of introducing dynamic elements into equation (3.68) but on the other hand does not specify the maximum number of lags.[15] It was decided to use lags up to four quarters on the assumption that the adjustment would require a year to be completed. Moreover the quarter immediately following the year is also considered to be of importance since in many cases, price changes are likely to be affected by cost and demand changes with a year lag.[16] The arguments presented in the preceeding discussion are general in the sense that they apply to all pricing models examined. Introducing the dynamics by using a maximum lag of four for all variables and an error term, equation (3.58) becomes

$$(3.59) \quad \text{dln } P_t = \pi_1 + \sum_{i=o}^{4} \pi_{2i} \text{dln } Pw_{t-i} + \sum_{i=o}^{4} \pi_{3i} \text{ dln } Pm_{t-i} + \sum_{i=o}^{4} \pi_{4i} \text{ dln } Pc_{t-i} + \sum_{i=o}^{4} \pi_{5i} \text{ dln } Y_{t-i} + \sum_{i=o}^{4} \pi_{6i} \text{ dln } P_{Bt-i} + u_t \qquad u_t \sim NID(0, 6^2u)$$

Equation (3.59) forms the testable hypothesis of the neoclassical price equation.

3.6.3. Expectations about the sign of the parameters.

Expectations about the signs of the coefficients are all positive, i.e. in the long-run we would expect

$$(3.60) \quad \sum_{i=o}^{4} \pi_{2i}, \sum_{i=o}^{4} \pi_{3i}, \sum_{i=o}^{4} \pi_{4i}, \sum_{i=o}^{4} \pi_{5i}, \sum_{i=o}^{4} \pi_{6i}, > o$$

In the short-run an individual π_i can assume any value, positive, negative or zero, given that the estimation of the lag parameters is totally unconstrained. On the whole, we would expect positive coefficients, but the test of the validity of our hypothesis rests with the long - run values. As such we consider the sum of the parameters on each variable that are left after the application of the sequential procedure described in section (2.6) on equation (3.59). The variance of the long-run coefficients is defined for each explanatory variable X_i as

$$(3.61) \qquad \mathrm{var} \sum_{i=0}^{4} X_i = \sum_{i=0}^{4} \mathrm{var}\, X_i + 2 \sum_{ij=0}^{4} \mathrm{COV}\, X_i X_j$$

$$\text{for} \quad i=0\ldots,\ j=0\ldots,\ i \neq j$$

The neoclassical price equation (3.59) contains five explanatory variables; the prices of factors of production originating from the production function and an income term and an index of "other prices" originating from the specification of the demand function.

It is argued that $\partial P/\partial PW, \partial P/\partial PM, \partial P/\partial PC$ are all positive. On the assumption that an increase in the prices of factors of production shifts the marginal cost curve upward at every output level[17], then an increase (say) in wages will shift the marginal cost curve upward and cut the marginal revenue curve at a lower output level. Moving up the downward sloping demand curve results to a higher price. In terms of figure 3.1, an increase in the prices of factors of production moves the marginal cost curve from MC_1 to MC_2 resulting to a change in output from q_1 to q_2 and to a change in price from p_1 to p_2.

It is also argued that $\partial P/\partial Y$ is positive. A change in income may result to a change in the slope of the demand curve or a shift of the demand curve. Recall that MR is defined as

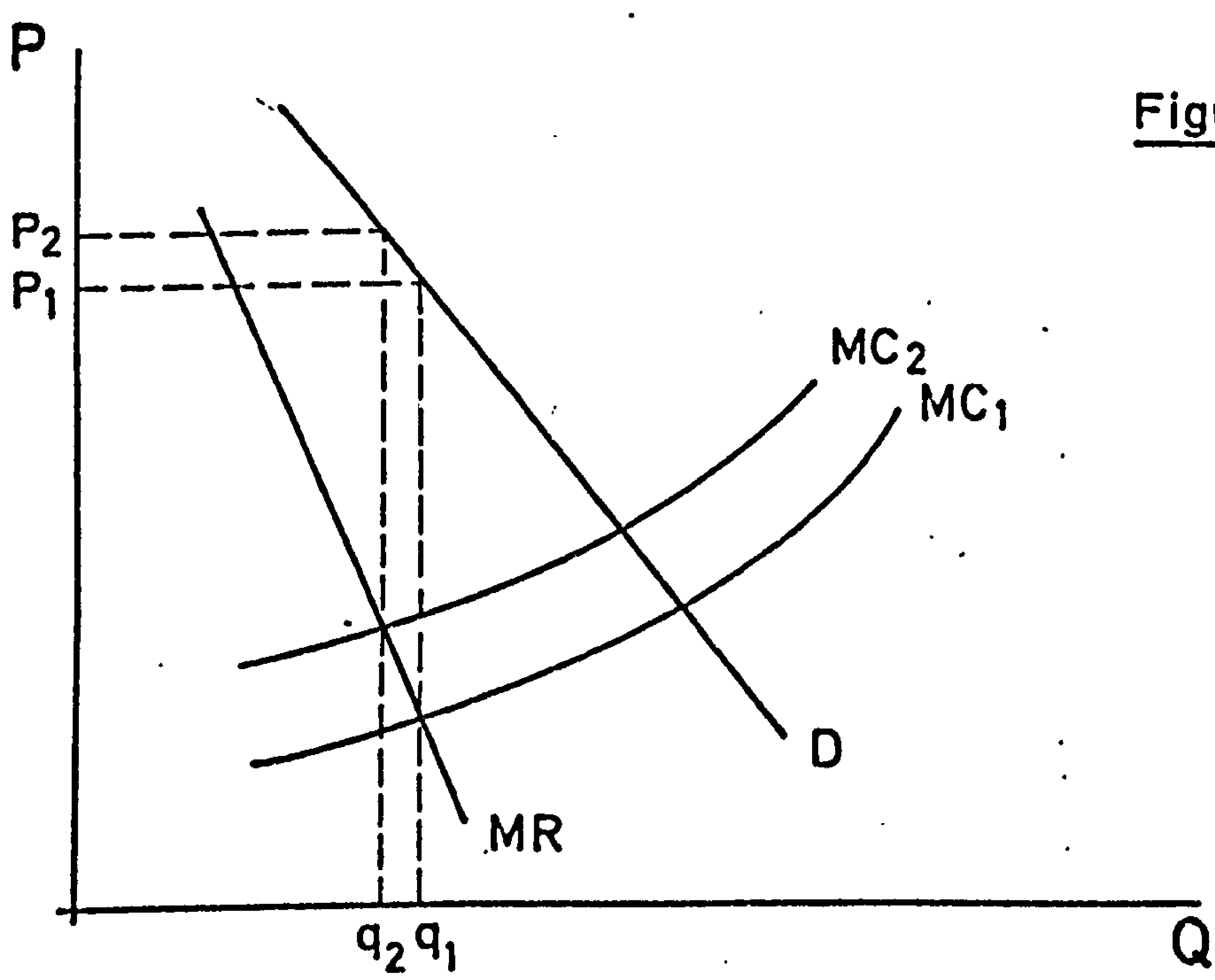


Figure 3.1

(3.62) $MR = Q \left(\frac{\partial P}{\partial Q}\right) + P$

If an increase in income results in a steepening of the demand curve (from D1 to D2 in figure 3.2) then $\partial P/\partial Q$ in (3.62) becomes more negative and MR falls. Given that the second order conditions for profit maximization are met, then the profit maximising output falls (from q1 to q2). With a negative sloped demand curve, price must rise (from p_1 to p_2).

However there is the possibility that an increase in Y causes the slope of the demand curve to become very flat and relatively large. This results to a much higher quantity sold with a lower price. J. Robinson (1933) [18] argues that the features of the demand curve leading to $\partial P/\partial Y < o$ are rather unlikely. The usual case $\partial P/\partial Y > o$ will be retained as the working hypothesis.

The second possibility of an increase of income is a rightward shift in the demand curve. This keeps $\partial P/\partial Q$ in (3.62) constant but increases P for a given Q. In terms of figure 3.3, MR rises from MR_1 to MR_2 and if the second order conditions for a maximum are met, the profit maximising quantity rises from q1 to q2. What happens to price depends on the slope of the marginal cost curve. The possibility of a rising or a constant MC satisfies the hypothesis that an increase in income resulting to a rightward shift in the demand curve will increase prices, ie $\partial P/\partial Y > o$ However if MC is falling, then $\partial P/\partial Y < o$, if

(3.63) $\frac{\partial AR}{\partial Q} > \frac{\partial MC}{\partial Q} > \frac{\partial MR}{\partial Q}$

ie if marginal cost falls faster than average revenue but not as fast as marginal revenue [19].

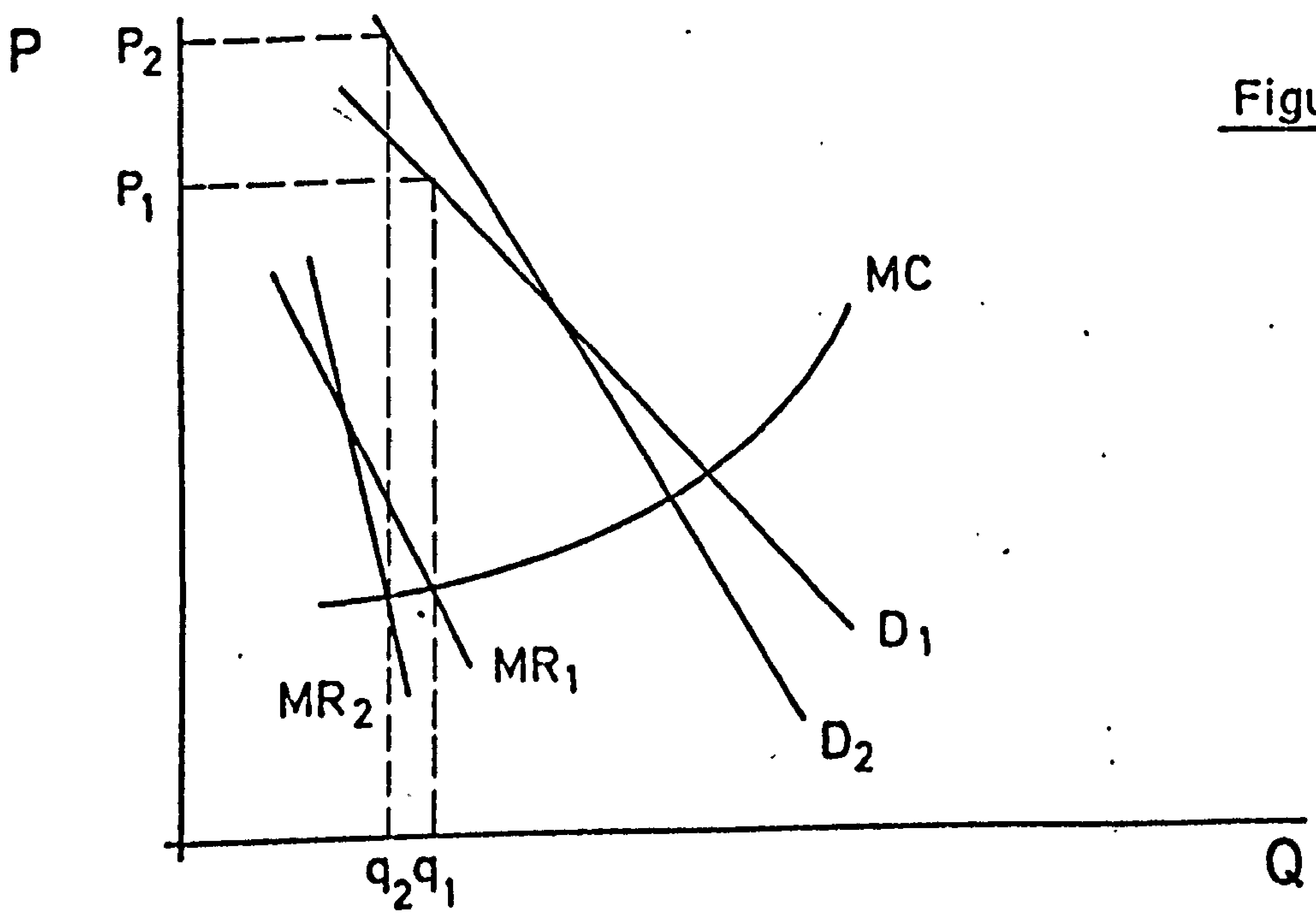


Figure 3.2

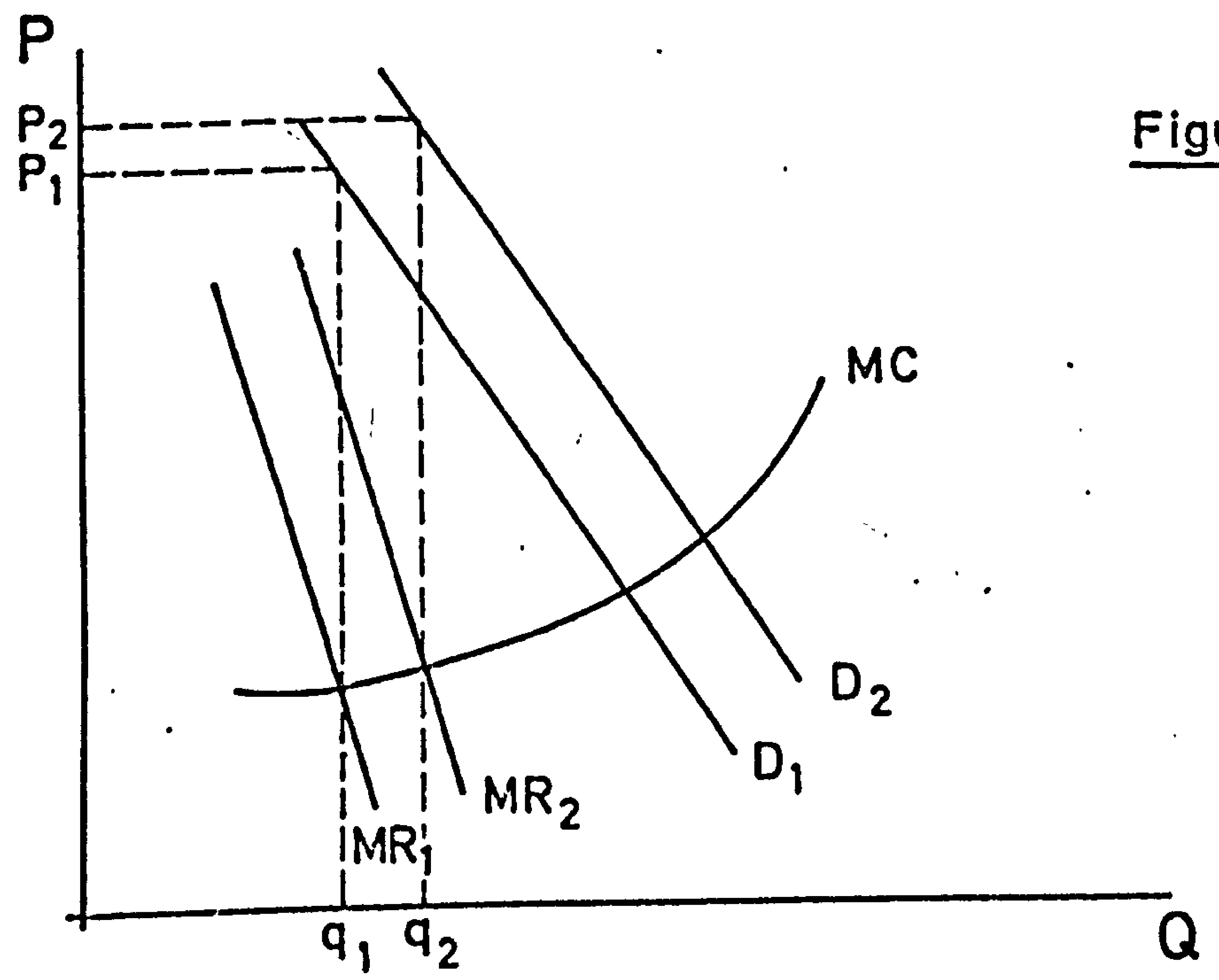


Figure 3.3

The expectation on the parameter $\sum_{i=0}^{4} \Pi_{6i}$ is probably the most difficult to determine. By equation (3.6) and on the assumption of zero homogeneity (no money illusion) on the demand function, we constrained the coefficient on P_B (in the demand equation) to equal the sum of the positive income elasticity (b) and the negative price elasticity (c_0). At first glance this means that the neoclassical model is compatible with a positive negative or zero coefficient or P_B. To evaluate the implications on the sign of the P_B coefficient we have to consider possible magnitudes for b and c_0. The income elasticity of demand for all goods in a macroeconomic framework should be close to unity. The output of the manufacturing sector is a significant portion of the total purchases and the income elasticity of demand for manufacturing products should not differ much from the income elasticity for all goods. The observation that manufacturing output is more sensitive to fluctuations of the business cycle than the total economy, would suggest an income elasticity for manufacturing more than the income elasticity for the total economy. Hence a value of b near or higher than unity should not be ruled out.

This being so, then regression results where the P_B variable has a coefficient of zero, may be interpreted in one of two ways; either on the existence of constant returns to scale [20] or on the fact that c_0 should be about minus one or greater. If $|c_0| > -1$ for the firm, then increasing prices would result in greater total revenue with a lower level of output. This means greater profits and indicates that producers are missing an opportunity. In the long-run however, this should be regarded as a rather unlikely possibility. On the other hand if $|c_0| < -1$, then lower prices will bring greater total revenue, but costs will rise with increased output and profits may be reduced. This is consistent with the assumption of profit maximization and therefore we would expect $|c_0| < -1$. This being the case, then it is normal to expect that on the grounds of the relative magnitudes of income and price elasticity the coefficient of $\sum_{i=0}^{4} \Pi_{6i}$ to be positive. The argument is further reinforced by the fact that due to the method of construction of P_B [21], "other prices" are by definition a complement on each sectoral PGi and as such a positive coefficient should be expected. Strictly speaking however any value on the P_B coefficient would be consistent with neoclassical price behaviour.

Finally a note about the constant term. Equation (3.59) makes no explicit mention of productivity. The omission is justified by the assumption that technological change proceeds smoothly at an exponential rate and does not vary over the business cycle. This is rationalised by the hypothesis that firms always raise prices in response to an increase in wages because all wage increases are regarded as permanent, whereas deviations of actual productivity from its trend are regarded as temporary and as such do not cause a change in price. Since the neoclassical equation is estimated with prices and wages expressed in growth rates, the influence of trend productivity advance in lowering prices (relative to wages) would have to show up as a negative constant term.

3.6.4. Expectations about the size of the parameters.

Having determined the expectations about the signs of the parameters of the neoclassical price equation an obvious question to be asked is how the estimated values compare to theoretical values. On the assumptions of a profit maximising behaviour on the part of the firm, a Cobb-Douglas production function and facing imperfect competition in the product market, the expectation would be that the long-run coefficient of the prices of factors of production would equal the factor bill over sales. From equation (3.12) we have

$$(3.64) \qquad \alpha = \frac{Co}{Co+1}\,\frac{L.Pw}{P.Q}, \quad \beta = \frac{Co}{Co+1}\,\frac{M.Pm}{P.Q}, \quad \gamma = \frac{Co}{Co+1}\,\frac{K.Pc}{P.Q}$$

In the case of perfect competition in the product market c_o/c_o+1 disappears while if we assume imperfect competition in the factors markets then from (3.25) we will have

$$(3.64)' \quad \alpha = \frac{c_o}{c_o+1}\frac{L.Pw}{P.Q}\left[1+\frac{1}{c_1}\right], \beta = \frac{c_o}{c_o+1}\frac{M.Pm}{P.Q}\left[1+\frac{1}{c_2}\right], \gamma = \frac{c_o}{c_o+1}\frac{K.PC}{P.Q}\left[1+\frac{1}{c_3}\right]$$

Where c_1, c_2, c_3 are the elasticities of factor demands with respect to factor prices for labour materials and capital respectively.

Moreover it is possible to test the overall effect of costs to prices in the long-run where the expectation would be that the sum of the elasticities of factor prices would equal $1/\sigma$, where σ has been defined as the degree of homogeneity of the production function. In the case of constant returns to scale we would expect the sum of factor price elasticities to be equal to one.

There is a problem however with regard to the measurement of factor shares. W.D. Nordhaus (1972) and D.G. McFetridge (1973)[22] assume that the long-run values of factor cost coefficients can be approximated by the relevant shares obtained from the input-output tables. However the information obtained from these tables refers to one year of the estimation period and most probably this year can not be considered as a representative indication of the factor shares of the period under study; even more it can not be considered as their long-run value. In section (2.4) it was shown how the generation of accounting identities for each sector and quarter was made possible. On the assumption that the relative factor shares do not fluctuate significantly over the period under study, the long-run values are approximated by the mean values of the relative

Table 3.4 Factor shares; mean values for the period 1963i-1977iv, two digit SIC sectors, Greek manufacturing

Sector	LSH	MSH	CSH
TOT	0.18840	0.74764	0.06396
20	0.11974	0.83917	0.04109
21	0.15453	0.79128	0.05419
22	0.13348	0.80377	0.06275
23	0.19925	0.72437	0.07638
24	0.25176	0.68675	0.06149
25	0.21743	0.71585	0.06671
26	0.28764	0.60817	0.10419
27	0.16804	0.75407	0.07788
28	0.38166	0.56228	0.05605
29	0.20470	0.75290	0.04241
30	0.23960	0.68449	0.07591
31	0.20836	0.68389	0.10775
32	0.05134	0.92223	0.02643
33	0.28863	0.62619	0.08417
34	0.12581	0.76474	0.10945
35	0.14826	0.81163	0.04011
36	0.20258	0.75173	0.05161
37	0.13619	0.81594	0.04786
38	0.42027	0.49076	0.08897
39	0.35386	0.57953	0.06661

factor shares during the whole period of the examination. These are given in table 3.4, where the labour share (LSH), materials share (MSH) and capital share (CSH) are defined as

(3.65) LSH = (LB + (o.175 * LB) + EMREM)/SAL

(3.66) MSH = CON/SAL

(3.67) CSH = (DEP + INT + RENT) /SAL , SAL= Sales

where all the variables on the r.h.s. of equations (3.65) - (3.67) have been defined in section (2.4). A note should be taken into the fact that by definitions (3.65) - (3.67) the sum of factor shares is less than unity since there are other miscellaneous expenses as well.[23] These expenses which after all do not exceed 4.5% on average were allocated accordingly so that the sum of factor shares in table (3.4) equals unity.

3.6.5 Presentation of the results: test statistics.

The results of estimation of equation (3.59) for the two digit SIC sectors of the Greek industry are presented in table 3.5 The methodology of estimation has been broadly outlined in section (2.6) and will not be repeated here. Before proceeding to the discussion of the results an explanation of the structure of table 3.5 is required.

Table 3.5 consists of 7 parts. In table 3.5.1. the long-run values of the coefficient for each variable are presented in the form of $\sum \pi_{ji}$. Table 3.5.2. presents a summary of the diagnostic tests and other statistics. The usual terminology is followed and we define

SSR = residual sum of squares

SE = standard error of the equation

$\bar{R}^2$ = multiple correlation coefficient corrected for degrees of freedom

DW = Durbin - Watson statistic to test for first order autocorrelation

Z1(4) = Langranze multiplier statistic to test for autocorrelation of up to fourth order. Assume that the regression equation to be estimated is of the general form (3.68).

$$(3.68) \quad Y_t = \sum_{i=1}^{k} X_{ti}\, \beta i + u_t \qquad t=1\ldots n$$

where the X_{ti} may include lagged values of Y_t and the assumption that u_t are independent is to be tested against a ρ^{th} the order autocorrelation alternative given by (3.69)

$$(3.69) \qquad u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \ldots + \rho_p u_{t-p} + \varepsilon_t \qquad \varepsilon_t \sim NID\ (0\ \sigma^2\varepsilon)$$

T.S. Breusch and L.G. Godfrey (1981) have shown that the LM statistic can be calculated as the product of the sample size n and the R^2 statistic from the regression of the OLS residual u_t on its first p lagged values u_{t-1}, u_{t-2}, ...u_{t-p} and the original regressors X_{ti}. If the assumption of independent errors is correct, then the LM statistic is asympotically distributed as chi-square with p degress of freedom. We can compare this sample value with the critical value (at the 5% level of sifnificance) and reject the null hypothesis of no autocorrelation for higher values than the critical

Z2(5) = a likelihood ratio (LR) statistic to test for the significance of the P_B variable defined as

$$(3.70) \qquad Z_{2(5)} = -2\ (\text{Log}\ L^R - \text{Log}\ L^U) \sim x^2(5)$$

ie Z2(5) is asymptotically distributed as chi-square (x^2) with 5 degrees of freedom, L^R and L^U are the restricted and unrestricted likelihoods respectively; L^U refers to the general model (3.59), while L^R refers to the same model with the restriction $\sum_{i=0}^{4} \pi_{6i}=0$ (5 restrictions).[24]

Z3(i) = a likelihood ratio (LR) statistic to test for the number of restrictions imposed on the general model which depending on the result of the Z2(5) may or may not include P_B as a regressor. The restricted model is assumed to be the best representation of the data generation process and is the model presented in table (3.5).Z3(i) is defined as

$$(3.71) \quad Z3(i) = -2\ (\text{Log } L^R - \text{Log } L^U) \sim \chi^2(i)$$

Z4(4,i) = a Chow-test for parameter stability which has an exact F-distribution with 4 and i degrees of freedom. Four extra observations are kept for all variables at the end of the period (4 quarters of 1978) for the generation of this test. The extended sample is divided into two subsamples, the second consisting of 4 observations and the null hypothesis being that the coefficients and the variance of each subsample are the same. If this is not true, Z4(4,i) will assume a value larger than the critical. Table (3.5.2) presents critical values at the 5% significant level.[25]

Z5(ij) = a Chow-test statistic that has an exact F-distribution with ij degrees of freedom.[26] The sample is divided into two subsamples, the first covering the period 1963i - 1970ii and the second the period 1970iii - 1977iv. Z5(ij) is defined as

$$(3.72) \quad Z5(ij) = \frac{\left[\Sigma e^2 p - (\Sigma e_1^2 + \Sigma e_2^2)\ \right]/K}{(\Sigma_{e1}^2 + \Sigma_{e2}^2)\ /\ (n_1+n_2 - 2K)}$$

where Σ_{ep}^2 = the residual sum of squares of the pooled sample

$\Sigma e_1^2, \Sigma e_2^2$ = the residual sum of squares of the first and second subsample respectively.

n_1, n_2 = the number of observations of the first and second subsample respectively.

K = the number of explanatory variables including the constant term.
$i = K$ and $j = n_1 + n_2 - 2K$

The null hypothesis is that there is no difference between the coefficients obtained from the two subsamples. Large values of the Z5(ij) statistic compared to the critical (at the 5% significance level) lead to the rejection of the null.

The other parts of table (3.5), ie (3.5.3)(3.5.4)(3.5.5)(3.5.6) and (3.5.7) present the results on the individual coefficients on the price of labour, price of materials, price of capital, income and "other prices" variable respectively.

3.6.6 Neoclassical equation: Discussion of the results

The performance of the neoclassical equation when applied to the two-digit SIC sectors of the Greek manufacturing during the period 1963i - 1977iv can be considered as satisfactory. As it will be seen further[27] out of the 21 equations estimated only 7 were able to pass through the strict criteria set out in section (2.6). This result has to be seen in the light of the results on the other theories discussed in latter chapters and from that point of view the performance of the neoclassical equation is better that that of full-cost theory and target rate of return theory.

A note about seasonality is required before proceeding to the presentation of the results. The method used to remove the seasonal pattern from the variables is the moving average method. All original as well as generated variables up to the final stage are taken as they are from the official sources, ie without deseasonalization. The moving average method is applied on to the final stage, ie on to the variables entering the price equations. Briefly the method consists of taking a central moving average of the original series, dividing the original series by the moving average to get a preliminary estimate of the seasonal component and then adjusting these estimates so that the sum of seasonally adjusted series for the calendar year is equal to the sum of the original series. Let the series to be adjusted, denoted by X_t. Then the ratio of the series to its

Table 3.5 Results on Neoclassical equation

Part 1 Long-run coefficients

Sectors	$\sum_{i=0}^{4} \pi_{2i} d\ln Pw_{t-i}$	$\sum_{i=0}^{4} \pi_{3i} d\ln PM_{t-i}$	$\sum_{i=0}^{4} \pi_{4i} d\ln P_{c_{t-i}}$	$\sum_{i=0}^{4} \pi_{5i} d\ln Y_{t-i}$	$\sum_{i=0}^{4} \pi_{6i} d\ln P_{B_{t-i}}$
TOT	0.295333 (3.121)	0.745424 (13.886)	0.093726 (1.442)		-0.233526 -(3.022)
20	0.123112 (4.779)	0.583920 (12.204)	0.047444 (1.797)	0.172883 (5.064)	0.392765 (4.950)
21	0.23245 (10.580)	0.657614 (13.841)	0.041242 (1.803)	0.10776 (2.661)	
22	0.34548 (10.031)	0.608436 (5.680)	0.093817 (1.771)	0.090234 (0.891)	
23	0.37639 (10.131)	0.49634 (6.249)	0.081630 (1.867)	0.076892 (3.282)	
24	0.340718 (9.830)	0.73103 (6.530)	-0.02948 (0.643)		
25	-0.373648 (3.536)	0.291400 (2.264)	0.135298 (1.035)		0.563251 (1.899)
26	0.309010 (4.728)	0.411126 (3.189)	0.159538 (1.931)	0.167029 (2.603)	0.204707 (1.929)
27	0.004382 (0.0372)	0.92237 (10.346)	0.091814 (1.342)		-0.21121 (1.9651)
28	0.295744 (1.447)	0.526783 (3.270)	0.246137 (1.804)	0.157701 (1.416)	
29	0.12095 (1.662)	1.01843 (13.313)	0.020003 (0.430)		
30	0.357906 (3.398)	0.760168 (4.235)	0.117188 (1.8112)	0.161115 (2.757)	-0.175271 (0.8705)
31	0.17249 (2.883)	0.645028 (16.987)	0.070779 (2.665)	-0.051940 (1.637)	
32	0.070249 (1.834)	1.01292 (15.24)	0.135945 (1.912)		-0.799361 (2.924)
33	0.353435 (5.442)	0.622270 (7.835)	-0.081649 (1.554)	-0.064465 (2.530)	0.0670406 (1.598)
34	0.275842 (14.039)	0.652043 (7.427)	0.078333 (1.981)	-0.135614 (1.881)	0.370862 (3.0988)
35	-0.000246 (0.003)	0.750078 (15.85)	0.113382 (2.582)		
36	0.217561 (9.173)	0.680857 (12.764)	0.0615931 (1.959)	0.0101989 (0.435)	
37	0.155399 (5.572)	0.924821 (10.278)	-0.111520 -(1.966)	0.0383709 (1.619)	
38	0.659226 (3.709)	0.577229 (2.334)	-0.12396 (0.620)		
39	0.295122 (4.440)	0.733216 (4.794)	0.105013 (1.290)		-0.238378 (1.2406)

Table 3.5 Results on Neoclassical equation

Part 2 Test statistics

Sector	SSR	SE	$\bar{R}^2$	DW	Z_1(4)	Z_2(5)	Z_3(1)	Z_4(41)	Z_5(11)
TOT	0.002397	0.007554	0.9556	2.509	11.064	11.586	(13) 10.570	0.489 (2.61) (4.46)	1.706 (2.09) (13.29)
20	0.002164	0.006858	0.9588	2.081	1.711	27.652	(17) 14.350	0.563 (2.57) (4.50)	1.308 (2.15) (9.37)
21	0.001489	0.005753	0.9526	2.543	8.596	7.548	(11) 13.236	0.204 (2.57) (4.49)	0.346 (2.12) (10.35)
22	0.007121	0.012722	0.8934	2.409	14.803	3.346	(13) 9.370	2.200 (2.57) (4.48)	0.528 (2.10) (11.33)
23	0.003094	0.008114	0.9027	2.504	8.728	10.546	(13) 12.00	0.193 (2.57) (4.51)	2.098 (2.18) (8.39)
24	0.005241	0.010449	0.8558	2.152	3.636	5.534	(14) 7.928	5.645 (2.57) (4.52)	0.259 (2.25) (7.41)
25	0.055539	0.033667	0.3635	1.679	5.247	11.304	(20) 19.55	15.15 (2.57) (4.53)	1.041 (2.34) (6.43)
26	0.006434	0.012377	0.8479	2.4397	3.353	17.266	(13) 14.06	1.234 (2.57) (4.47)	0.989 (2.09) (13.29)
27	0.007077	0.12829	0.9056	2.662	13.696	11.918	(14) 9.208	5.626 (2.57) (4.47)	3.119 (2.09) (12.31)
28	0.007418	0.038908	0.4390	2.429	4.329	5.410	(15) 8.09	2.284 (2.57) (4.53)	2.167 (2.34) (6.43)
29	0.011019	0.014845	0.8100	2.087	2.347	6.800	(16) 18.95	0.298 (2.57) (4.54)	2.761 (2.43) (5.45)
30	0.003583	0.009841	0.9178	2.412	11.052	18.084	(8) 4.062	0.307 (2.61) (4.41)	0.666 (2.12) (18.19)
31	0.004254	0.009414	0.9000	2.346	4.969	8.266	(14) 8.922	1.956 (2.57) (4.52)	1.484 (2.25) (7.41)
32	0.012331	0.016934	0.9425	2.440	8.246	19.606	(14) 8.723	1.259 (2.57) (4.47)	2.107 (2.09) (12.31)
33	0.001669	0.006628	0.9585	2.317	8.812	11.898	(9) 5.498	0.719 (2.61) (4.42)	0.831 (2.14) (17.21)
34	0.005043	0.010706	0.8843	1.559	4.902	15.084	(15) 14.32	0.141 (2.57) (1.48)	0.364 (2.10) (11.33)
35	0.004546	0.009732	0.9050	2.053	1.827	8.206	(14) 8.206	0.487 (2.57) (4.52)	1.137 (2.25) (7.41)
36	0.003881	0.008810	0.9039	2.117	4.530	7.192	(16) 14.902	0.345 (2.57) (4.54)	2.375 (9.43) (5.45)
37	0.002904	0.008034	0.9149	2.269	1.665	10.298	(11) 9.906	1.276 (2.57) (4.49)	0.581 (2.12) (10.35)
38	0.087398	0.042671	0.3399	2.821	12.151	10.714	(10) 16.889	0.123 (2.57) (11.52)	0.540 (2.25) (7.41)
39	0.011618	0.016068	0.7913	2.206	4.197	8.412	(16) 12.236	1.098 (2.57) (4.49)	0.750 (2.12) (10.35)

Table 3.5 Results on Neoclassical equation

Part 3 Individual coefficients on $d\ln w_{t-1}$

Sector	Π_1	Π_{20}	Π_{21}	Π_{22}	Π_{23}	Π_{24}
TOT	-0.00414	0.54155	-0.08738	-0.15874		
	(1.572)	(8.812)	(1.444)	(3.124)		
20	-0.00817	0.12311				
	(1.136)	(4.779)				
21	-0.000171	0.28297			-0.05052	
	(1.231)	(15.421)			(2.655)	
22	-0.0102	0.29302				0.05246
	(3.450)	(12.083)				(2.069)
23	-0.00783	0.37639				
	(0.454)	(10.131)				
24	-0.00656	0.340718				
	(3.610)	(9.830)				
25	0.0151		-0.37365			
	(2.311)		(3.536)			
26	-0.0114	0.402143		-0.0931326		
	(1.431)	(9.666)		(2.270)		
27	0.00237	0.452717		-0.185837	-0.169723	-0.092775
	(0.638)	(10.880)		(4.096)	(3.288)	(1.942)
28	-0.00571	0.495701	-0.19996			
	(0.666)	(3.731)	(1.862)			
29	-0.00371	0.187584	-0.06635			
	(1.223)	(4.434)	(1,435)			
30	-0.0112	0.434982	-0.045327.			-0.031749
	(3.995)	(11.690)	(1.625)			(1.534)
31	-0.00233	0.363011		-0.121312	-0.069207	
	(0.970)	(11.718)		(3.394)	(2.351)	
32	0.00751	0.070249				
	(1.882)	(1.834)				
33	-0.00413	0.471478	-0.051166	-0.022496		-0.0443809
	(2.023)	(15.666)	(1.8344)	(1.8243)		(1.549)
34	-0.003712	0.275842				
	(1.317)	(14.039)				
35	0.00168	0.141998				-0.142244
	(0.656)	(2.8711)				(3.066)
36	-0.00224	0.217501				
	(1.399)	(9.178)				
37	-0.00336	0.155499				
	(1.989)	(5.572)				
38	-0.00651	0.43043				0.228798
	(0.759)	(3.869)				(1.991)
39	-0.00676	0.377825		-0.082703		
	(1.879)	(8.664)		(1.969)		

Table 3.5 Results on Neoclassical equation

Part 4 Individual coefficients on $d\ln P_{M_{t-1}}$

Sector	Π_{30}	Π_{31}	Π_{32}	Π_{33}	Π_{34}
TOT	0.70654 (21.135)		-0.10621 (2.017)	0.27190 (3.939)	-0.12681 (2.348)
20	0.65569 (19.658)				-0.071741 (2.328)
21	0.645933 (20.284)		0.102723 (2.234)	-0.09104 (1.915)	
22	0.61959 (9.214)	-0.10385 (1.594)		0.16426 (2.615)	-0.071564 (1.612)
23	0.413017 (6.251)	0.243344 (3.558)			-0.160820 (3.246)
24	0.745238 (10.184)	-0.155418 (2.132)			0.141289 (1.932)
25				0.29140 (2.264)	
26	0.614965 (6.412)	-0.208170 (1.688)	0.266241 (1.982)	0.339245 (2.504)	-0.601155 (5.236)
27	0.593707 (10.027)		0.203741 (3.262)	0.124926 (2.293)	
28	0.52678 (3.270)				
29	1.01843 (13.313)				
30	0.955644 (7.307)	0.361495 (1.845)	-0.150180 (1.885)	0.159180 (1.913)	-0.240625 (1.989)
31	0.645028 (16.987)				
32	0.726068 (23.837)	0.0615009 (1.751)	-0.074029 (2.053)	0.171378 (5.684)	0.128059 (4.547)
33	0.713852 (17.444)		-0.0847431 (1.604)	0.133510 (2.640)	-0.140349 (3.551)
34	0.619407 (8.226)			0.032636 (1.513)	
35	0.750078 (15.858)				
36	0.680857 (12.764)				
37	0.764903 (18.840)		0.116444 (2.679)	0.131019 (2.949)	-0.087545 (2.091)
38	0.393817 (2.050)		0.183412 (1.934)		
39	0.645520 (6.259)	0.349278 (3.314)			-0.261532 (2.277)

Table 3.5 Results on Neoclassical equation

Part 5 Individual coefficients on $dlnKc_{t-1}$

Sector	Π_{40}	Π_{41}	Π_{42}	Π_{43}	Π_{44}
TOT	0.12589 (3.888)	-0.96219 (1.969)	-0.05527 (1.777)		0.085293 (2.460)
20	0.04744 (1.797)				
21			0.041242 (1.8034)		
22	0.093817 (1.771)				
23	0.132975 (4.161)			-0.041345 (1.506)	
24			-0.083753 (2.345)	0.0542641 (1.600)	
25	0.28887 (3.004)			-0.15357 (1.658)	
26	0.04985 (1.827)				0.109690 (1.872)
27	0.140940 (3.285)		0.091258 (2.051)	-0.140384 (3.125)	
28	0.246147 (1.804)				
29					0.020003 (0.430)
30		0.023620 (1.592)		-0.007122 (1.099)	0.100689 (2.687)
31					1.070779 (2.667)
32			0.135245 (1.912)		
33	0.0658438 (2.331)	-0.0945693 (3.3274)		-0.087939 (3.042)	0.0350151 (1.724)
34	0.130140 (4.499)		-0.052707 (1.829)		
35	0.142582 (4.106)		-0.111891 (3.272)		0.0826908 (2.346)
36	0.061593 (1.959)				
37			-0.049582 (1.558)	-0.14279 (4.465)	0.080848 (2.482)
38	0.25474 (1.598)			-0.378697 (2.352)	
39				-0.088323 (1.495)	0.193336 (3.226)

Table 3.5 Results on Neoclassical equation

Part 6 Individual coefficients on $d\ln Y_{t-i}$

Sector	Π_{50}	Π_{51}	Π_{52}	Π_{53}	Π_{54}
TOT					
20			0.07859 (3.686)	0.09430 (4.024)	
21		0.075674 (4.497)		-0.037337 (1.9593)	0.069415 (3.706)
22		-0.099704 (2.412)	0.065796 (1.452)	0.123142 (2.930)	
23		0.076892 (3.282)			
24					
25					
26				0.081179 (1.947)	0.085849 (2.243)
27					
28	0.157701 (1.446)				
29					
30		0.0380626 (1.822)	0.123052 (3.368)		
31		-0.0518403 (1.637)			
32					
33		-0.063445 (2.630)			
34		-0.030418 (1.797)	-0.035632 (1.725)		-0.060564 (1.848)
35					
36					0.010199 (0.435)
37		0.0383709 (1.619)			
38					
39					

Table 3.5 Results on Neoclassical equation

Part 7 Individual coefficients on $d\ln P_{B_{t-1}}$

Sector	Π_{60}	Π_{61}	Π_{62}	Π_{63}	Π_{64}
TOT	-0.23353 (3.022)				
20		0.16177 (2.568)			0.23100 (4.025)
21					
22					
23					
24					
25		0.563251 (1.899)			
26					0.204707 (1.929)
27	-0.211209 (1.965)				
28					
29					
30	-0.474920 (4.980)	0.143660 (1.788)		-0.0157842 (1.495)	0.171773 (1.585)
31					
32	0.307123 (2.425)	-0.463807 (3.368)		-0.305343 (1.775)	-0.337334 (2.014)
33	-0.13225 (2.360)			0.100032 (1.636)	0.099262 (1.598)
34	0.171346 (1.990)		0.199516 (1.844)		
35					
36					
37					
38					
39	-0.425541 (2.703)				0.187163 (1.328)

moving average is defined as

$$(3.73) \quad F_t = \frac{X_t}{(M.A.Xt)}$$

where $M.A.X_t$ is defined as

$$(3.74) \quad M.A.X_t = (\tfrac{1}{2})(X_{t-\frac{p}{2}} + X_{t+\frac{p}{2}}) + (\frac{1}{p-1})(X_{t-\frac{p}{2+1}} + X_{t-\frac{p}{2+2}}) + \ldots + X(t+\frac{p}{2-1})$$

where p is the periodicity of the series, which in the case of quarterly observations is equal to 4.

Starting from table (3.5.2), the multiple correlation coefficient is rather high with scores around 90% with the exception of sectors 25,28 and 38 where it is around or below 40%. The hypothesis of zero autocorrelation in the residuals of up to fourth order was rejected in 5 sectors (SIC: TOT,22,27,30 and 38). Autocorrelation does not seem to be present in the rest of the sectors on the basis of the Z1 statistic. However there is the possibility that autocorrelation of the fourth order is present,[28] something that can not be adequately captured by the Z1 statistic. A further LM test for the detection of fourth order autocorrelation was carried out[29] and as a result autocorrelation was found present in two more sectors, ie SIC:32 (Z1(1) = 5.08) and SIC:33 (Z1(1) = 5.15). A final mispecification test is given by the Z4(4,i) statistic and on the basis of the results presented in table 3.5.2 three sectors, SIC:24,25 and 27 are found to be mispecified. This makes a total of 9 sectors found to be mispecified on the basis of econometric criteria ie. SIC:TOT,22,24,25,27,30,32,33 and 38. The Chow Z5 statistic indicates that a different pricing pattern in the two subsamples is found in sectors 27,29 and 32.

Turning to the long-run values of the explanatory variables reported in table 3.5.1 it can be seen that the coefficients on the wage rate are almost always positive (with the exception of SIC:25) and on the whole significant. At the 5% significance level only 6 sectors fail to pass the test (SIC:27,28,29,32,35 and 39) although 29 and 32 are significant at the 10% level. Moreover individual lag coefficients indicate that as a rule the adjustment is completed during the first three quarters (current quarter and two lags). Extension to the third and fourth quarters takes place in 8 sectors, but then again the main bulk of the response occurs in the current quarter. Material prices are always positive and significant indicating, perhaps their relative importance in the pricing process. The inability of other studies to obtain significant values for import prices has to do probably with the fact that the various proxies that are used in place of input prices are neither consistent with, nor corresponding to the sectoral coverage of output prices the variance of which are supposed to explain. Individual lag coefficients are more evenly distributed around the five quarter period than those on wages, although again the majority of the response is centered around the current quarter. The picture drawn by the results on the long-run values of the price of capital services is rather disappointing particularly in the light of the extensive calculations undertaken to secure a proper measure of the user-cost. Nonetheless the fact that the Pc variable is included in the neoclassical price should be considered as a step further from the existing evidence of neoclassical price equations. Five sectors indicated a positive significant sum of coefficients at the 5% level (SIC:26,31,34,35,36), seven sectors had positive and significant values at the 10% level (SIC:20,21,22,23,28,30,32), sector 37 had a negative value and the rest were insignificant. A possible justification of the relative weakness of the Pc variable may be that the lag pattern is constrained to only 5 lags, despite the fact that pilot experimentation on 3 sectors proved that longer lags were insignificant. The distribution of lags included 13 coefficients on the current quarter, 3 on the first, 8 on the second and 9 coefficients on the third and fourth quarters.

Significant values on the income variable were obtained in 9 sectors (12 are being reported) of which 5 positive at the 5% significance level, one at the 10% level and 3 negative. The income elasticity of prices (on the positive long-run values) ranges between 10% and 20%, while individual values are distributed on a much larger range. Almost one third of the sectors produced significant results on the long-run values of the P_B coefficient of which five had the expected positive sign (SIC:25 and 33 are significant at the 10% level) and three had a negative sign. The individual coefficients were rather scattered through the period and no distinctive pattern of lags could be determined. In general the impact of the demand variables can be considered as low, since in only two sectors (SIC:20 and 26) both variables are significant with the expected sign. Although it is difficult to compare empirical results based on different data sets the above conclusion seems to be in accordance with M.C. Sawyer's (1983) conclusions about the significance of the demand change variables (real income and the general wholesale price index)[30] . On the other hand the limited role of demand variables has to be contrasted with the significant role played by cost elements.

On this front a question still remains to be answered on how the sum of the coefficiens on each factor price variable compares with the theoretical values as these are determined by equations(3.65)(3.66)(3.67). Table (3.6) presents the results of this comparison. The first column accounts for the sums of the coefficients (and their respective t-statistics) on all factor prices to test whether the sum significantly differs from unity. The second, third and fourth columns give the values (and their respective t-statistics) on the ratios given by (3.75)

Table 3.6 Sums of coefficients of prices of factors of production. Comparison with theoretical values. Neoclassical equation, 2 digit SIC sectors, Greek manufacturing

Sector	SUM - 1 (t)	$\sum_{i=0}^{4} \Pi_{2i}$-LSH(t)	$\sum_{i=0}^{4} \Pi_{3i}$-MSH(t)	$\sum_{i=0}^{4} \Pi_{4i}$-CSH(t)
TOT	-0.1345 (2.078)	0.1069 (1.130)	-0.0022 (0.041)	0.0298 (0.458)
20	0.2455 (6.337)	0.0034 (0.131)	-0.2553 (5.334)	0.0064 (0.241)
21	0.0687 (1.932)	0.0779 (3.546)	-0.1337 (2.813)	-0.0129 (0.566)
22	-0.0477 (0.867)	0.2120 (6.155)	-0.1953 (1.824)	0.0311 (0.586)
23	-0.0456 (0.939)	0.1771 (4.768)	-0.2280 (2.871)	0.0053 (0.120)
24	0.0423 (0.491)	0.0890 (2.566)	0.0443 (0.386)	-0.0910 (1.984)
25	0.9470 (120.11)	-0.5910 (5.594)	-0.4244 (3.298)	0.0686 (0.525)
26	-0.1203 (1.581)	0.0214 (0.327)	-0.1970 (1.528)	0.0554 (0.669)
27	0.0186 (0.239)	-0.1637 (1.389)	0.1680 (1.884)	0.0139 (0.204)
28	0.0687 (0.393)	-0.0859 (0.420)	-0.0355 (0.220)	0.1900 (1.393)
29	0.1594 (2.034)	-0.0838 (1.151)	0.2655 (3.471)	-0.0224 (0.482)
30	0.2353 (2.107)	0.1183 (1.123)	0.0757 (0.422)	0.0413 (0.638)
31	-0.1117 (2.867)	-0.0358 (0.600)	-0.0389 (1.023)	-0.0370 (1.392)
32	0.2184 (3.928)	0.0189 (0.494)	0.0907 (1.365)	0.1088 (1.538)
33	-0.1059 (1.856)	0.0638 (0.982)	-0.0039 (0.049)	-0.1658 (3.156)
34	0.0062 (0.159)	0.1500 (7.636)	-0.1127 (1.284)	-0.0312 (0.787)
35	-0.1368 (2.535)	-0.1485 (1.811)	-0.0616 (1.300)	0.0733 (1.669)
36	-0.0399 (1.143)	0.0150 (0.632)	-0.0709 (1.329)	0.0099 (0.318)
37	-0.0312 (0.458)	0.0193 (0.692)	0.1089 (1.210)	-0.1594 (2.810)
38	0.1145 (2.028)	0.2390 (1.344)	0.0865 (0.350)	-0.2129 (1.065)
39	0.1334 (2.035)	-0.0587 (0.884)	0.1537 (1.005)	0.0384 (0.474)

(3.75) $\sum_{i=0}^{4} \pi_{2i}$ -LSH, $\sum_{i=0}^{4} \pi_{3i}$-MSH, $\sum_{i=0}^{4} \pi_{4i}$-CSH

for the prices of labour, materials and capital respectively

The assumption of long-run unitary homogeneity is verified in 11 sectors, a result which is rather suprising in the light of the small differences of the individual factor costs from their theoretical long-run values. Indeed 15 sectors exhibit an insignificant difference (at the 5% significance level) between the estimated values of Pw and labour share, 16 for materials prices and 18 for capital services prices. This result is further reinforced by the fact that the assumption that was made about productivity trend seems to hold since in only 4 sectors the constant term was found to be positive. (see table 3.5.3).

The discussion of the results on the coefficients proceeded on the assumption that all equations were able to pass the econometric criteria set on section (2.6). However as it was mentioned before this is not true, since on the grounds of mispecification due to autocorrelation for example, seven sectors failed to pass the test. Since neoclassical price theory is only the first of a bunch of pricing models to be tested against the data of Greek industrial sectors it is useful to summarize the equations that are considered to pass the criteria for acceptance as these criteria were mentioned before. This is done in table (3.7), where it is shown that on econometric grounds 9 sectors seem to posess a data generation process that can not adequately be described as neoclassical. Moreover 5 more sectors are not in accordance with neoclassical behaviour since expectations about the long-run coefficients (or factor costs) are not met. The 7 sectors considered to posess a satisfactory neoclassical behaviour are SIC:20,21,23,26,31,34 and 36. This of course does not mean to imply that the neoclassical theory is rejected in 14 sectors and accepted in 7. What it means is that on the basis of this sample evidence the above seven sectors can be

Table 3.7 Summary of sectoral results: Neoclassical Equation.

SECTOR	RESULTS	SECTOR	RESULTS	SECTOR	RESULTS
TOT	Auto	26	Accepted	33	4th Auto
20	Accepted	27	Auto, Z4, $d\ln Pw=0$	34	Accepted
21	Accepted	28	$d\ln Pw=0$	35	$d\ln Pw=0$
22	Auto	29	$d\ln Pw=0$	36	Accepted
23	Accepted	30	Auto	37	$d\ln Pc=0$
24	Z4, $d\ln Pc=0$	31	Accepted	38	Auto
25	Z4, $d\ln Pw<0$, $d\ln Pc=0$	32	4th Auto	39	$d\ln Pc=0$

considered to posess a data generation process that can be adequately (on the basis of the criteria applied) described by a neoclassical pricing model.

In conclusion neoclassical price behaviour is consistent with the data in seven two digit sectors and inconsistent in the rest. The cost factors seem to behave well and overwhelm the demand factors most of which do not have the expected signs. Moreover cost factors are rather in accordance with the theoretical values as these are given by the mean values of the relative factor shares.

The neoclassical theory is the only pricing model in this study that is based on an explicit short-run profit maximising behaviour. As such it can be seen as a reference point to the markup pricing models to be considered in latter chapters. In the second part of this chapter we will examine the performance of the other short-run pricing model, the average cost model.

3.7 The average-cost model: General considerations.

The emergence of average cost pricing into the literature coincided with the refutation of the basic postulates of the neoclassical analysis of price determination as that was presented by J. Robinson (1933) and E.H. Chamberlin (1933). Traditionally the starting point for average cost pricing is considered to be the paper by R.L. Hall and C.J. Hitch (1939), although due to some confusion on terminology it is thought to refer to full-cost pricing.[31] A brief summary on the main findings of the Hall-Hitch paper that serves both as a critique of the neoclassical theory and as an introduction to the average cost theory is as follows:

Firms do not act atomistically; instead they are conscious of the reactions of their competitors. Oligopoly is found to be the main market structure of the business world. Firms do not attempt to maximise short-run profits by applying the rule MC=MR; instead they aim at long-run profit maximization. Prices are set by applying the average cost principle which states that prices are set in such a way as to cover the average variable cost, the average fixed cost and a profit margin. Moreover firm's preoccupation is with price and not with output. The firm would set its price based on the average cost principle and would sell at that price whatever the market would take. Although the firms in general would adhere to the average cost pricing rule, they would be prepared to depart from it if they want to secure a big order or if they thought they could not set this price without damaging their goodwill or endangering their future position, or in view of their rivals charging a lower price.

Subsequent studies to the Hall-Hitch paper indicated the prevalence of average cost model in the modern industrial world. A number of papers reporting average cost pricing were mentioned in chapter 1 and will not be repeated here. Instead a formal model will be developed paying particular attention to the points that were raised in the short survey of chapter 1 ie, the determinants of the markup and in particular the relationship between markup and demand and the relationship between marginal and average cost.

3.8 Derivation of the Average cost model.

3.8.1 Introduction.

The average cost asserts that prices are set equal to average costs which are defined in a way that includes a certain profit margin. Let

(3.76) $$P_t = AC_t + \Pi_t$$

Where P_t = average cost price.

AC_t = average unit costs.

Π_t = Profits per unit of output.

Equation (3.76) can be written in a multiplicative form as (3.77)

(3.77) $$P_t = M_t \cdot AC_t$$

where M_t = (1+m) = the markup on AC_t taking account of profits.

Taking the total differential on (3.77), dividing by P_t and rearranging we have after dropping the t-subscripts

(3.78) $$\frac{dP}{P} = \frac{dM}{M} + \frac{M}{P} dAC$$

Consider at the moment that unit costs can be defined as the sum of unit labour, unit materials and unit capital costs.

(3.79) $AC = ULC + UMC + UCC$

Introduce (3.79) into (3.78) and have

(3.80) $$\frac{dP}{P} = \frac{M}{P}\, dULC + \frac{M}{P}\, dUMC + \frac{M}{P}\, dUCC + \frac{dM}{M}$$

Which can be written as

(3.81) $$\frac{dP}{P} = \frac{M.ULC}{P}\frac{dULC}{ULC} + \frac{M.UMC}{P}\frac{dUMC}{UMC} + \frac{M.UCC}{P}\frac{dUCC}{UCC} + \frac{dM}{M}$$

which is equivalent to

(3.82) $$\frac{dP}{P} = \alpha_1 \frac{dM}{M} + \alpha_2 \frac{dULC}{ULC} + \alpha_3 \frac{dUMC}{UMC} + \alpha_4 \frac{dUCC}{UCC}$$

where $\alpha_1 = 1$

$\alpha_2 = M.ULC/P$, $\alpha_3 = M.UMC/P$, $\alpha_4 = M.UCC/P$

$\alpha_2 + \alpha_3 + \alpha_4 = 1$

Equation (3.82) represents a model whereby the rate of change of prices is a function of the rate of change of unit costs and the rate of change of the markup. Apart from the fact that the markup is unobservable and has to be determined, the model is incomplete in many respects and there are a number of issues that need clarification before (3.82) is ameliorated.

First the model is not based on any optimising behaviour on the part of the firm . However it bears a close relationship to the neoclassical model and under certain assumptions is tantamount to it. The comparison involves among other things (a) an examination of the relationship between the markup (m) and the price elasticity of demand (η)[32] and (b) the relationship between marginal and average cost which in turn rests on the assumptions made about the shape of these curves (marginal cost curve and average cost curve).

Second equation (3.82) is expressed in terms of unit costs. This means that the effects of factor productivities and factor prices on product prices are constrained to be equal (and opposite in sign). However this might not be the case, particularly with respect to unit labour cost. Although materials and capital productivity may be considered to be constant over the cycle, the same is not true with labour productivity.

Third the definition of unit costs includes the unit capital costs. Since average cost model is a short-run model there may be doubts on whether capital costs should be included in equation (3.82)

Fourth the markup (M) is left unspecified in equation (3.82). The assumption followed by almost all researchers in the area is that demand elements enter the price equation through the markup. However the mechanism by which this achieved is subject to controversy.

3.8.2 Average cost model and the Neoclassical model: a comparison.

The model depicted by equation (3.82) does not make any mention of optimising behaviour on the part of the firm in the short-run. In other words is is completely reticent about the pricing objectives of the firm and furthermore it is compatible with any such objectives since the selection of any price is equivalent to the selection of a markup which together with average cost determines that price. The question here is whether such a model is compatible with the neoclassical model based on the short-run maximization of profits.

The debate between proponents of marginal analysis and average cost theorists[33] has been partly resolved by the acceptance on both sides that average cost pricing behaviour on the part of the firm can be nothing more than the heuristic process by which the firm maximizes profits. The need for this arises because the choice of profit maximising price is very complex, since it requires complicated cost and demand data, estimates on elasticities, assesment of the reactions of competitors and the rest. Average cost pricing with markups that can be adjusted to take account of a volatile situation in the market can be seen as a reaction to these complexities and uncertainties. Indeed it can be seen as a move out of necessity on the part of the firm that massively reduces information gathering costs, but on the other hand does not prevent sequential adjustment towards profit maximisation, if this is the objective of the firm.

There are two ways by which we can examine the rationale provided for the average cost model as the practical way for achieving maximum profits. The first is to consider the "empirical" support provided by a number of authors.[34] W. Baumol and R. Quandt (1964) for example in a simulation experiment have generated a series of cost/output and demand/price points from which they were able to calculate the profit that would be earned, had the average cost pricing method been used. This was compared with the maximum attainable profit generated on the basis of different possible cost and demand functions that were fitted to the original data. The conclusion was that the average cost method reached approximately 80% of the maximum attainable profit. In view of the high costs that would have been incurred for the calculation of marginal costs and revenues if the maximization of profits was actually undertaken in practice, the figure reached by the average cost method can well be translated as equivalent to profit maximization.

The second approach of comparing the average cost model with the neoclassical model involves (A): An examination of the shape of marginal and average cost curves and in particular the empirical proposition adopted by many authors that marginal costs are constant or equivalently that average variable cost curves have a flat stretch instead of being U shaped as the traditional theory postulates. If this is so, then AC=MC. The question to be asked is whether firms base their pricing decisions on costing calculations based on that part of the average cost curve. (B) An examination of the relationship between markup, (M), and the price elasticity of demand (η). In particular it will be suggested that setting a gross profit margin in the form of M is tantamount to estimating the price elasticity of demand. Given that marginal costs are constant and that the enterpreneur bases his pricing decisions on the flat part of the average cost curve, then the application of the average cost principle is equivalent to pricing based on the rule MC=MR.

(A) The shape of the marginal cost curve has been a rather controversial issue although the majority of evidence reports on constant marginal costs. W.J. Eiteman (1947) for example reports that firms believe their marginal costs to be constant. The same conslusion is reached by J. Johnson (1960) and is further reinforced by the findings of W.J. Eiteman and G.E. Guthrie (1952) who, based on the evidence of a survey of 350 firms, report that average variable cost is perceived to be constant, while average total cost declines up to capacity (due to the decline of average fixed cost). A.A. Walters (1963) reports that these findings can not be considered as unanimous, although according to his evidence cost data suggest a pattern where direct costs are more or less constant up to capacity. The same conclusions are also reached by P.W.S. Andrews (1963). A. Alchian (1959) in a reformulation of the theory of costs considers marginal costs as a function of output in two dimentions, the rate of output (a flow variable) and the total contemplated volume of output (a stock variable). It is assumed that marginal cost is an increasing function of the rate of output, the volume of output being held constant. J. Hirschleifer (1962) has integrated A. Alchian's contribution into the theory of the firm. G.S. Stigler (1939) finally presents a theoretical rationale for the constancy of marginal cost. He argues that the firm builds flexibility into its plant because it expects fluctuations in output levels and because it wishes to minimise costs over the expected output range not just a single output flow. It seems well founded therefore to consider marginal costs as constant over the firm's expected range of output and as rising over output rates greater than expected.

The preceeding analysis documents the cases of constant marginal (and averag costs). To the left of the flat stretch of AC, (where $\partial AC/\partial Q<o$), $MC<AC$, while to the right (where $\partial AC/\partial Q>o$), $MC>AC$. The firm will base its pricing decision on the constant part of the average cost curve and if marginal costs were easily approximated it would have made no difference if MC or AC were used. The decreasing part of the average cost curve reflects reductions in costs due to better utilization of machinery and increases in skills and productivity of labour as well as better usage of materials. The increasing part of the average cost curve reflects increases in the cost of labour due to overtime work, waste in materials and increased cost in capital due to frequent breakdown of machinery etc. According to the traditional theory of the firm, pricing based on either of these parts of the average cost curve should be excluded since it represents a deviation from the short-run profit maximization. It does not however represent a deviation from long-run profit maximization and therefore has to be considered, although as a rather unlikely possibility. Moreover, it is important to note that if firms produce on the rising (falling) part of their marginal cost curves they will raise (lower) prices only by the percentage increase (decrease) in average costs, not in marginal costs.

(B) It will be argued that the setting of a gross profit margin (M) is equivalent to estimating the price elasticity of demand and applying marginal analysis for the determination of prices, provided that $\vartheta AC/\vartheta Q$ is zero.

Consider the definition of MC and MR

$$(3.83) \qquad MC = \frac{\vartheta(AC.Q)}{\vartheta Q} = Q\frac{\vartheta AC}{\vartheta Q} + AC$$

$$MR = \frac{\vartheta(P.Q)}{\vartheta Q} = Q\frac{\vartheta P}{\vartheta Q} + P$$

The first order condition for profit maximization implies that

$$(3.84) \qquad P = AC + Q\left[\frac{\vartheta AC}{\vartheta Q} - \frac{\vartheta P}{\vartheta Q}\right]$$

which by using the assumptions of constant average costs can be further written as

$$(3.85) \qquad P = AC - Q\frac{\vartheta P}{\vartheta Q} \rightarrow \frac{P}{AC} = \frac{\eta}{\eta-1}$$

Given that the existance of a maximum reauires that $\eta > 1$, then the term $\eta/\eta-1$ of equation (3.85) can be written as

$$(3.86) \qquad \frac{\eta}{\eta-1} = 1+k$$

and so equation (3.85) is equivalent to

$$(3.85)' \qquad \frac{P}{AC} = 1+k$$

Which is further equivalent to equation (3.77) of the average cost rule that can be written as

$$(3.77)' \quad \frac{P}{AC} = (1 + m)$$

3.8.3. The treatment of labour productivity.

The specification of equation (3.82) in terms of unit costs implicitly assumes that the effect of changes in factor productivities and factor prices on output price is equal and opposite in sign. The issue requires examination particularly with respect to the labour input. Materials output ratio and capital output ratio may be considered to grow more or less smoothly over the cycle and little would be lost if we substitute in equation (3.82) in place of dUMC/UMC and dUCC/UCC the rate of change of factor prices of dPm/Pm and of dPc/Pc. Indeed this is the pattern followed in many studies, the main reason for this being attributed to the fact that the precise measurement of material and capital inputs is usually not possible.

With regard to labour productivity the majority view taken in many studies is that firms always raise prices in response to wage increases since they are regarded as permanent, whereas productivity changes are regarded as transitory and as such do not cause a change in price. This results in measuring productivity either as a long term trend[35] or alternatively to consider a long-term trend and deviations of actual productivity from its trend to capture short-run changes[36]. Another view is that taken by the neoclassical model whereby productivity is assumed to grow smoothly over the cycle and as such is captured by the constant term.

These hypotheses however can not be considered to describe adequately the movements of labour productivity in a short-run model like the average cost model. Price decisions are taken on a quarterly basis and there is no extra assumption about the time horizon. of the enterpreneur(as for example in the full or normal cost models) by which short-run changes can be regarded as transitory or permanent. Changes in productivity as well as changes in wages are considered to exert an effect on prices within the price-decision period of the enterpreneur. Short-run fluctuations in demand resulting in short-run fluctuations in output will be reflected in productivity changes which in turn will have an effect on prices.

The specification adopted in equation (3.82) takes the view that labour productivity changes and wage rates have the same effect on prices. A number of studies have adopted this pattern as for example the ones following the approach by R.G. Lipsey and M. Parkin (1972) without however establishing if the hypothesis is true.[37] However such an assumption should be a testable hypothesis.
Consider the definition of ULC

$$(3.87) \qquad ULC = \frac{PW.L}{Q}$$

Introducing (3.87) into equation (3.82) we have

$$(3.88) \qquad \frac{dP}{P} = \alpha_1 \frac{dM}{M} + \alpha_2 \frac{dPw}{Pw} - \alpha_2 \frac{d(Q/L)}{Q/L} + \alpha_3 \frac{dUMC}{UMC} + \alpha_4' \frac{dUCC}{UCC}$$

Equation (3.88) will be estimated without imposing the restrictions on productivity and wages. If on empirical grounds the restriction that the rate of change of wages and productivity is found to have an equal (and opposite) effect on prices then equation (3.82) will be assumed to hold.

3.8.4 The treatment of capital costs.

The definition of average costs in equation (3.79) includes unit capital costs. This can be thought of as a departure from the short-run nature of the average cost model particularly in view of the fact that the preceeding discussion about the shape of the average cost curve implicitly referred to the average variable cost curve. In section 1.3.6. it was argued that a strict modelling of the average cost equation should include only variable costs (direct or prime costs) and they were defined as costs that vary directly with output, ie materials consumption and direct labour (wages). However it is also argued that in such a case the markup would not account only for profits as it should in principle do, but also for any non-direct cost that is not included in the cost function. A problem therefore arises as of what the precise definition of unit costs should be and implicitly on what is accounted by the markup.

One possible direction is to follow M. Kalecki's (1971) lead and regard unit costs as consisting of unit labour and unit material costs. Strictly speaking unit labour cost should exclude the salaries and expenses of administrative staff and in general all labour expenses not involved directly in production but paid on a fixed-term basis. However this can not be considered as a practical possibility in this study, since the classification used by Labour Statistics does not correspond to this distinction. According to Labour Statistics the labour-force is classified into wage earners and salaried earners. Wage earners correspond to workers directly involved in the production but salaried earners correspond only partly to administrative - technical and clerical staff and partly to manual workers that have been awarded the status of salaried employee but none the less are involved directly into the production process.[38] Since there are no means of distinguishing among the two categories of salaried staff, labour bill includes both direct and indirect labour. Under these circumstances equation (3.82) may be written as (3.82)'

(3.82)' $$\frac{dP}{P} = \alpha_1 \frac{dM}{M} + \alpha_2 \frac{dULC}{ULC} + \alpha_3 \frac{dUMC}{UMC}$$

...

where $\alpha_1 = 1$

$\alpha_2 = M.ULC/P \quad \alpha_3 = M.UMC/P$

$\alpha_2 + \alpha_3 \neq 1$

The other possible direction is to consider unit capital costs as affecting the average cost price. Indeed W.D. Nordhaus (1972) has argued that the omission of capital costs from the neoclassical model is not justified. By the same reasoning capital costs should be included in the average cost model. First the inclusion of capital costs would make possible the comparison with other markup theories such as full-cost and target rate of return models where capital costs are an argument in the price equation. Second the possibility of comparing empirical estimates of the coefficients with their theoretical values is made operational only when all cost elements are included. Third it all depends on the definition of capital costs adopted. O. Eckstein and G. Fromm (1969) for example argue that

"the traditional version of the classical theory of the firm calls for no direct influence of the size of the capital stock on short-run profit maximising price output decisions; the capital stock makes itself felt through the short-run cost curve".

O. Eckstein and G. Fromm (1969) p. 1163.

"Alternatively short-run cost can be defined to include the quasi-rent on capital with the quasi-rent varying with the rate of utilization. However the traditional exposition does not solve explicitly for quasi-rents and hence leave the influence of utilization of capital vague".

O. Eckstein and G. Fromm (1969) note 4, p. 1163.

The above discussion does not offer a solution as to the definition of unit costs that should be used in the average cost model. It was decided therefore to consider both possibilities as two distinct cases and estimate the average cost model with and without capital costs. Since equation (3.82)' is nested within (3.82) the question of the significance of UCC can be determined empirically. As far as the definition of UCC is concerned this will be discussed in section 3.9.3.

3.8.5. The role of demand in the price equation.

Demand influences can be viewed to affect prices through a number of routes, most of which are not clearly specified in the literature in a satisfactory manner. Although great care is taken to define costs, ie whether actual or standard costs form the basis of pricing calculations of the enterpreneur, the same is not true as far as demand is concerned. Indeed the way in which demand enters markup models seems to be the main issue in markup theories and has initiated a number of debates in which uncompromising views have been expressed on both sides[39]. This section will be concerned with these problems and at the same time will set the framework for the specification of demand that will be used in all markup models.

In chapter 1 it was argued that a broad classification of pricing models can be defined between the competitive, price-taking approach and the non-competitive, price-making approach. In the former the specification of the rate of change of prices as a function of excess demand is considered a satisfactory representation, provided that excess demand is measured accurately. For the non-competitive price making theories the problem of modelling demand is centered in the markup models. In the neoclassical profit maximising equation demand was specified as a function of income and "other prices" despite the fact that such a specification was constrained by econometric problems. In the markup models, demand pressures are considered to have an effect on prices, if at all, only through the markup. A number of opinions have been expressed into how prices respond to changes in demand, given costs, ie how the markup responds to demand changes. Prices may rise in relation to costs in periods of expansion and fall in periods of recession, ie the markup responds positively to pressures of demand. There is also the opposite view frequently adopted in concentrated industries practicing target rate of return pricing. A third view is that the markup is ·responsive to temporary demand changes; instead prices are set on the basis of standard costs. Each of the above views corresponds to a particular model of markup pricing. Another view which is outside the domain of markup models is that prices rise or fall according to the conditions of demand without examining if they do so in relation to costs. This is the competitive view discussed earlier and examined in chapter 1. The question therefore is not if the markup is a function of demand pressures but how demand pressures can be formulated operationally.

The majority of markup models take the view that the rate of change of markup is a function of excess demand. On the assumption (a) that excess demand is defined as the difference between demand and supply and (b) that both schedules can be measured accurately, then such a view would coincide with the competitive approach as far as the formulation of demand is concerned. It would result in other words in an equation whereby the rate of change of prices will be a function of the rate of change of costs and the level of excess demand. It has been pointed out by a number of authors, notably by M.C. Sawyer (1983) and K. Coutts, W. Godley and W. Nordhaus (1978), that

"....this is an unsatisfactory mix of competitive pricing reflected in linking excess demand and price changes and oligopolistic pricing reflected in cost-plus pricing."

M.C. Sawyer (1983) p.65

and "...empirical tests of the effect of demand on price derived from [markup] theories should specify how shifts in demand schedules affect the relation of price to unit costs. If one abandons all markup theories in favour of the excess demand view that prices in periods of expansion rise and fall in periods of recession of demand, then unit costs are irrelevant. Supply and demand shedules are subsumed within a single excess demand function".

K. Coutts, W. Godley, W. Nordhaus (1978) p.64

The criticism appears to be valid provided that the proxies used to measure excess demand are accurate reflections of the conditions of demand and supply in the product market. Given that this is not the case,[40] it will be argued that the use of the term excess demand in the markup models is highly misleading since it does not represent excess demand; the term excess demand is used in exchange of demand pressures. Indeed even K. Coutts, W. Godley and W. Nordhaus (1978) who are so keen to criticise the use of excess demand levels in a price change equation and argue instead that changes in demand should be used, in practice employ the same proxy (for demand) that other authors testing markup models term excess demand.

The proxy used to measure demand pressures in the majority of the markup models and in this study as well, is the ratio of actual over trend output. This proxy is a highly misleading indicator of excess demand as this is defined and used in the competitive price taking model. Under certain circumstances however, it can be regarded as a good approximation of demand pressures in the product market for markup price-making models.

Consider the relationship between (α) demand and supply in the competitive model and (b) the ratio between actual and trend output.[41] Since data on output demanded and output supplied do not exist nor can they be approximated to a sufficient degree of accuracy, the assumption that is used is that actual output traded is always determined by the demand function while trend output is supposed to account for what firms plan to supply. In figure 3.4. demand and supply curves are depicted by D and S respectively and output q_T is taken as the trend output. Assuming that the market is in equilibrium, then for prices to change, excess demand has to be different than zero.

Consider the traditional excess demand analysis and assume for reasons of convenience that the output traded is systematically determined in terms of demand and supply functions, ie we observe output only along the D and S lines. It is also conventional to assume that output traded is the minimum of ex-ante demand and supply. Note that this assumption is in contradiction with the assumption used as far as the ratio between actual and trend output is concerned. Then for prices above equilibrium as excess supply decreases, the term actual minus trend output increases. (The extent to which actual output is below trend output has declined). However for prices below equilibrium as excess demand decreases the term actual minus trend output increases. (The extent to which actual output is below trend has declined). In such a case there is a positive relationship between excess demand and actual minus trend output for prices above equilibrium and a negative one for prices below equilibrium. This is clearly avoided under the assumption that actual output is always demand determined, but then again such an assumption is at odds with the traditional excess demand analysis.

It is obvious therefore that the ratio between actual and trend output can not be considered as a measure of excess demand unless very strict assumptions are employed. Nonetheless this ratio provides an adequate representation of the pressure of demand and as such it has been employed in this study. Consider for example a change in demand, resulting in a demand shift from D_1 to D_2. Since the supply curve can only change

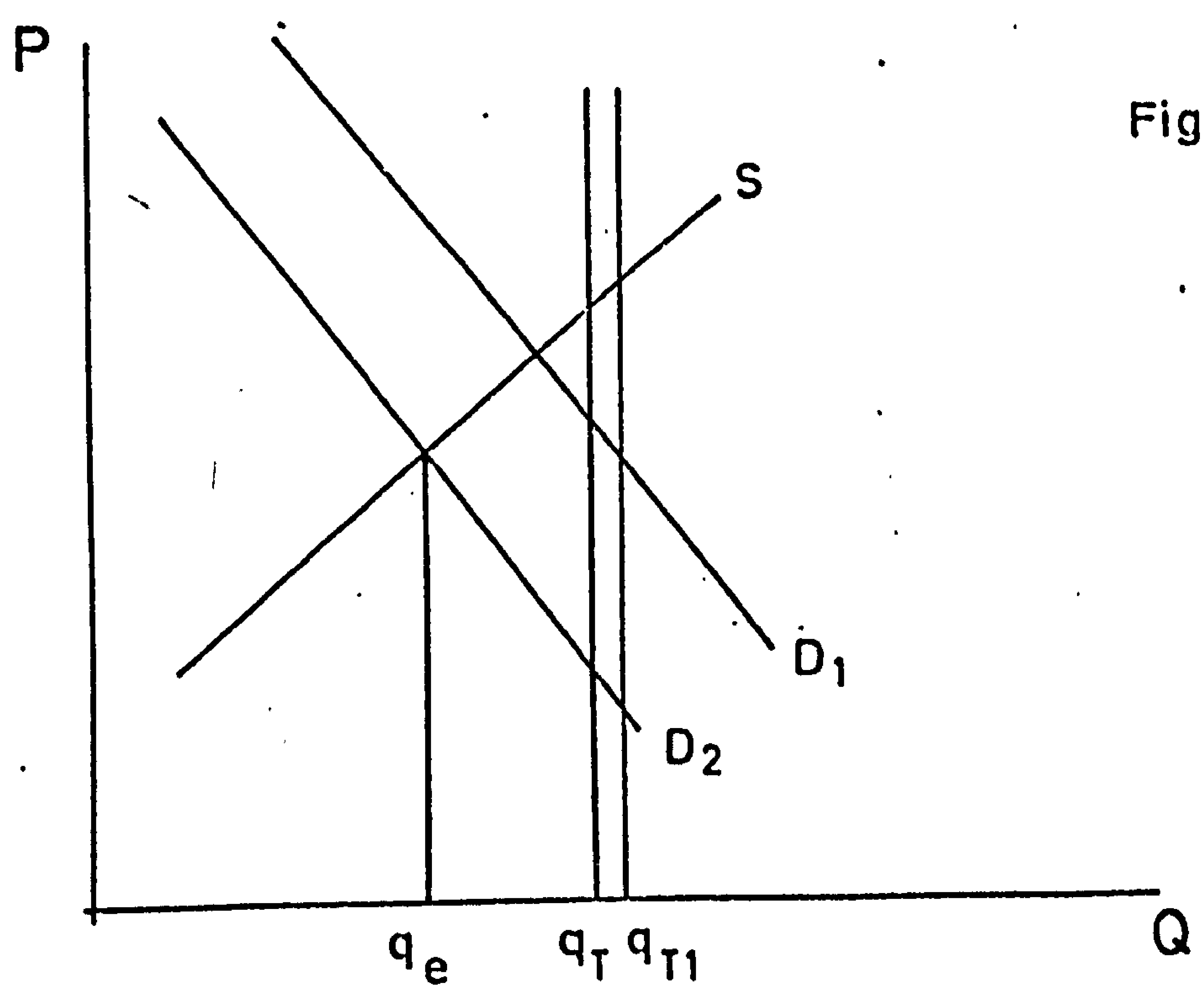


Figure 3.4

linearly (from q_T to q_{T1}) then the change in demand is almost equivalent to the change in the actual over trend output ratio. Given therefore that actual over trend output is employed the question is not whether changes in the level of demand or the level of excess demand, but rather on how the relationship between the markup and actual over trend output should be formulated. This will be the subject matter of the next-subsection.

The above analysis also sets the framework within which the debate between R.R. Neild (1963) (1973), F. Rushdy and P.S. Lund (1967) and B.T. McCallum (1970) on how demand influences prices should be considered.

R.R. Neild (1963) examined price equations for British manufacturing in which the price level is a function of unit labour costs and material prices as in (3.89)

$$(3.89) \qquad P_t = \beta_0 + \beta_1 ULC_t + \beta_2 m_t + \beta_3 m_{t-1} + \beta_4 m_{t-2} + \beta_5 P_{t-1}$$

where ULC is a measure of unit labour cost and m stands for materials prices.

R.R. Neild used three measures of unit labour cost, one representing actual labour cost and two measures of standard unit labour cost. His hypothesis was that standard labour costs are the basis for pricing instead of actual costs and this seems to be confirmed by his results. With regard to demand influences, R.R. Neild introduced a variable C_t defined as

$$(3.90) \qquad C_t = d_t + d_{t-1} + \dots + d_1$$

Where d_t is an index of excess demand for labour used as a proxy for excess product demand. The cummulative variable C_t was used in place of d_t because

"It seems more reasonable to assume a given level of excess demand would be associated with a change in price".

R.R. Neild (1963) p.20

The results of the C_t coefficient were statistically significant but negative and this was regarded as unacceptable. R.R. Neild's conclusion was that demand added nothing to the explanation of prices. R.R. Neild's results were strongly contested by F. Rushdy and P.S. Lund. It was first argued that in two equations where a trend productivity measure was used, R.R. Neild introduced implicitly demand factors and this can be an explanation of the poor results on the demand variable. Secondly the demand variable was criticised on two grounds. (α) The implication of the introduction of the cummulative index (C_t) that an equal weight is attached to the current and previous demand experience

"...is a fairly rigid assumption and it might be better to assume that the effect of recent demand is fairly small."

F. Rushdy and P.S. Lund (1967) p.365.

(b) Even if the cummulative excess demand index should be used it should not be appended to the reduced form equation but to the structural equation. By not doing that

"Neild reversed the acceptable distributed lag form and therefore is not suprising that he failed to obtain significant results for his demand variable".

F. Rushdy and P.S. Lund (1967) p.336.

F. Rushdy and P.S. Lund then went on to test Neild's equation (3.89) by appending not the cumulative level of excess demand but d_t with significant results for excess demand. This formulation together with the criticism on Neild has been rejected by B.T. McCallum who argued that on the basis of conventional theory, the change in price and not the price level is a function of excess demand. Thus, since the price level is the cumulative version of the change in prices, the cumulative excess demand should be included in a price level equation. Equivalently the rate of change of prices should include the level of excess demand as an argument and this is the final batch of tests that F. Rushdy and P.S. Lund do.

There is of course a number of points that are omitted from this brief presentation which can be found into a number of survey articles that treat the subject rather extensively.[42] Having highlighted the role of demand in price markup equations it still remains to adopt a specific formulation as far as the markup is concerned such that equation (3.82) can be made operational. The next section is concerned with that.

3.8.6. The determinants of the markup.

The average cost price equation involves as an argument the rate of change of markup (dM/M). This section will be concerned with the way by which a behavioural model about the markup factor can be formulated. In the previous section it was shown that a common consensus of all markup models is that demand influences enter the price equations, if at all, only through the markup. However the precise mechanism by which this is realised is neither clear nor unique as the discussion of the formulation of demand in the debate between R.R. Neild and F. Rushdy and P.S. Lund has shown.

Moreover the preceeding analysis has taken for granted that demand pressures affect the markup. A justification of the relationship between the rate of change of prices and demand pressures probably passes through the justification of the relationship between prices and markup, markup and the price elasticity of demand and finally the price elasticity of demand and demand pressures. From these relationships the first is inherent in the markup models, while the second has been established in section 3.8.5. What is left is to examine the movememts of elasticity of demand over the phases of the business cycle.

The simplest, although most unlikely case to consider is that where firms are faced with a demand function for which shifts are isoelastic with regard to price. Assuming for convenience constant marginal costs such a situation can be depicted in figure 3.5. With an isoelastic shift of the demand curve (from D_1 to D_2), the elasticity is unaltered and the equilibrium price remains the same. Price is simply a markup on marginal costs.

∠ would tend to shop around more when business activity is slack queues become shorter and customers

However in practice the elasticity of demand varies over the cycle and this variation may be materialised through various channels that may have opposite effects. R.F. Harrod (1936) for example argued that the elasticity of demand facing a firm in a non-competitive environment would increase during a recession because the firm's customers ∠ become more aware of the existence of price differentials and hence the elasticity of demand facing each firm increases. On the other hand it has been argued by M. Abramovitz (1938) and R. Heflebower (1941) among others that Harrod's argument reflects only one of the many possible influences of the business cycle over price elasticity. For example it is quite possible (see R. Heflebower (1941)) that during a recession the number of necessity items bought may increase. Since the price elasticity for necessities is likely to be lower than the price elasticity for other products, this might cause the elasticity of demand to decline on average in a recession. Similar arguments can be considered depending on what determining factors of the demand function we examine and the possible movements of these factors during the course of the business cycle.[43] Nonetheless R.F. Harrod's (1936) argument is considered to give an accurate reflection of the negative relationship between elasticity and the phases of the cycle and consequently the positive relationship between markup $(\eta/\eta-1)$ and demand pressures. A diagrammatic representation establishing the positive relationship between markup and shifts in demand is given in figure 3.6.

Figure 3.5

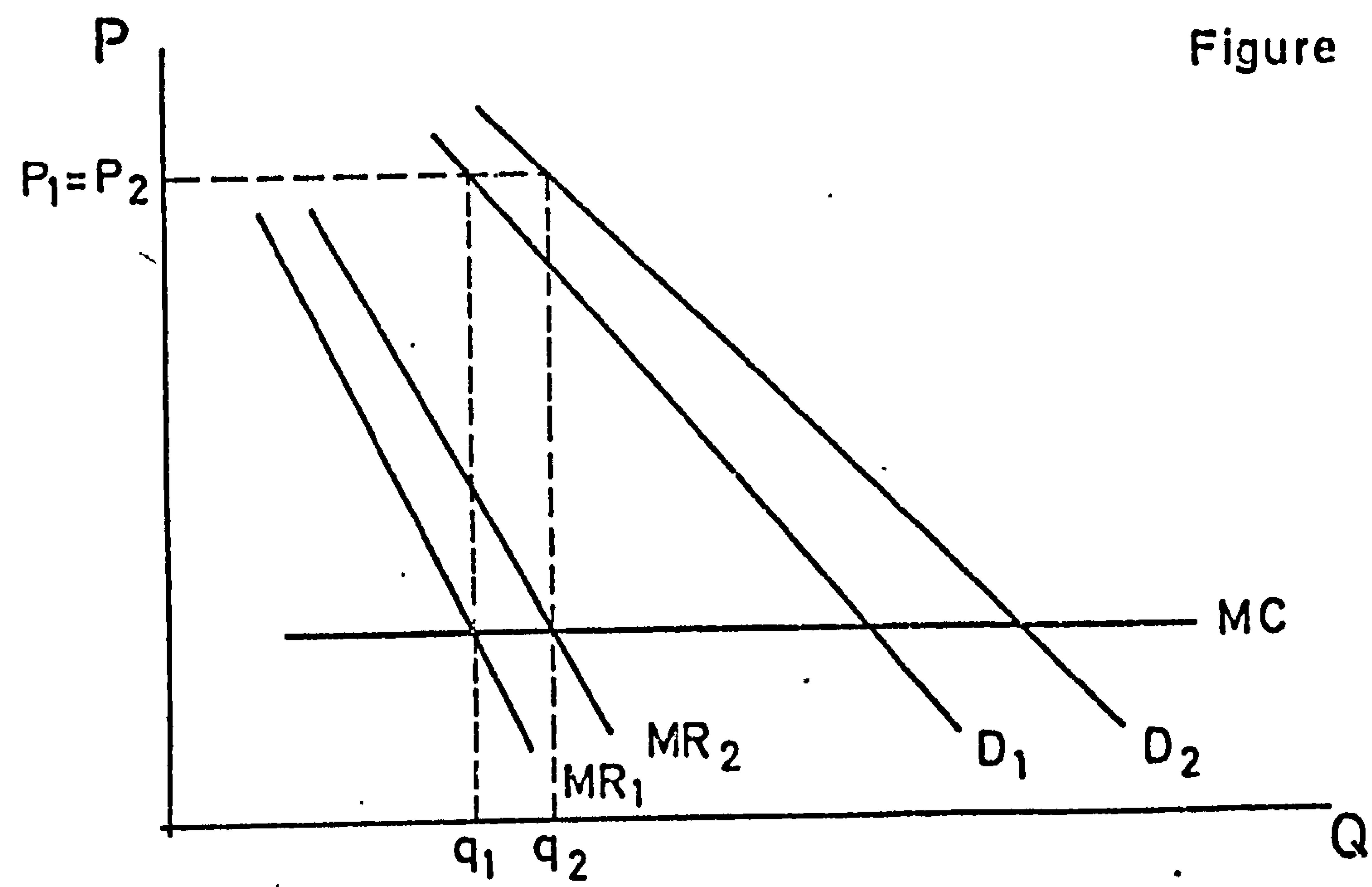
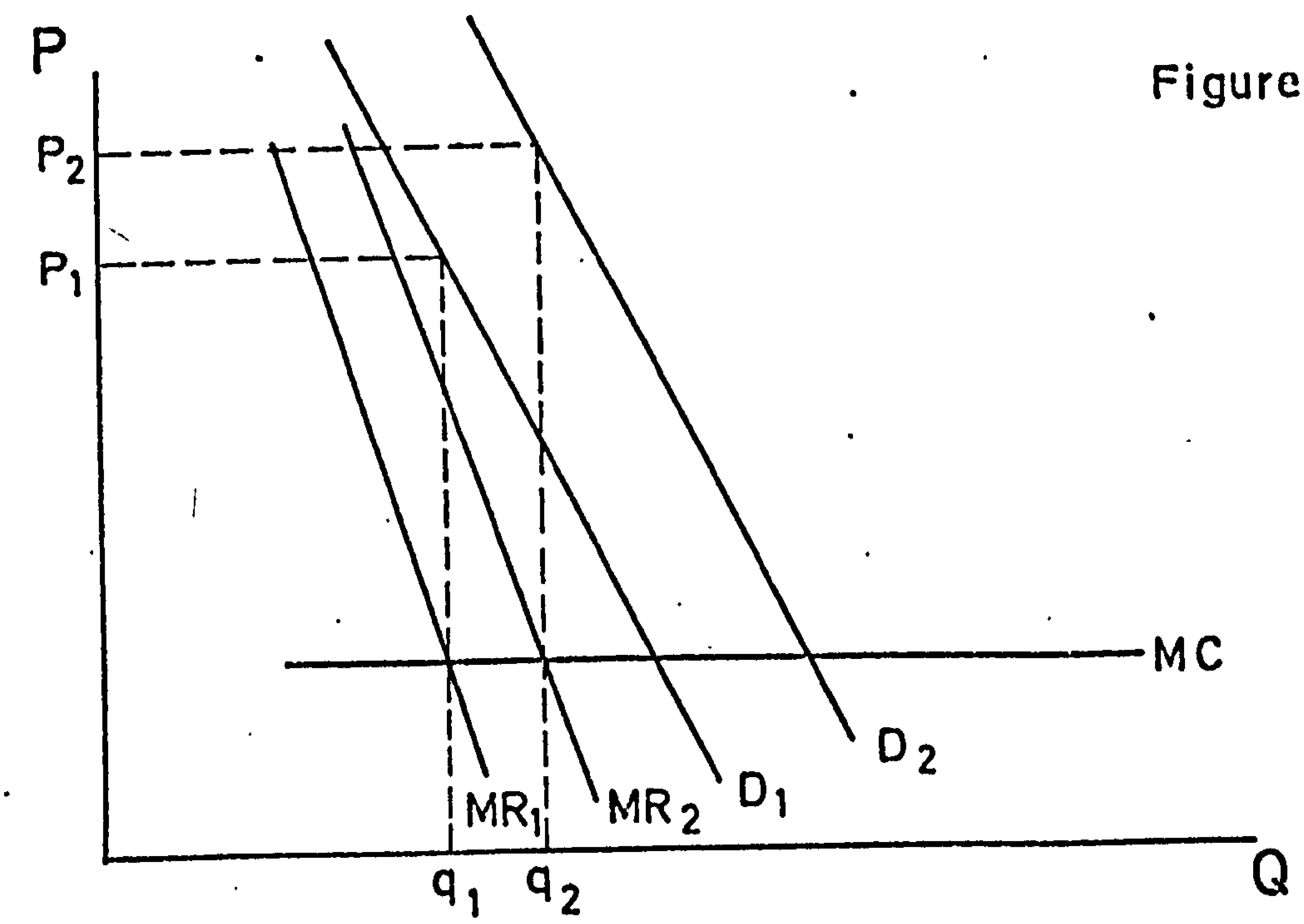


Figure 3.6



Assume again for convenience constant marginal costs; then the elasticity of demand has to remain constant if the price remains constant. If the elasticity increases the price falls, and if it is reduced the price rises. Consider the case of a parallel outward shift in the demand function. If D_1 is the original demand function and D_2 is the new one, then the adjustment which follows will be an increase in price if marginal costs do not vary with output. Since

$$P = \frac{\eta}{\eta - 1} MC, \quad M = \frac{\eta}{\eta - 1}, \quad \text{and } MC = \text{constant},$$

the markup varies positively with demand pressures.

The discussion so far has established the relationship between the markup and the movements of demand over the business cycle, without examining yet the form of this relationship. Demand pressures can be introduced in markup equations in two ways.

The first is to consider that the level of markup depends on the pressures of demand over the cycle as these are measured by the ratio of actual over trend output, ie

$$(3.91) \quad \ell n\, M_t = \beta_2 \; \ell n \left(\frac{Q}{QN}\right)_t$$

Non-competitive firms might raise their markup margins to a high level during a boom of a given intensity and shift to a lower level during a recession in which demand exhibits a given degree of weakness. Equation (3.91) is equivalent in a rate of change form to (3.92)

$$(3.92) \quad \Delta \ell n\, M_t = \beta_2 \; \Delta \ell n \left(\frac{Q}{QN}\right)_t$$

The formulation has been (implicitly) used by W. Godley and W. Nordhaus (1972) and K.J. Coutts, W. Godley and W. Nordhaus (1978) among others.

A disadvantage inherent in (3.92) is that it implies that if for example demand pressures are always positive and at a constant rate then the markup will not change. Even in the spirit of the normal cost hypothesis,[44] a constant markup is a very strict assumption to make and in a sence reduces the possible role of demand effects in the price equation. An alternative formulation that has been used rather extensively[45] is to assume that price adjusts to eliminate demand pressures as in

$$(3.93) \quad \Delta \ell n M_t = \beta_1 \ \ell n \ (\frac{Q}{QN})_t$$

Which results in a level markup equation of the form

$$(3.94) \quad \ell n \ M_t = \beta_1 \sum_{i=0}^{\infty} \ell n \ (\frac{Q}{QN})_{t-i}$$

Equations (3.91) and (3.94) can be thought to refer back to the argument between R.R. Neild (equation (3.94)) and F. Rushdy and P.S. Lund (equation (3.91)). Whatever the merits of the one or the other approach it was decided to combine them in a form such as (3.95) whereby the rate of change of prices over costs depends on the level of demand pressures and the speed at which these change over the cycle.

$$(3.95) \quad \Delta \ell n M_t = \beta_1 \ell n (\frac{Q}{QN})_t + \beta_2 \Delta \ell n (\frac{Q}{QN})_t$$

Equation (3.95) is equivalent to a level markup formulation as in (3.96)

$$(3.96) \quad \ell n \ M_t = (\beta_1 + \beta_2) \ \ell n \ (\frac{Q}{QN})_t + \beta_2 \sum_{i=1}^{\infty} \ell n (\frac{Q}{QN})_{t-i}$$

Apart from the fact that equation (3.95) provides an adequate representation of the determination of the rate of change of prices over costs it also provides for the possibility of empirical discrimination between equations (3.92) and (3.93).

The formulation of the markup as given in equation (3.95) concludes the points raised in section 3.8.1. Based on these points it is now possible to derive the average cost price equation. This is done in the next section.

3.8.7 Derivation of the average cost equation.

The discussion in sections (3.8.3), (3.8.4) and (3.8.6) provides the following ammendments in the average cost model as this is given by equation (3.82).

(1) With regard to labour productivity it is possible to test the restriction that the rate of change of wages and productivity have an equal and opposite effect on the rate of change of prices by employing equation (3.88).

(2) With regard to capital costs it was decided to let the matter be determined empirically by estimating two equations (3.82) and (3.82)' and performing a likelihood ratio test to test for the significance of the unit capital cost terms.

(3) As far as the rate of change of the markup is concerned the formulation is given by equation (3.95).

With these ammendments the average cost model will result in the following two equations each of which accounts for two variants depending on the assumptions about labour productivity. If capital costs are not included, then the average cost model will be

$$(3.97) \qquad d\ell nP_t = \alpha_0 + \alpha_1 d\ell nULC_t + \alpha_2\ d\ell nUMC_t + \alpha_4\ \ell n(\frac{Q}{QN})_t + \alpha_5\ d\ell n(\frac{Q}{QN})_t$$

Or if a separate effect of wages and labour productivity is assumed

$$(3.97)' \qquad d\ell nP_t = \alpha_0 + \alpha_1 d\ell n Pw_t - \alpha_1 d\ell n(\frac{Q}{L})_t + \alpha_2 d\ell n\ UMC_t + \alpha_4\ \ell n(\frac{Q}{QN})_t + \alpha_5 d\ell n(\frac{Q}{QN})_t$$

If capital costs are included then the average cost model becomes

$$(3.98) \qquad d\ell nP_t = \alpha_0 + \alpha_1 d\ell n\ ULC_t + \alpha_2 d\ell n\ UMC_t + \alpha_3 d\ell n\ UCC_t + \alpha_4\ \ell n(\frac{Q}{QN})_t + \alpha_5 d\ell n(\frac{Q}{QN})_t$$

or if a separate effect of wages and labour productivity is assumed

$$(3.98)' \qquad d\ell nP_t = \alpha_0 + \alpha_1 d\ell n\ Pw_t - \alpha_1\ d\ell n(\frac{Q}{L})_t + \alpha_2 d\ell n\ UMC_t + \alpha_3 d\ell n\ UCC_t + \alpha_4\ \ell n(\frac{Q}{QN})_t + \alpha_5\ d\ell n(\frac{Q}{QN})_t$$

Equations (3.97) or (3.97)' and (3.98) or (3.98)' are the final equations for the average cost model. In the next section the specification of the variables that enter the above equations is discussed. Particular emphasis is given to the measurement of the demand variable.

3.9 Average cost model: Variable specification.

In this section the variables that enter the average cost equation are defined. These are the unit labour, the unit material and unit capital costs, and also a measure of demand.

3.9.1. The unit labour cost.

Unit labour cost is defined as

$$(3.99) \qquad ULC = \frac{Pw.L}{Q}$$

Where Pw is the wage rate, L is the labour input and Q is output. Specification of unit labour cost requires specification of each element in equation (3.99). The wage rate index, Pw, was defined as a weighted sum of the wages and salaries of each labour category on which there is available information. A definition of Pw was given in equation (3.48)' and the data generations on each argument of equation (3.48)' are explained in detail in appendix 3.

$$(3.48)' \qquad Pw = P_{SM}\left(\frac{LSM}{LT}\right)+P_{SF}\left(\frac{LSF}{LT}\right)+P_{WM}\left(\frac{LWM}{LT}\right)+P_{WF}\left(\frac{LWF}{LT}\right)$$

Labour input L, can be defined either as the number of people employed or the number of manhours used. Despite the fact that in principle the second measure reflects more accurately the fluctuations of labour input over the cycle[46] the first measure is employed. The reason is that as far as the salaried earners are concerned there are no available data with regard to weekly hours worked. Instead the number of hours worked by salaried employees was fixed to 48, a number that corresponds to the minimum hours of work per week. However, since the number of actual hours worked per week by salaried earners, flucutates significantly across sectors, this assumption may overstate or understate the true number of hours worked per week by salaried employees.

The number of people employed has been defined in equation (2.9) as

$$(2.9) \qquad LT = LSM + LSF + LWM + LWF$$

where all variables are further discussed in Appendix 3.

Finally output, Q is measured by Gross Production Value (GPV) at constant 1970 prices. The definition is given by equation (2.26) and the procedure for the calculation of GPV is described in section (2.4).

3.9.2. The unit materials cost.

Unit materials cost is defined as

$$(3.100) \qquad UMC = \frac{Pm.M}{Q}$$

Where Pm is the price of materials, M is the quantity of materials used and Q is the output.

Pm was defined in section 3.5.2. and further discussed in Appendix 3.

M, is approximated by the materials consumption bill expressed in constant 1970 prices (CONqn) and is given in equation (2.21)

$$(2.21) \qquad M = CON_{qn} = INDS_q * CON_{yn}$$

3.9.3. The unit capital cost.

The discussion in section 3.8.3. has indicated that there are grounds to argue that the inclusion of unit capital costs is incompatible with the average cost models. The definition of unit capital costs as

(3.101) $$UCC = \frac{Pc.K}{Q}$$

where Pc is the user-cost of capital

and K is the capital-stock,

would indeed be inconsistent with one of the assumed characteristics of the average cost model ie ease of cost calculations for the enterpreneur. As can be seen from Appendix 3, the user-cost of capital formula involves extensive calculations on variables such as tax rates, allowances, etc, on which the effects of fluctuations in output are almost impossible to calculate in the short-run, let alone with speed and accuracy.

A measure of capital costs that would better serve the purpose of the average cost model would be to define UCC as

(3.102) $$UCC = \frac{DEP + INT + RENT}{Q}$$

where DEP = depreciation expenditure

INT = financial expenditure

RENT = expenditure on rent

The calculation of these variables on a quarterly basis is described in Appendix 3.

3.9.4 The specification of the demand pressure variable.

The measurement of demand pressures is one of the weakest points in pricing literature. Since demand pressures are not observed in practice, a number of proxies have been tried, but even the choice of proxies in most cases is constrained by data unavailability. It is possible to distinguish three broad categories of these proxies.

The first contains measures that are based upon demand conditions in the labour market. An example is W.S. Yordon's (1961) use of[47]

$$\frac{(AWH)_t}{(AWH)^*_t} \quad \text{where } AWH_t \text{ is average weekly hours and } AWH^*_t \text{ is a 12 quarter average of average weekly hours.}$$

Other examples are the unemployment rate, inversely related to price changes through the Phillips curve, or the J.C.R. Dow and L.A. Dicks - Mireaux (1958) index based upon the excess of unfilled vacancies over unemployment. The problem with such measures is that they are more closely related to wage rate changes rather than price changes. Moreover demand pressures in the labour market lag behind pressures in the product market and the extent of this lag is clearly important.

A second category is based on variables that represent economic behaviour in the product market. Analytic descriptions of such behaviour can be found in the work of O. Eckstein (1964), O. Eckstein and G. Fromm (1968), T.S. Courchene (1969) and V. Zarnovitz (1962) among others. The problem faced here is to provide an operational definition of the demand variable. Increases in demand during a period can be met in two ways; by increasing production or by drawing down inventories. If demand is not met during a period, it will result in an increase of unfilled orders or a withdrawal of orders. Excess demand is the difference between demand and production. O. Eckstein and G. Fromm (1968) provide an operational definition of this difference as equal to the build up of unfilled orders plus the drawdown of inventories plus the withdrawal of orders, or formally as

$$d-x = (d'-s) + (s-x) + (d-d') \qquad (3.103)$$

where d = demand, x = production, d' = orders not withdrawn, and s = sales. Consequently the first term in the r.h.s. of (3.103) gives the orders in-force minus sales which is the backlog of unfilled orders. The second term gives sales minus production which is the drawdown of inventories and the third shows the orders that are not withdrawn. The relative importance between orders and inventories differs depending on whether the industry produces mainly to order or to stock. Since data on d' are usually not available equation (3.103) has not been employed in this study.

The third measure of demand pressure and the most popular one is an index based upon the relationship between current output and some measure of capacity. Since information on the first two measures is absent for the Greek industry, a capacity utilization index will be used in this study to represent pressures of demand.

Capacity utilization can be described by a number of measures and can be generated by a number of approaches that differ in accuracy and in the complexity of data calculations.[48] The capacity concept that will be used here relates to output and therefore is different from concepts refering to a single factor of production such as the rate of unemployment or the utilization of fixed capital. The distinction is important since sometimes capacity utilization is taken to mean capital utilization. Following L.R. Klein (1960) capacity output is defined as the production flow associated with the input of fully utilized manpower, capital and other relevant factors of production, and capacity index as an index combination of all fully utilized factors including others as well as the capital stock. Hence capacity utilization ratio is a measure of realized output relative to potential output, while capital utilization is a measure of utilized inputs of capital relative to available inputs of capital. Similarly a labour utilization ratio is a measure of utilized inputs of labour relative to available inputs of labour.

Ready made data on capacity utilization rates are not existent for the two digit SIC sectors of Greek manufacturing. In the absence of available information two indices have been constructed and are used alternatively as proxies for demand pressures in the demand market.

The first method is based on two assumptions; (1) the output supplied by the sector under consideration can be represented by the trend value of its real output and (2) given trend output, then actual output is determined by demand conditions. Actual output is measured by Gross Production Value at constant 1970 prices as this is given by equation (2.26). Having assumed that productive capacity grows smoothly over time, the question is how to approximate such a path. Since a linear time trend may be objectionable in a rapidly growing industrial sector, such as Greece's in the period under examination, a reasonable suggestion would be to calculate output as

$$(3.104) \qquad Q_t = \sum_{i=o}^{m} \beta i \; t^i$$

Where i takes integer values and m is the degree of regression giving the best fit. In practice however, a quadratic time trend (m=2) was found to give the best fit in the majority of the two digit SIC sectors. For reasons of uniformity of results, the quadratic time trend is applied in all sectors. The results of the regression equation (3.105) are given in table (3.8)

$$(3.105) \quad \ell n Q_t = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + u_t$$

Capacity output (or trend output or normal output) is defined as

$$(3.106) \qquad \ell n Q_t = \hat{\alpha}_0 + \hat{\alpha}_1 t + \hat{\alpha}_2 t^2$$

where carrets denote estimates of equation (3.105)

Table 3.8 Estimation of normal (capacity) output

Sector	a_o	a_1	a_2	$\bar{R}^2$	SE
TOT	23.136	0.1028 (19.05)	−0.00053 (2.550)	0.9885	0.0445
20	21.624	0.0642 (5.466)	0.00099 (2.328)	0.9274	0.0097
21	19.656	0.1521 (13.25)	−0.00283 (3.874)	0.9622	0.0947
22	20.789	0.0379 (2.359)	0.00403 (2.270)	0.8010	0.2304
23	21.410	0.0574 (7.159)	0.00229 (4.491)	0.9799	0.0581
24	19.637	0.0872 (11.73)	0.00375 (7.944)	0.9907	0.0613
25	18.876	0.1743 (17.24)	−0.00378 (5.881)	0.9742	0.0834
26	18.731	0.0943 (12.99)	0.00098 (2.132)	0.9709	0.0599
27	19.414	0.1624 (23.72)	0.00542 (12.45)	0.9760	0.0565
28	19.569	0.0881 (12.58)	0.00225 (5.058)	0.9442	0.0578
29	19.210	0.0653 (2.012)	0.00268 (6.547)	0.9407	0.0532
30	19.294	0.1612 (18.86)	0.00177 (3.260)	0.9857	0.0705
31	20.131	0.1772 (32.74)	0.00281 (8.170)	0.9942	0.0447
32	19.467	0.2114 (9.670)	−0.00581 (4.195)	0.9014	0.1799
33	20.257	0.1102 (17.27)	−0.00020 (0.496)	0.9875	0.0527
34	19.178	0.3593 (23.03)	0.01087 (10.97)	0.9783	0.1287
35	20.581	0.1081 (10.80)	−0.00061 (0.957)	0.9646	0.0833
36	19.727	0.0742 (8.807)	0.00099 (1.839)	0.9692	0.0695
37	19.986	0.2615 (17.53)	−0.00912 (9.622)	0.9532	0.1231
38	19.805	0.0774 (4.076)	0.00232 (1.926)	0.9084	0.1567
39	17.481	0.1405 (12.67)	0.00248 (0.353)	0.9763	0.0914

Capacity utilization CU_t may now be defined as

$$(3.107) \qquad CU_t = \ln Q_t - \ln QN_t$$

The second method is known as the Wharton capacity utilization index.[49] Its construction involves marking off cyclical peaks for output and then fitting linear segments between successive peaks. The Wharton capacity utilization index may be defined as

$$(3.108) \qquad W_t = \frac{Q_t}{Q^c_t} \qquad \text{or equivalently } CW_t = \ln Q_t - \ln Q^c_t$$

where Q^c_t indicates full capacity output. The series for full capacity output is derived by a process of linear interpolation between succesive peaks for the series of actual output. The procedure by which capacity output is defined, together with the diagrams showing the relative movement of actual and capacity output are given in Appendix 3. Nonetheless a summary of the results is given in table 3.9, where the peak quarters for each sector are given.

It is obvious that the two methods are similar, but not identical. The difference lies in the treatment of supply fluctuations. The trend method assumes the same growth rates throughout the period and consequently it may overestimate or underestimate the true growth rate of QN. Therefore since both possibilities may occur, the CU index may take values that exceed 1 which may be interpreted as demand exceeding supply if QN is the supply, or as demand exceeding capacity if QN is defined as capacity output. In the Wharton method, W_t can be 1 only at the maximum since Q^c_t is be definition capacity output. A way of

Table 3.9 Wharton Capacity Utilization index: Peak quarters, two digit SIC sectors, Greek manufacturing

Sector	Peak quarters					
TOT	63_{iii}	64_{iii}	65_{ii}	70_{i}	74_{i}	76_{iv}	77_{iv}
20	65_{i}	70_{ii}	71_{ii}	73_{iii}	74_{iii}	76_{iii}	
21	63_{i}	70_{iii}	73_{ii}	77_{iv}			
22	65_{iii}	66_{ii}	71_{i}	77_{iv}			
23	65_{iii}	66_{iii}	73_{ii}	76_{ii}	77_{iv}		
24	65_{i}	65_{iii}	68_{iv}	74_{iv}	76_{i}	76_{iii}	76_{iv}
25	67_{i}	73_{iv}	76_{iv}	77_{i}			
26	63_{iii}	70_{ii}	73_{iv}	76_{ii}			
27	70_{iv}	73_{i}	73_{iii}	77_{iv}			
28	67_{i}	69_{i}	69_{ii}	77_{iv}			
29	65_{iii}	71_{i}	76_{ii}	77_{ii}			
30	63_{ii}	68_{iii}	77_{i}	77_{iii}			
31	65_{i}	65_{iv}	73_{iii}	77_{i}			
32	70_{i}	74_{i}	74_{iii}				
33	65_{iv}	70_{iii}	74_{i}	77_{i}			
34	67_{i}	70_{i}	70_{ii}	73_{i}	77_{iii}		
35	63_{i}	66_{i}	69_{iii}	73_{iii}	77_{iv}		
36	69_{iii}	69_{iv}	75_{iv}	76_{iv}			
37	64_{iii}	67_{iv}	71_{i}	73_{iii}	76_{iv}		
38	71_{i}	75_{iii}	76_{iv}				
39	63_{ii}	68_{i}	73_{ii}	77_{iv}			

comparison between the two measures is given by the correlation coefficient presented in table (3.10), together with the means and standard deviations of the two indices. The correlation coefficient exceeds in all cases 0.6 and in every case is significant at the 1% level of significance.

The discussion on demand pressure variables concludes the section of variable specification. In the next section we examine the empirical performance of the average cost model.

3.10 Average cost model: a testable form.

This section consists of two parts; the first derives the econometric specification and discusses the methodology of the average cost model. The second part deals with the presentation and discussion of the results.

3.10.1. Econometric specification and methodology.

Based on the discussion of the previous sections the average cost model has been derived in equation (3.97) where unit capital cost was not included as an argument and equation (3.98) which is inclusive of capital costs. Both equations were further amended depending on whether wages and labour productivity are assumed to have equal and opposite effects on prices or not (equations (3.97)' and (3.98)' respectively). All equations however are not expressed in a testable form since it is implicitly assumed that the adjustment of prices to changes in unit costs and the demand pressures is instantaneous. In section 3.6.2. we presented the arguments concerning the dynamic specification of the neoclassical equation. It was then suggested that a maximum lag of four quarters is sufficient to capture the effects of cost and demand on prices. The same number of lags is applied on the variables of the average cost model as well.

Table 3.10 Mean and standard deviation of CU_t and CW_t
Correlation coefficient between CU_t and CW_t
Two digit SIC sectors, Greek manufacturing

	CU_t		CW_t		
Sector	mean	st.deviation	mean	st.deviation	r
TOT	100.276	7.425	92.283	4.656	0.627
20	100.371	8.617	91.399	5.607	0.754
21	100.914	13.393	83.526	9.472	0.853
22	101.230	15.393	81.319	10.566	0.973
23	100.217	7.069	87.702	7.216	0.621
24	100.458	9.810	86.420	9.278	0.628
25	101.015	14.038	87.013	7.807	0.663
26	100.301	7.920	90.144	7.442	0.613
27	100.903	13.475	87.086	9.008	0.780
28	100.562	10.539	88.373	9.072	0.796
29	100.995	8.740	87.718	8.122	0.864
30	100.995	14.121	83.410	10.752	0.727
31	100.642	10.939	86.303	7.394	0.706
32	108.743	19.822	57.014	20.747	0.834
33	100.281	7.631	86.581	6.737	0.846
34	106.828	18.236	76.556	16.310	0.621
35	100.511	10.341	85.484	8.127	0.690
36	100.201	5.302	87.256	5.157	0.886
37	101.561	17.036	85.293	8.497	0.738
38	101.033	13.915	80.891	13.384	0.849
39	100.506	10.228	79.610	11.476	0.771

No exception is made for the demand pressure variable despite some evidence provided by R.J. Gordon (1975) to the effect that excess demand affects prices with lags up to 8 years.[so] By introducing lags and an error term, the average cost model equation becomes:

(A) Capital costs excluded.

(A1) Wages and labour productivity have equal effect on prices.

$$\text{(3.109)} \quad d\ln P_t = \pi_0 + \sum_{i=0}^{4} \pi_{1i} \, d\ln ULC_{t-i} + \sum_{i=0}^{4} \pi_{2i} d\ln UMC_{t-i} + \sum_{i=0}^{4} \pi_{4i} \ln(\frac{Q}{QN})_{t-i}$$

$$+ \pi_5 d\ln(\frac{Q}{QN})_t + u_t \qquad u_t \sim NID(0, 6^2 u)$$

(A2) Wages and labour productivity have unequal effect on prices.

$$\text{(3.110)} \quad d\ln P_t = \pi_0 + \sum_{i=0}^{4} \pi_{1i} d\ln Pw_{t-i} - \sum_{i=0}^{4} \pi_{1i} d\ln(\frac{Q}{L})_{t-i} + \sum_{i=0}^{4} \pi_{2i} d\ln UMC_{t-i}$$

$$+ \sum_{i=0}^{4} \pi_{4i} \ln(\frac{Q}{QN})_{t-i} + \pi_5 \, d\ln(\frac{Q}{QN})_t + u_t \qquad u_t \sim NID(0, 6^2 u)$$

(B) Capital costs included

(B1) Wages and labour productivity have equal effect on prices.

$$\text{(3.111)} \quad d\ln P_t = \pi_0 + \sum_{i=0}^{4} \pi_{1i} \, d\ln ULC_{t-i} + \sum_{i=0}^{4} \pi_{2i} \, d\ln UMC_{t-i} +$$

$$+ \sum_{i=0}^{4} \pi_{3i} \, d\ln UCC_{t-i} + \sum_{i=0}^{4} \pi_{4i} \ln(\frac{Q}{QN})_{t-i} + \pi_5 \, d\ln(\frac{Q}{QN})_t + u_t$$

(B2) Wages and labour productivity have unequal effect on prices.

$$\text{(3.112)} \quad d\ln P_t = \pi_0 + \sum_{i=0}^{4} \pi_{1i} d\ln Pw_{t-i} - \sum_{i=0}^{4} \pi_{1i} d\ln(\frac{Q}{L})_{t-i} + \sum_{i=0}^{4} \pi_{2i} d\ln UMC_{t-i}$$

$$+ \sum_{i=0}^{4} \pi_{3i} \, d\ln UCC_{t-i} + \sum_{i=0}^{4} \pi_{4i} \ln(\frac{Q}{QN})_{t-i} + \pi_5 d\ln(\frac{Q}{QN})_t + u_t$$

where the term $\sum_{i=0}^{4} \pi_{4i} \ln\left(\frac{Q}{QN}\right)_{t-i} + \pi_5\, d\ln\left(\frac{Q}{QN}\right)_t$ can be either

$\sum_{i=0}^{4} \pi_{41i} CU_{t-i} + \pi_{51}\, ECU_t$ if the trend method is used, (See, equation (3.107)

or $\sum_{i=0}^{4} \pi_{42i} CW_{t-i} + \pi_{52} ECW_t$, if the Wharton method is used, equation (3.108

and where, $ECU_t = dCU_t$, $ECW_t = dCW_t$

Expectations about the signs of the coefficients in the long-run are as:

$$\frac{\partial d\ln P_t}{\partial d\ln\left(\frac{Q}{L}\right)_t} < 0, \quad \frac{\partial d\ln P_t}{\partial d\ln ULC_t}, \frac{\partial d\ln P_t}{\partial d\ln UMC_t}, \frac{\partial d\ln P_t}{\partial d\ln UCC_t}, \frac{\partial d\ln P_t}{\partial d\ln Pw_t} > 0 \tag{3.113}$$

$$\frac{\partial d\ln P_t}{\partial CU_t}, \frac{\partial d\ln P_t}{\partial CW_t}, \frac{\partial d\ln P_t}{\partial ECU_t}, \frac{\partial d\ln P_t}{\partial ECW_t} > 0$$

As far as the coefficient on the demand pressure variable is concerned, the previous discussion, particularly in section 3.8.6 has shown that in principle such a coefficient may be positive, negative or zero depending on how demand shifts. Nonetheless as an intuitively plausible assumption we can consider that put forward by R.F. Harrod (1936) providing for a negative relationship between price elasticity of demand and the phases of the business cycle and consequently a positive relationship between the rate of change of prices and demand pressures.

The prodedure adopted for testing the average model is based on the following steps

(1) Two sets of results are presented based on whether capital costs are included or not.

(2) On each set of results a test of the hypothesis of equal coefficients between wages and productivity is carried out by means of a likelihood ratio test, $Z^{51}_{2(5)}$.

(3) On each general model (3.109) - (3.112) a choice is made on empirical grounds between the two specifications of the demand pressure variables.[52]

(4) Following the first three steps, the model selection procedure from general to specific is applied as discussed in section 2.6. Consequently since we have two sets of results it is possible that the average cost model may be represented in each sector by two specifications in the case where both models (3.109 or 3.110) and (3.111 or 3.112) pass the criteria set in section 2.6.

(5) Application of step (4) can be regarded as final if one would be interested only in the estimation of the average model. However the aim of this study is to evaluate the various pricing models estimated by testing between them (see section 2.6.6 in particular). To cover this a further step is required. This step involves the selection of one model out of the possible four (equations (3.109) to (3.112)) by means of a likelihood ratio test, whenever this is possible.

This procedure is applied after step (4) but on the general form of all four models since specific forms are likely to be non-nested. Even in the general form though, there is a possibility of arriving at a non-nested solution. The various combinations are as follows:

Case 1: Equation (3.109) nested in (3.111)

Case 2: Equation (3.109) nested in (3.112)

Case 3: Equation (3.110) non-nested in (3.111)

Case 4: Equation (3.110) nested in (3.112)

Therefore apart from the case where we have to compare equation (3.110) to (3.111) all other combinations can be tested by likelihood ratio tests with 5 or 10 degrees of freedom depending on the particular test; Case (1) involves 5 d.f. since we are testing for the significance of

UCC.(Z6(5)). Case (2) involves 10 d.f. since we are testing jointly for the differnetial effect of wages and productivity (5.d.f.) and UCC (5.d.f.), (Z7(10)), and finally case (4) involves 5.d.f.. Values of the statistics Z6(5) and Z7(10) are given in table 3.17.

The procedure will result in one equation being chosen (except for case (3)). This equation however may or may not (depending on step (4)) pass the econometric and other criteria discussed in section 2.6. In other words, this procedure may result in cases where a model that is rejected on econometric grounds be prefered to a model that is not rejected.

3.10.2. Presentation and discussion of the results

The results on equations (3.109) and (3.110) are given in table (3.11) which consists of 8 parts. Parts (1) and (2) provide the sums of coefficients and summary statistics respectively while parts (3)-(8) give the individual coefficients on the respective variables.

The assumption of equal effects of wages and labour productivity on prices is rejected at the 5% significance level in 13 out of 21 sectors (see Z2(5) in part 2 of table (3.11)). Consequently part (1) provides sums of coefficients of dln ULC for 8 sectors and sums of dlnPw and dln (Q/L) for 13 sectors. The sums of coefficients on ULC and Pw are always positive and significant at the 5% level, while the sums of coefficients of labour productivity are always negative and significant. The unit material cost coefficients are positive and significant in every sector and therefore as far as the cost elements are concerned the average cost model is 100% accurate in predicting the signs of the parameters since all are correctly signed and significant at the 5% significance level. Turning to the demand variables, the Wharton generated series enters in 6 sectors and the time-trend generated variable enters in 15. Positive and significant coefficents for the level of demand can be found in sectors 22,24 (at the 10% significance level), 25,30,34,35 (at the 10% level) and 39. The rate of

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ble 3.11 Results on average cost equation (3.109) and (3.110)

rt 1 Long-run coefficients

ctor	$\sum_{i=o}^{4} \Pi_{1i} dlnULC_{t-i}$	$\sum_{i=o}^{4} \Pi_{1i} dlnPW_{t-i}$	$\sum_{i=o}^{4} \Pi_{1i} dln(\frac{Q}{L})_{t-i}$	$\sum_{i=o}^{4} \Pi_{2i} dlnUMC_{t-i}$	$\sum_{i=o}^{4} \Pi_{41i} CU_{t-i}$	$\Pi_{51} ECU_t$	$\sum_{i=o}^{4} \Pi_{42i} CW_{t-i}$	Π_{52}EC
		0.267603 (2.033)	-0.098711 (1.972)	0.494371 (5.721)			-0.000961 (1.392)	
	0.20367 (10.817)			0.66967 (16.222)			-0.000691 (1.649)	
		0.190255 (3.277)	-0.12595 (4.375)	0.818996 (10.474)	-0.00023 (1.528)			
	0.190606 (9.326)			0.53466 (9.374)			0.000526 (3.291)	
		0.40163 (6.173)	-0.24779 (3.548)	0.46449 (8.368)	0.000121 (0.357)	0.001293 (1.814)		
		0.29767 (10.165)	-0.10273 (5.787)	0.39495 (9.441)	0.000204 (1.774)	0.000281 (3.992)		
	0.125603 (1.985)			0.52041 (3.960)			0.00111 (1.971)	
	0.36386 (11.32)			0.54821 (14.05)	-0.000199 (0.923)			
		0.28115 (2.388)	-0.131611 (2.876)	0.60884 (7.082)			0.000321 (1.309)	
		0.972961 (5.268)	-0.21727 (2.862)	0.23804 (2.599)		0.00161 (5.139)		
		0.290042 (8.307)	-0.085514 (4.569)	0.535785 (8.065)	-0.000468 (2.366)			
		0.697627 (4.429)	-0.259636 (8.381)	0.325990 (5.659)	0.000522 (2.512)			
	0.203914 (4.146)			0.589156 (11.958)	0.00074 (0.344)			
	0.114507 (5.573)			0.773395 (18.00)	0.000109 (1.474)			
		0.484072 (7.764)	-0.122600 (2.526)	0.204390 (2.767)		-0.001819 (2.428)		
		0.383842 (5.513)	-0.051895 (2.033)	0.179932 (4.964)			0.0000154 (2.559)	
	0.16157 (5.898)			0.613833 (10.617)	0.000416 (1.779)			
		0.288557 (6.715)	-0.095977 (4.561)	0.623345 (13.188)	-0.000123 (0.396)			
		0.0873103 (2.328)	-0.074979 (4.070)	0.618959 (10.473)	0.000109 (0.963)			
	0.494696 (4.089)			0.789604 (5.033)	-0.000264 (0.542)			
		0.395519 (7.520)	-0.102478 (1.956)	0.327325 (4.86[illegible])	0.001679 (3.478)			

Table 3.11 Results on average cost equations (3.109) and (3.110)

Part 2 Test statistics

Sector	SSR	SE	$\bar{R}^2$	DW	$z_{1(4)}$	$z_{2(5)}$	$z_{3(i)}$	$z_{4(41)}$	$z_{5(ij)}$
TOT	0.019224	0.020443	0.6750	1.681	6.112	12.038	(13) 14.742	0.395 (2.57) (4.51)	1.170 (2.12) (9.39)
20	0.004242	0.009709	0.9175	1.6856	1.688	1.269	(7) 2.566	1.207 (2.57) (4.49)	0.845 (2.12) (10.35)
21	0.005122	0.010914	0.8296	2.1815	9.541	38.094	(10) 10.872	0.916 (2.56) (4.47)	1.712 (2.09) (12.31)
22	0.019850	0.019925	0.7384	2.6825	12.151	5.880	(17) 14.712	3.73 (2.53) (4.54)	2.96 (2.45) (5.45)
23	0.006475	0.011864	0.7920	2.319	5.246	25.420	(13) 14.440	1.811 (2.57) (4.50)	2.413 (2.18) (9.37)
24	0.003193	0.008143	0.9124	1.604	4.231	16.082	(15) 14.210	0.313 (2.57) (4.52)	0.073 (2.25) (7.41)
25	0.061042	0.034940	0.3144	1.575	1.469	3.482	(12) 10.83	1.61 (2.58) (4.54)	1.39 (2.40) (5.45)
26	0.003986	0.009209	0.9158	2.113	0.819	1.000	(9) 3.516	1.11 (2.57) (4.51)	0.731 (2.18) (8.39)
27	0.014547	0.018183	0.8104	1.816	2.412	16.911	(11) 10.49	0.836 (2.57) (4.48)	1.815 (2.13) (11.33)
28	0.023029	0.02288	0.8060	2.270	16.48	42.04	(11) 14.06	3.11 (2.57) (4.48)	4.09 (2.13) (11.33)
29	0.030294	0.008476	0.9381	2.207	5.745	125.82	(10) 3.310	1.426 (2.61) (4.41)	0.329 (2.16) (12.25)
30	0.012216	0.016662	0.7642	1.905	8.351	40.766	(11) 10.31	1.09 (2.57) (4.48)	0.888 (2.13) (11.33)
31	0.008164	0.013322	0.7998	2.134	8.770	1.412	(8) 10.32	1.371 (2.57) (4.50)	1.952 (2.18) (9.37)
32	0.0172935	0.018981	0.9278	2.415	7.757	6.178	(10) 6.412	0.913 (2.57) (4.52)	1.281 (2.18) (7.41)
33	0.010691	0.014771	0.7934	1.8433	1.874	19.926	(16) 15.69	1.612 (2.57) (4.53)	0.793 (2.34) (6.43)
34	0.014058	0.016938	0.7103	0.9545	16.527	36.708	(16) 22.60	4.11 (2.57) (4.53)	3.714 (2.24) (6.43)
35	0.007028	0.012100	0.8532	2.118	2.019	8.712	(10) 6.312	1.012 (2.57) (4.52)	2.013 (2.25) (7.41)
36	0.002550	0.007701	0.9266	1.994	6.755	36.162	(10) 8.466	3.001 (2.57) (4.47)	4.512 (2.09) (12.31)
37	0.005829	0.01126	0.8348	2.615	7.999	15.150	(13) 13.920	2.419 (2.57) (4.50)	2.118 (2.18) (9.37)
38	0.079398	0.040671	0.4004	2.737	9.767	4.584	(10) 5.018	4.132 (2.57) (4.59)	3.093 (2.25) (7.41)
39	0.015665	0.018257	0.7306	2.037	5.143	15.760	(14) 7.02	0.919 (2.57) (4.51)	0.976 (2.18) (8.39)

Table 3.11 Results on average cost equation (3.109) and (3.110)

Part 3 Individual coefficients on dln ULC_{t-i}

Sector	Π_0	Π_{10}	Π_{11}	Π_{12}	Π_{13}	Π_{14}
TOT	-0.00651 (0.868)					
20	-0.00562 (1.542)	0.24265 (15.954)				-0.038984 (2.187)
21	-0.00311 (1.390)					
22	0.0313 (3.621)	0.190606 (9.325)				
23	0.00106 (0.316)					
24	0.00104 (0.677)					
25	0.0270 (1.728)				0.1256 (1.985)	
26	0.0002 (0.578)	0.424639 (16.195)	-0.060784 (2.667)			
27	0.00439 (0.858)					
28	-0.00897 (1.510)					
29	0.00029 (0.172)					
30	-0.01804 (2.247)					
31	0.00313 (1.556)	0.298043 (8.179)			-0.09413 (2.772)	
32	0.00316 (1.046)	0.114507 (5.073)				
33	-0.00309 (1.108)					
34	0.00636 (1.547)					
35	0.00349 (1.163)	0.196134 (7.533)				-0.034477 (1.488)
36	-0.00176 (0.974)					
37	0.00268 (1.234)					
33	-0.00633 (0.851)	0.378366 (4.106)			0.11633 (1.554)	
39	-0.0023 (0.746)					

Table 3.11 Results on average cost equation (3.109) and (3.110)

Part 4 Individual coefficients on $dlnPW_{t-i}$

Sector	Π_{10}	Π_{11}	Π_{12}	Π_{13}	Π_{14}
TOT	0.267603 (2.033)				
20					
21	0.259603 (7.112)				0.069348 (1.891)
22					
23	0.314423 (5.386)		0.087209 (1.657)		
24	0.297674 (10.165)				
25					
26					
27	0.327444 (4.752)	0.094486 (1.619)			-0.145777 (2.559)
28	0.419302 (4.563)		0.255873 (2.857)	0.181614 (1.955)	0.116172 (1.758)
29	0.166017 (6.179)				0.124025 (4.577)
30	0.53523 (9.153)	0.179710 (2.900)	0.083064 (1.876)	-0.100379 (1.843)	
31					
32					
33	0.484072 (7.764)				
34	0.309322 (7.691)	0.0745198 (1.991)			
35					
36	0.281806 (11.792)	-0.060900 (2.406)			0.0676511 (2.965)
37					0.0873103 (2.329)
38					
39	0.395519 (7.520)				

Table 3.11 Results on average cost equation (3.109) and (3.110)

Part 5 Individual coefficients on $d\ln(\frac{Q}{L})_{t-i}$

Sector	Π_{10}	Π_{11}	Π_{12}	Π_{13}	Π_{14}
TOT				-0.098711 -(1.972)	
20					
21			-0.064452 (4.3964)		-0.061495 (4.311)
22					
23	-0.161300 (3.370)			-0.0864922 (2.168)	
24	-0.102725 (5.787)				
25					
26					
27	-0.131611 (2.875)				
28	-0.433368 (4.985)				0.216099 (2.399)
29	-0.163897 (11.372)				0.078383 (5.541)
30	-0.125897 (3.643)				-0.13374 (4.223)
31					
32					
33	-0.1226 (2.526)				
34	-0.0518945 (2.033)				
35					
36	-0.159135 (9.619)				0.063158 (3.677)
37	-0.16092 (6.058)				0.086123 (3.168)
38					
39	-0.156710 (3.464)	0.054232 (1.590)			

Table 3.11 Results on average cost equation (3.109) and (3.110)

Part 6 Individual coefficients on $d\ell nUMC_{t-i}$

Sector	Π_{20}	Π_{21}	Π_{22}	Π_{23}	Π_{24}
TOT	0.28856	0.22421	0.096171		-0.11457
	(6.417)	(5.047)	(2.094)		(2.515)
20	0.68968			0.046338	-0.066351
	(21.261)			(1.904)	(1.988)
21	0.303645	0.163628	0.199158	0.089634	0.0629311
	(9.255)	(5.238)	(5.973)	(2.983)	(2.060)
22	0.455743	0.078922			
	(10.674)	(2.242)			
23	0.464487				
	(8.638)				
24	0.467535				-0.0725845
	(13.618)				(2.297)
25	0.270263			0.250142	
	(2.921)			(2.711)	
26	0.466295	0.0819174			
	(13.670)	(2.385)			
27	0.401305	0.167884	0.222493		-0.182844
	(8.577)	(3.276)	(4.795)		(3.708)
28	0.55378			-0.163898	-0.151848
	(10.570)			(3.131)	(2.627)
29	0.58615	0.06076	0.047147		-0.161283
	(20.690)	(2.591)	(2.0516)		(5.250)
30	0.187596	0.041995			0.0963941
	(5.025)	(1.827)			(2.558)
31	0.458305		0.130851		
	(11.594)		(3.239)		
32	0.670654			0.0544599	0.0482307
	(21.524)			(2.102)	(1.967)
33	0.267595				-0.063205
	(6.560)				(2.018)
34	0.170032				
	(4.966)				
35	0.602309		0.068039		-0.056515
	(14.796)		(1.595)		(1.474)
36	0.60896		0.073332	0.068059	-0.127007
	(18.505)		(2.505)	(1.940)	(3.729)
37	0.650547		0.055059		-0.086646
	(14.391)		(1.423)		(2.022)
38	0.59054				0.199066
	(5.689)				(2.171)
39	0.185862	0.141463			
	(4.009)	(3.195)			

Table 3.11 Results on average cost equation (3.109) and (3.110)

Part 7 Individual coefficients on CU_{t-i}

Sector	Π_{410}	Π_{411}	Π_{412}	Π_{413}	Π_{414}
TOT					
20					
21		0.000503 (3.677)			-0.000730 (5.005)
22					
23		0.000716 (2.659)			-0.000545 (2.066)
24			0.000205 (1.774)		
25					
26	0.000944 (2.954)	-0.000817 (2.570)			-0.000327 (1.691)
27					
28					
29	-0.000687 (3.824)	0.000612 (3.243)			-0.000394 (2.807)
30					0.000522 (2.512)
31	0.000990 (2.683)	-0.000944 (1.908)	0.00115 (2.516)	-0.00112 (3.369)	
32	0.001559 (12.204)	-0.001451 (9.822)			
33					
34					
35	0.000416 (1.779)				
36				-0.000585 (2.083)	0.000462 (1.671)
37				-0.000633 (2.630)	0.000743 (3.172)
38	0.0014066 (1.434)	-0.0016707 (1.623)			
39			0.001045 (3.314)		0.000634 (2.029)

Table 3.11 Results on average cost equation (3.109) and (3.110)

Part 8 Individual coefficients on CW_{t-i}

Sector	Π_{420}	Π_{421}	Π_{422}	Π_{423}	Π_{424}
TOT				0.00104 (1.633)	-0.001997 (2.953)
20			-0.000986 (2.423)	0.001370 (4.798)	-0.001074 (4.047)
21					
22			0.000526 (3.291)		
23					
24					
25	0.00111 (1.971)				
26					
27	0.00200 (4.735)	-0.00168 (3.641)			
28					
29					
30					
31					
32					
33					
34	0.0001542 (2.559)				
35					
36					
37					
38					
39					

change of demand is found to play a role in 4 sectors of which in 3 has a positive coefficient.

Table 3.12 Summary of sectoral results: Average cost equation (3.109) and (3.110).

Two digit SIC sectors Greek manufacturing.

SECTOR	RESULTS	SECTOR	RESULTS	SECTOR	RESULTS
TOT	ACCEPTED	26	ACCEPTED	33	ACCEPTED
20	ACCEPTED	27	ACCEPTED	34	AUTO,Z4
21	ACCEPTED	28	AUTO,Z4	35	ACCEPTED
22	AUTO,Z4	29	ACCEPTED	36	AUTO,Z4
23	ACCEPTED	30	ACCEPTED	37	ACCEPTED
24	ACCEPTED	31	ACCEPTED	38	AUTO
25	ACCEPTED	32	ACCEPTED	39	ACCEPTED

The multiple correlation coefficient takes high scores (80% or more in 15 sectors) with the exception of sectors 25 and 38 where it is significantly low. Note that both these sectors scored a value less than 40% in the neoclassical model as well. The Z1(4) statistic indicates autocorrelation of up to 4th order in sectors 22,28,34 and 38. Moreover a test of 4th order autocorrelation indicates significant value only in sector 36 (Z1(1) = 5.918). A further mispecification test is given by Z4(4,i) on the grounds of which sectors 22,28,34 and 36 are found to be mispecified. Finally the Chow Z5 statistic indicates a different pricing pattern in the two subsamples (see before) in sectors

Table 3.13 Sums of coefficients of cost variables Comparison with theoretical values. Average Cost equation (3.109) and (3.110) 2 digit SIC sectors, Greek manufacturing

Sector	$\sum_{i=o}^{4} \Pi_{1i}$-LSH(t)		$\sum_{i=o}^{4} \Pi_{2i}$-MSH(t)	
TOT	-0.0195	(0.1617)	-0.2533	(2.931)
20	0.0839	(4.458)	-0.1695	(4.106)
21	-0.0902	(2.105)	0.0272	(0.354)
22	0.0571	(2.795)	-0.2691	(4.718)
23	-0.0454	(0.738)	-0.2599	(4.682)
24	-0.0568	(1.282)	-0.2918	(6.975)
25	-0.0918	(1.451)	-0.1954	(1.487)
26	0.0762	(2.371)	-0.0599	(1.537)
27	0.0185	(0.179)	-0.1452	(1.689)
28	0.3740	(1.188)	-0.3242	(3.540)
29	-0.0002	(0.003)	-0.0265	(0.399)
30	0.1984	(1.857)	-0.3585	(6.223)
31	-0.0044	(0.090)	-0.0947	(1.923)
32	0.0632	(3.019)	-0.1489	(3.465)
33	0.0718	(1.033)	-0.4218	(7.774)
34	0.2064	(2.176)	-0.5947	(17.36)
35	0.0134	(0.489)	-0.1978	(3.421)
36	-0.0100	(0.114)	-0.1284	(2.716)
37	-0.1237	(16.80)	-0.1970	(3.333)
38	0.0744	(0.615)	0.2988	(1.905)
39	-0.0608	(1.146)	-0.2522	(3.745)

SIC:22,23,28,34,36 and 38.

Turning to the individual coefficients, the unit labour cost (part 3) shows a strong effect only on the current quarter. Wages and productivity also show the same pattern but the effect of the 4th lag seems to be important particularly with regard to productivity. The unit materials cost presents a pattern of lags that is more spread out in all quarters than that of labour variables. On the current quarter we have 21 sectors with significant coefficients, on the first quarter 8 sectors, 8 on the second, 6 on the third and 14 sectors on the fourth quarter. Finally the demand variables, particularly the trend generated ones, seem to be concentrated on the first and fourth lags.

In summary the average cost model as given by equations (3.109) and (3.110) is accepted as a satisfactory representation of the data generation process in 16 sectors. Table (3.12) provides a summary evidence of these results and also gives an account of the statistics on which the rejection is based in the sectors where the model is rejected. Finally as a means of testing the size of the cost coefficents, a comparison of the long-run values with the shares of labour and materials as given in table (3.4) is carried out. The results are given in table (3.13). Inspection of the table indicates that as far as the long-run values of the variables are concerned, in 14 out of 21 sectors the difference between the long-run values and the share of labour bill in Gross Production Value is not statistically significant. As far as the materials cost is concerned the long-run values of UMC almost always underestimate the share of materials in Gross Production Value and in only 7 sectors the difference is not statistically significant.

The results on equations (3.111) and (3.112) are given in table (3.14), parts (1) to (9). The test of equal effects of wages and labour productivity on prices is rejected at the 5% significance level in 14

Table 3.14 Results on average cost equation (3.111) and (3.112)

Part 1 long-run coefficients

Sector	$\sum_{i=0}^{4} \Pi_{1i} dlnULC_{t-i}$	$\sum_{i=0}^{4} \Pi_{1i} dlnPW_{t-i}$	$\sum_{i=0}^{4} \Pi_{1i} dln(\frac{Q}{L})_{t-i}$	$\sum_{i=0}^{4} \Pi_{2i} dlnUMC_{t-i}$	$\sum_{i=0}^{4} \Pi_{3i} dlnUCC_{t-i}$	$\sum_{i=0}^{4} \Pi_{41i} CC_{t-i}$	$\Pi_{51} ECU_t$	$\sum_{i=0}^{4} \Pi_{42i} CW_{t-i}$	$\Pi_{52} ECW_t$
TOT	0.371185 (4.128)			0.35688 (3.990)	0.19754 (2.410)	0.00025 (0.710)			
20	0.16966 (5.857)			0.68311 (21.807)	0.06885 (2.431)			-0.00053 (1.407)	-0.00011 (2.343)
21		0.28399 (8.915)	-0.16473 (3.817)	0.59125 (9.580)	0.09241 (3.585)			0.000193 (1.442)	
22		0.19707 (4.082)	-0.02012 (2.466)	0.38132 (5.857)	0.050084 (2.610)	-0.000467 (1.483)			
23		0.41848 (7.734)	-0.06582 (1.754)	0.40350 (8.864)	0.063241 (1.474)			-0.000253 (1.034)	-0.000117 (1.789)
24		0.49368 (8.469)	-0.05948 (3.227)	0.44515 (8.705)	-0.057051 (2.113)			-0.000251 (2.455)	
25	0.081987 (2.2245)			0.423512 (3.003)	0.11075 (2.493)			0.002125 (2.911)	
26		0.204596 (2.436)	-0.150850 (2.210)	0.55296 (10.408)	0.149257 (2.145)	-0.000184 (0.925)			
27		0.384292 (11.141)	-0.032781 (1.338)	0.74897 (15.430)	0.117183 (4.166)	0.00032 (2.624)	0.00560 (4.110)		
28		0.645155 (3.985)	-0.099155 (1.173)	0.367274 (3.740)	0.18872 (3.216)		0.00137 (4.407)		
29		0.275038 (6.441)	-0.10309 (4.765)	0.49629 (7.160)	0.067375 (2.637)	-0.00030 (1.328)			
30		0.620216 (8.432)	-0.131374 (5.595)	0.372164 (6.179)	0.206109 (4.392)	-0.000036 (0.189)	0.000657 (1.986)		
31	0.18882 (4.009)			0.57763 (12.29)	0.069188 (2.455)	0.00020 (0.920)			
32	0.140603 (6.663)			0.706503 (24.52)	0.0371916 (3.477)	0.000054 (0.766)			
33		0.641567 (7.613)	-0.193826 (2.940)	0.280691 (7.146)	0.098731 (2.912)	0.000439 (1.246)			
34		0.244512 (8.231)	-0.151396 (2.955)	0.438581 (6.011)	-0.038525 (2.213)			0.000009 (0.145)	
35	0.082717 (1.956)			0.68756 (16.792)	0.144542 (3.226)			0.000246 (1.050)	
36		0.322104 (7.617)	-0.104871 (5.035)	0.627721 (14.19)	-0.052992 (2.189)	-0.000319 (1.400)			
37		0.102483 (2.482)	-0.0752763 (3.658)	0.648943 (9.444)	0.0679644 (2.649)	-0.000075 -(0.098)			
38	0.27480 (2.617)			0.79686 (5.131)	0.22662 (1.874)	-0.000360 (0.9006)			
39		0.304462 (5.926)	0.069444 (1.685)	0.33147 (4.488)	0.090584 (2.679)	0.002028 (4.210)			

Table 3.14 Results on average cost equation (3.111) and (3.112)

Part 2 Test statistics

Sector	SSR	SE	$\bar{R}^2$	DW	$Z_{1(4)}$	$Z_{2(5)}$	$Z_{3(1)}$	$Z_{4(41)}$	$Z_{5(11)}$
TOT	0.011856	0.016801	0.7804	1.947	4.110	4.14	(9) 8.188	1.08 (2.43) (4.46)	0.812 (2.09) (13.29)
20	0.004217	0.009621	0.9179	1.718	1.819	5.35	(12) 7.944	1.301 (2.57) (4.49)	1.010 (2.12) (10.35)
21	0.003583	0.009349	0.8750	2.054	9.115	42.28	(13) 12.58	0.573 (2.59) (4.45)	1.389 (2.01) (14.27)
22	0.018405	0.020003	0.7364	2.044	3.916	17.43	(18) 28.75	2.01 (2.57) (4.50)	3.096 (2.08) (9.37)
23	0.006436	0.011829	0.7933	1.982	3.465	34.06	(18) 23.99	1.013 (2.51) (4.50)	2.110 (2.08) (9.37)
24	0.002446	0.074555	0.9268	2.157	4.505	11.36	(16) 17.504	1.211 (2.57) (4.48)	1.074 (2.09) (11.33)
25	0.052619	0.033110	0.3844	2.015	2.898	8.706	(15) 10.728	0.903 (2.57) (4.52)	2.96 (2.25) (7.41)
26	0.002785	0.008561	0.9272	2.216	7.475	14.894	(10) 8.768	0.171 (2.61) (4.42)	0.234 (2.05) (17.21)
27	0.005536	0.010970	0.9310	2.039	3.656	42.836	(18) 23.692	1.73 (2.61) (4.50)	0.184 (2.08) (9.37)
28	0.021965	0.022601	0.8107	2.369	5.619	38.646	(15) 15.430	1.193 (2.57) (4.47)	1.97 (2.09) (12.31)
29	0.004628	0.010140	0.9114	2.147	5.485	110.442	(17) 14.144	0.608 (2.57) (4.47)	1.444 (2.12) (9.37)
30	0.007825	0.013815	0.8379	1.901	4.209	42.006	(13) 8.839	1.612 (2.59) (4.45)	1.054 (2.01) (14.27)
31	0.007199	0.012649	0.8196	2.148	7.597	4.494	(4) 7.597	1.07 (2.57) (4.49)	2.03 (2.12) (10.35)
32	0.015893	0.018009	0.9350	2.233	6.577	3.952	(16) 12.268	2.61 (2.57) (4.53)	2.071 (2.34) (6.43)
33	0.008393	0.013508	0.8277	1.6195	7.652	12.412	(18) 19.184	1.112 (2.57) (4.50)	0.693 (2.16) (9.35)
34	0.010077	0.015133	0.7687	1.5216	6.986	36.270	(16) 24.85	3.61 (2.57) (4.48)	4.092 (2.16) (11.33)
35	0.006091	0.011384	0.8700	2.344	4.975	9.122	(14) 13.684	1.851 (2.57) (4.51)	0.919 (2.18) (8.39)
36	0.002529	0.007669	0.9272	2.125	6.237	17.661	(15) 17.090	3.121 (2.57) (4.47)	4.007 (2.09) (12.31)
37	0.005395	0.011334	0.8325	2.5203	8.127	17.664	(14) 18.304	0.129 (2.59) (4.45)	0.961 (2.09) (12.89)
38	0.077704	0.040235	0.4137	2.758	10.110	3.852	(15) 11.290	3.951 (2.57) (4.52)	2.779 (2.25) (7.41)
39	0.016921	0.019179	0.7027	2.024	6.475	18.574	(18) 27.232	1.951 (2.57) (4.50)	2.009 (2.08) (9.37)

Table 3.14 Results on average cost equation (3.111) and (3.112)

Part 3 Individual coefficients on $dlnULC_{t-i}$

Sector	Π_o	Π_{10}	Π_{11}	Π_{12}	Π_{13}	Π_{14}
TOT	0.00138 (0.462)		0.16038 (3.644)		0.14067 (2.292)	0.07396 (1.766)
20	-0.0044 (1.190)	0.21604 (9.670)				-0.04638 (2.067)
21	-0.00070 (0.253)					
22	0.00400 (1.219)					
23	-0.00812 (1.166)					
24	-0.00967 (3.355)					
25	0.0413 (1.364)				0.08199 (2.224)	
26	0.00107 (0.389)					
27	-0.00944 (4.639)					
28	-0.00736 (1.363)					
29	-0.00056 (0.258)					
30	-0.0141 (0.410)					
31	0.00224 (1.154)	0.28129 (7.976)			-0.092476 (2.868)	
32	0.00299 (1.061)	0.140603 (6.663)				-0.057985 (2.113)
33	-0.00827 (0.411)					
34	0.00204 (0.517)					
35	0.00477 (1.455)	0.140702 (4.519)				
36	-0.00184 (1.019)					
37	0.00097 (0.408)					
38	-0.00466 (0.657)	0.274803 (2.617)				
39	-0.00283 (0.868)					

Table 3.14 Results on average cost equation (3.111) and (3.112)

Part 4 Individual coefficients on $d\ln PW_{t-1}$

Sector	Π_{10}	Π_{11}	Π_{12}	Π_{13}	Π_{14}
TOT					
20					
21	0.28399 (8.915)				
22	0.19707 (4.082)				
23	0.418480 (7.734)				
24	0.36662 (12.368)			0.064364 (2.204)	0.062703 (2.0105)
25					
26	0.400925 (12.493)	-0.066665 (2.284)	-0.073502 (2.080)		-0.056162 (1.625)
27	0.384292 (11.141)				
28	0.25992 (2.988)			0.20947 (2.307)	0.17577 (1.920)
29	0.17253 (5.223)				0.102508 (3.025)
30	0.512363 (11.538)	0.107853 (2.459)			
31					
32					
33	0.515012 (8.275)	0.126555 (2.391)			
34	0.244512 (8.231)				
35					
36	0.293652 (12.054)	-0.045725 (1.874)			0.074177 (3.390)
37					0.102483 (2.482)
38					
39	0.304462 (5.925)				

Table 3.14 Results on average cost equation (3.111) and (3.112)

Part 5 Individual coefficients on $d\ln(\frac{Q}{L})_{t-i}$

Sector	Π_{10}	Π_{11}	Π_{12}	Π_{13}	Π_{14}
TOT					
20					
21		-0.035639 (2.253)	-0.043599 (3.150)	-0.044186 (2.889)	-0.0413067 (2.977)
22					-0.020124 (2.466)
23	-0.222887 (4.4634)				0.157068 (2.933)
24	-0.059479 (3.227)				
25					
26	-0.262520 (6.877)		-0.069887 (1.921)		0.181557 (5.172)
27	-0.032781 (1.338)				
28	-0.360210 (5.016)				0.26106 (3.126)
29	-0.164167 (8.785)				0.06115 (3.288)
30	-0.069449 (3.272)				-0.061924 (3.096)
31					
32					
33	-0.108840 (2.262)	-0.084986 (1.967)			
34	-0.057091 (2.321)	-0.063843 (2.343)	-0.030462 (1.501)		
35					
36	-0.156375 (9.099)				0.0515041 (3.117)
37	-0.16856 (6.207)				0.092283 (3.255)
38					
39	0.069444 (1.685)				

Table 3.14 Results on average cost equation (3.111) and (3.112)

Part 6 Individual coefficients on $d\ln UMC_{t-i}$

Sector	Π_{20}	Π_{21}	Π_{22}	Π_{23}	Π_{24}
TOT	0.33283 (8.723)	0.20597 (4.709)			−0.18193 (2.999)
20	0.68311 (21.807)				
21	0.231140 (8.394)	0.110967 (4.283)	0.141667 (4.684)	0.045818 (1.752)	0.0618324 (2.205)
22	0.262753 (5.158)	0.118569 (3.227)			
23	0.403502 (8.864)				
24	0.45530 (15.238)	0.10583 (3.132)			−0.11598 (3.738)
25	0.244712 (2.679)			0.17880 (1.868)	
26	0.609712 (17.631)			0.075245 (2.298)	−0.131991 (4.145)
27	0.645512 (17.793)		0.103456 (3.593)		
28	0.55232 (10.808)	0.087015 (1.767)		−0.11472 (2.207)	−0.157342 (2.704)
29	0.66059 (13.23)				−0.164299 (4.291)
30	0.29358 (8.568)	0.138503 (4.370)			−0.059857 (1.932)
31	0.459971 (12.254)		0.117663 (3.037)		
32	0.706503 (24.515)				
33	0.280691 (7.146)				
34	0.255563 (6.7390)	0.119183 (3.311)	0.08382 (2.354)		
35	0.68756 (16.792)				
36	0.623468 (17.908)		0.101716 (3.480)		−0.0974633 (3.185)
37	0.663919 (12.338)		0.122555 (2.549)		−0.137542 (2.947)
38	0.593148 (5.773)				0.203709 (2.252)
39	0.162938 (3.363)	0.168532 (3.714)			

Table 3.14 Results on average cost equation (3.111) and (3.112)

Part 7 Individual coefficients on $dlnUCC_{t-i}$

Sector	Π_{30}	Π_{31}	Π_{32}	Π_{33}	Π_{34}
TOT	0.032259 (1.539)	0.10928 (1.927)			
20	0.030465 (1.710)				0.038385 (1.919)
21	0.135714 (6.888)			−0.043304 (2.321)	
22		0.050084 (2.610)			
23			0.0632411 (1.474)		
24			0.036979 (2.023)		−0.094030 (4.615)
25				0.110753 (2.493)	
26	0.0966066 (1.9137)		−0.0548326 (1.690)		0.107483 (3.375)
27	0.117183 (4.166)				
28					0.188723 (3.216)
29	0.067375 (2.637)				
30	0.173050 (6.038)	0.079242 (3.278)			−0.046183 (2.031)
31	0.069188 (2.455)				
32					0.0371916 (3.4773)
33	0.098731 (2.912)				
34					−0.038525 (2.2143)
35	0.104196 (3.657)				0.040345 (1.678)
36	−0.0234096 (1.561)				−0.029589 (2.048)
37	0.038085 (1.569)		0.0498794 (2.124)		
38	0.228621 (1.874)				
39	0.050219 (2.287)				0.040365 (1.699)

Table 3.14 Results on average cost equation (3.111) and (3.112)

Part 8 Individual coefficients on CU_{t-i}

Sector	Π_{410}	Π_{411}	Π_{412}	Π_{413}	Π_{414}
TOT	0.00248 (4.105)		-0.004933 (4.510)	0.006227 (4.819)	-0.003528 (3.924)
20					
21					
22	-0.000921 (4.678)	0.000734 (3.096)		-0.000281 (1.946)	
23					
24					
25					
26	0.002411 (5.266)	-0.003187 (6.058)		0.000591 (2.374)	
27	0.00270 (10.400)	-0.00238 (8.550)			
28					
29	0.000498 (1.325)	-0.0007989 (2.514)			
30	0.001407 (4.911)		-0.001442 (4.525)		
31	0.000919 (2.612)	-0.000898 (1.912)	0.0010611 (2.442)	-0.000877 (2.651)	
32	0.001404 (11.188)	-0.001323 (9.387)			
33	0.0021541 (4.005)	-0.001745 (3.063)			
34					
35					
36	-0.000319 (1.400)				
37	0.000458 (1.330)	-0.000820 (1.900)	0.001118 (2.850)	-0.000831 (2.127)	
38	0.002065 (1.939)	-0.002426 (2.152)			
39			0.0011793 (3.539)		0.000849 (2.552)

Table 3.14 Results on average cost equation (3.111) and (3.112)

Part 9 Individual coefficients on CW_{t-i}

Sector	Π_{420}	Π_{421}	Π_{422}	Π_{423}	Π_{424}
TOT					
20			-0.00104 (3.629)	0.001329 (4.932)	-0.00082 (3.023)
21	0.000193 (1.442)				
22					
23			0.000980 (2.699)	-0.001233 (3.223)	
24	-0.00025088 (2.455)				
25	0.0011121 (2.035)			0.0010146 (1.739)	
26					
27					
28					
29					
30					
31					
32					
33					
34	0.000598 (5.253)			-0.000589 (4.391)	
35	0.001375 (3.390)	-0.001128 (2.753)			
36					
37					
38					
39					

Table 3.15 Sums of coefficients of cost variables Comparison with theoretical values. Average Cost equation (3.111) and (3.112) 2 digit SIC sectors, Greek manufacturing

Sector	$\sum_{i=o}^{4} \Pi_{1i}$-LSH	(t)	$\sum_{i=o}^{4} \Pi_{2i}$-MSH	(t)	$\sum_{i=o}^{4} \Pi_{3i}$-CSH	(t)
TOT	0.1864	(2.053)	-0.3908	(4.369)	0.1336	(1.634)
20	0.0499	(1.723)	-0.1561	(4.982)	0.0278	(0.980)
21	-0.0353	(1.508)	-0.2000	(3.241)	0.0382	(1.483)
22	0.0435	(0.397)	-0.4225	(6.489)	-0.0127	(0.660)
23	0.1534	(1.838)	-0.3209	(7.049)	-0.0131	(0.306)
24	0.1824	(2.202)	-0.2416	(4.725)	-0.1185	(4.389)
25	-0.1354	(3.675)	-0.2923	(2.073)	0.0440	(0.991)
26	-0.2339	(1.967)	-0.0552	(1.039)	0.0451	(0.648)
27	0.1835	(4.418)	-0.0051	(0.105)	0.0393	(1.397)
28	0.1643	(0.846)	-0.1950	(1.986)	0.1327	(2.261)
29	-0.0327	(0.318)	-0.2566	(3.702)	0.0250	(0.977)
30	0.2492	(1.446)	-0.3123	(5.186)	0.1309	(2.789)
31	-0.0195	(0.414)	0.1063	(2.261)	-0.0386	(1.368)
32	0.0893	(4.230)	-0.2157	(7.487)	0.0108	(1.006)
33	0.1581	(1.650)	-0.3455	(8.796)	0.0146	(0.429)
34	-0.0327	(1.852)	-0.3262	(4.470)	-0.1479	(8.496)
35	-0.0655	(1.549)	-0.1241	(3.030)	0.1044	(2.331)
36	0.0147	(0.174)	-0.1240	(2.800)	-0.1046	(4.321)
37	-0.1089	(4.711)	-0.1670	(2.430)	0.0401	(1.200)
38	-0.1455	(1.385)	0.3061	(1.971)	0.1397	(1.145)
39	0.0201	(0.498)	-0.2481	(3.359)	0.0240	(0.709)

of 21 sectors as the statistic Z2(5) indicates. The ULC variables are always positive and significant, so are the wage variables. Labour productivity is insignificant in 4 sectors of which one has a positive coefficient (sector 39). The UMC variable is positive and significant in all sectors. The UCC variable shows significant and positive sums of coefficients in 16 sectors, giving a strong indication of the necessity of introducing capital costs in the average cost model. The performance of the UCC variable is far better than that of the neoclassical model where only 5 sectors had a positive and significant P_c variable. Insignificant results for the unit capital cost variable are obtained in sectors 23 and 28, while negative significant results are found in sectors 24,34 and 36. Finally, in line with previous results the demand variables play a significant role only in 4 sectors, ie SIC:25,27,28 (only ECU_t) and 39.

Turning to part (2), autocorrelation based on the DW and the Z1(4) statistics seems to be present only in sector 38. Nonetheless in 3 more sectors, 4th order autocorrelation is present. These are sectors 32 (Z1(1) = 4.218), 34 (Z1(1) = 4.461)and 36 (Z1(1) = 5.869).Moreover, the Chow-test for post-parameter stability shows mispecification in sectors 24,32,34,36 and 38.

The individual lag coefficients for all variables follow more or less the pattern of the previous table. The coefficients of unit capital costs provide a pattern of significant results in the current and fourth quarter and they are almost always insignificant in the inbetween quarters.

A comparison of the cost coefficients with their theoretical values for the average cost equation inclusive of unit capital costs is given in table 3.15. The capital cost variable sums of coefficients is in line with the share of capital cost in Gross Production Value, but it seems that the inclusion of capital costs has caused a further underestimation of the material cost variable, since now in only two sectors, the difference between the share of materials and the UMC sums of coefficient is statistically insignificant.

Table 3.16: Summary of sectoral results: average cost equation (3.111) and (3.112)

Two digit sectors, Greek manufacturing.

Sector	Results	Sector	Results	Sector	Results
TOT	Accepted	26	Accepted	33	Accepted
20	Accepted	27	dln (Q/L) =o	34	Auto, Z4
21	Accepted	28	dln (Q/L) = o	35	Accepted
22	Accepted	29	Accepted	36	Auto, Z4
23	Accepted	30	Accepted	37	Accepted
24	Z4, dlnUCC<o	31	Accepted	38	Auto, Z4
25	Accepted	32	Auto, Z4	39	dln (Q/L) >o

A summary information of the results on equations (3.111) and (3.112) is given in table (3.16) together with an explanation of the reasons for rejection in sectors where the average cost model is rejected.

Finally in line with previous discussion, table (3.17), gives the average cost model finally adopted as an adequate representation of the data generation process. Statistics Z6(5) and Z7(10) are likelihood ratio tests, comparing the restricted and unrestricted general form equations (cases (1) (2) and (4)). A non-nested outcome is arrived only in sector TOT, where both equations (3.110) and (3.111)

Table 3.17 Average cost model. Final specifications 2 digit sectors, Greek manufacturing

Sector	Average cost equation (3.109) (3.110)		Average cost equation (3.111) (3.112)		Final specification
TOT	(3.110)		(3.111)		(3.110) (3.111)
20	(3.109)		(3.111)		(3.109) Z6(5) = 5.346
21	(3.110)		(3.112)		(3.112) Z6(5) =42.282
22	(3.109)	Rejected	(3.112)		(3.112) Z7(10)=19.854
23	(3.110)		(3.112)		(3.110) Z6(5) = 8.016
24	(3.110)		(3.112)	Rejected	(3.112) Z6(5) =22.598
25	(3.109)		(3.111)		(3.111) Z6(5) =18.706
26	(3.109)		(3.112)		(3.112) Z7(10)=18.938
27	(3.110)		(3.112)	Rejected	(3.112) Z6(5) =16.736
28	(3.110)	Rejected	(3.112)	Rejected	(3.112) Z6(5) =15.716
29	(3.110)		(3.112)		(3.112) Z6(5) =11.394
30	(3.110)		(3.112)		(3.112) Z6(5) =21.876
31	(3.109)		(3.111)		(3.111) Z6(5) =17.818
32	(3.109)		(3.111)	Rejected	(3.109) Z6(5) = 8.216
33	(3.110)		(3.112)		(3.112) Z6(5) =16.804
34	(3.110)	Rejected	(3.112)	Rejected	(3.110) Z6(5) =10.558
35	(3.109)		(3.111)		(3.111) Z6(5) =20.896
36	(3.110)	Rejected	(3.112)	Rejected	(3.110) Z6(5) = 9.076
37	(3.110)		(3.112)		(3.110) Z6(5) = 8.644
38	(3.109)	Rejected	(3.111)	Rejected	(3.109) Z6(5) = 5.001
39	(3.110)		(3.112)	Rejected	(3.110) Z6(5) = 8.970

are accepted. In the remaining 20 sectors, average cost inclusive of capital is preferred in 12 sectors. Finally as can be seen from table (3.17), the average cost model provides a sufficient representation of the data generation process in 15 sectors. Compared with the neoclassical model examined earlier and with the long-term models to be discussed in the next chapters, the average cost equations seem to provide a satisfactory description of the pricing process of the Greek industrial sectors.

NOTES

1. If the firm produces more than one product, then we can assume that all products can be transformed into one homogenous as

   $y = g\,(y_1, y_2, \ldots, y_m)$

2. See R. Dorfman (1951), chapter 1.

3. These can be summarized into the following

   (1) The elasticity of substitution between inputs is constrained to unity, while in the C.E.S. can take any value between zero and infinity.

   (2) The Cobb-Douglas function implies an elasticity of demand greater than unity for the various inputs with respect to their prices

   (3) The existence of constant or increasing returns to scale is inconsistent with the assumptions of perfect competition and profit maximization.

4. Referring to equation (3.1) these properties are

$$\frac{\partial f}{\partial x_1} \geqq 0, \quad f(0,0) = f(0,x_2) = f(x_1,0) = 0, \quad \frac{\partial^2 f}{\partial xi^2} < 0$$

5. For example

$$\frac{\partial \Pi}{\partial L} = \left(1+\frac{1}{C_0}\right)\left[Ae^{\delta t}L^{\alpha}M^{\beta}K^{\gamma}\right]^{1/c_0} Ae^{\delta t}L^{\alpha-1}M^{\beta}K^{\gamma}\,\alpha\Gamma_0^{-1/c_0}Y^{-b/c_0}P_B^{(b+c_0)/c_0} - P_W = 0.$$

$$\longrightarrow \frac{\partial \Pi}{\partial L} = \left(1+\frac{1}{C_0}\right)Q^{1/c_0}\frac{Q}{L}\,\alpha\Gamma_0^{-1/c_0}Y^{-b/c_0}P_B^{(b+c_0)/c_0} - P_W = 0 \longrightarrow$$

$$\longrightarrow \frac{\partial \Pi}{L} = \left(1+\frac{1}{C_0}\right)\frac{PQ}{L}\,\alpha - P_W = 0 \quad \text{Q.E.D.}$$

6. For example from (3.12)

$$\frac{\vartheta\Pi}{\vartheta M} = (1+\frac{1}{Co})\frac{PQ}{M}\beta - Pm = o \longrightarrow Pm = \beta(1+\frac{1}{Co})\frac{PQ}{M} \longrightarrow$$

$$M^{-1} = Pm\, Q^{-1}P^{-1}\beta^{-1}(1+1/Co)^{-1} \longrightarrow M = P.Q.Pm^{-1}\beta\,(1+1/Co)\ \text{Q.E.D.}$$

7. For example from (3.13)

$$K = P\Gamma_0 Y^b P^{Co} P_B^{-(b+Co)} P_C^{-1}\gamma(1+1/Co) \longrightarrow$$

$$K = P^{(1+Co)}\Gamma_0 Y^b P_B^{-(b+Co)} P_C^{-1}\gamma(1+1/Co) \quad \text{Q.E.D.}$$

8. By substituting (3.15) into (3.18) we have

$$\Gamma_0 Y^b P^{Co} P_B^{-(b+Co)} = Ae^{t}\left(\frac{\alpha}{Pw}\right)^{\alpha}\left(\frac{\beta}{Pm}\right)^{\beta}\left(\frac{\gamma}{Pc}\right)^{\gamma} P^{\sigma(1+Co)}\Gamma_0^{\sigma} Y^{b\sigma}P_B^{-\sigma(b+Co)}(1+1/Co)$$

$$P^{Co-\sigma(1+Co)} = Ae^{\delta t}\left(\frac{\alpha}{Pw}\right)\left(\frac{\beta}{Pm}\right)\left(\frac{\gamma}{Pc}\right)^{\gamma}\Gamma_0^{\sigma-1}Y^{b(\sigma-1)}P_B^{-(\sigma-1)(b+Co)}(1+1/Co)$$

Q.E.D.

9. From (3.21) we have

$$P = [A\Gamma_0^{(\sigma-1)}(1+1/Co)^{\sigma}]^{\Theta} e^{\delta\Theta t} Y^{\Theta b(\sigma-1)} P_B^{-\Theta(b+Co)(\sigma-1)} Pw^{-\alpha\Theta} Pm^{-\beta\Theta} Pc^{-\gamma\Theta}\alpha^{\alpha\Theta}\beta^{\beta\Theta}\gamma^{\gamma\Theta}$$

$$P = [A\Gamma_0^{(\sigma-1)}(1+1/C_0)^{\sigma}\alpha^{\alpha}\beta^{\beta}\gamma^{\gamma}]^{\Theta} e^{\delta\Theta t} Y^{\Theta b(\sigma-1)} P_B^{-\Theta(b+Co)(\sigma-1)} Pw^{-\alpha\Theta}\cdot Pm^{-\beta\Theta}\cdot Pc^{-\gamma\Theta}$$

Q.E.D.

10. See for example W.D. Nordhaus (1972) p. 39.

11. See T.A. Scountzos and G.S. Mattheos (1980)

12. See for example P.H. Earl's (1974) survey on the lag responses of prices to costs, pp 88-92.

13. See for example papers by S. Domberger (1979) (1983) and R. Dixon (1983) producing opposing results.

14. See for example G.C. Harcourt and P. Kenyon (1976), A.Wood (1975) and A.J. Eichner (1973) (1976).

15. See J.D. Sargan (1980) for a procedure of choosing the maximum lag, particularly pp 116-121.

16. The introduction of longer lags on the price of capital services (Pc) variable was ruled out on the basis of experimentation with a number of sectors. Lags of up to 8 and 12 quarter periods were tried but in all three pilot cases (SIC:20,30,36) the coefficients on the longer lags proved largely insignificant.

17. See C.E. Ferguson (1969) particularly chapters 6 and 7 and P.E. Samuelson (1947) pp 57-89.

18. See J. Robinson (1933), chapter 4.

19. For a proof see D.H. Hay and D.S. Morris (1979) appendix to chapter 4, p. 142.

20. By (3.23) $\sigma=1$

21. See section 3.5 and Appendix 3.

22. See W.D. Nordhaus (1972) p. 38 and D.G. McFe tridge (1973) p.146.

23. See equation (2.2)

24. See also point 8 in section 3.4.

25. See D.F. Hendry (1980).

26. See G.C. Chow (1960).

27. See table 3.7.

28. See K.F. Wallis (1972)

29. The statistic is the same with Z1 with two modifications. First there is only one degree of freedom and second equation (3.69) should be substituted by (3.69)'

$$(3.69)' \quad u_t = \rho_4 u_{t-4} + \varepsilon_t \qquad \varepsilon_t \sim NID(0, \sigma^2_\varepsilon)$$

30. See M.C. Sawyer (1983) pp.79-80.

31. See for example A. Koutsoyiannis (1975) note on page 264 and D.A. Hay and D.S. Morris (1979) note 12 on page 119.

32. (η) by the notation of equation (1.8) or (c_o) by the notation of equation (3.5).

33. See for example R.L. Hall and C.L. Hitch (1939), R.A. Lester (1946), F. Machlup (1946), H.M. Oliver (1947), R.A. Gordon (1948) and M. Friedman (1953).

34. See for example W. Baumol and R. Quandt (1964), R.H. Day, S. Morley and K.R. Smith (1974) and R.H. Day, D.S. Aigner and K.R. Smith (1971).

35. See for example R.R. Neild (1963).

36. See for example C.L. Schultze and S.L. Tryon (1965).

37. See for example L.A. Dicks-Mireaux (1961), A.G. Hines (1964), L.R. Klein and R.S. Ball (1959), F.C. Ripley and L. Segal (1973), T.D. Sheriff (1977) and Y. Shinkai (1974).

38. This is further discussed in chapter 4.

39. See for example the debate between R.R. Neild (1963)(1973), F. Rushdy and P. Lund (1967), B.T. McCallum (1970) and J. Johnston (1967) among others and more recently the debate between W. Godley and W. Nordhaus (1972), D.E.W. Laidler and M. Parkin (1975), K.S. Coutts, W. Godley and W. Nordhaus (1978), W. Godley (1977), M. Parkin (1977) (1978).

40. For a number of demand measures see section 3.9.4.

41. The analysis follows closely the work of M.C. Sawyer (1983) pp.43-45.

42. See for example P.H. Earl (1973) S.A. Trevithic and C. Mulvey (1975), J. Johnston (1967), M. Parkin, M.T. Summer and R.A. Jones (1972).

43. See J. Robinson (1933) pp. 70-71.

44. See section 1.3.8 and chapter 5.

45. See for example references in P.H. Earl (1973) p.19.

46. See also M.F. Feldstein (1973).

47. See also the debate between J.V. Yance (1960)(1961) and W.S. Yordon Jr. (1961).

48. For a recent survey of these measures see L.S. Christiano (1983).

49. See L.R. Klein and R. Summers (1966).

50. See K. Coutts, W. Godley, W. Nordhaus (1978) p.62.

51. The likelihood ratio test is applied on the general models (3.109) (3.110) and (3.111)(3.112).

Consider for example the two nested models

$$\underline{\text{Restricted}} \quad d\ln P_t = \pi_0 + \pi_{10} d\ln ULC_t + \pi_{11} d\ln ULC_{t-1} + \pi_{12} d\ln ULC_{t-2} +$$

$$\pi_{13}\, d\ln ULC_{t-3} + \pi_{14} d\ln ULC_{t-4} + \ldots + u_t$$

$$\underline{\text{Unrestricted}} \quad d\ln P_t = \pi_0 + \pi_{10}\, d\ln P_{wt} - \pi_{10} d\ln (Q/L)_t +$$

$$+ \pi_{11} d\ln Pw_{t-1} - \pi_{11}\, d\ln (Q/L)_{t-1} +$$

$$+ \pi_{12} d\ln Pw_{t-2} - \pi_{12} d\ln (Q/L)_{t-2} +$$

$$+ \pi_{13} d\ln Pw_{t-3} - \pi_{13} d\ln (Q/L)_{t-3} +$$

$$+ \pi_{14} d\ln P_{W\,t-4} - \pi_{14} d\ln (Q/L)_{t-4} + \ldots + u_t$$

Z2(5) is defined as $Z2(5) = -2\,(\log L^R - \text{Log } L^U) \sim x^2(5)$
If Z2(5) obtains values less than the critical at the 5% significance level (11.07), then the restricted model is chosen, ie. wages and labour productivity have the same effect on prices.

52 Actually the choice between CU and CW involves application of a non-nested procedure. Such a procedure however has been considered as extremely time consuming due to the number of combinations and the number of equations involved and also due to the fact that both specifications and almost identical (in most sectors yielding the same results). Instead the choice between the two variables is based on grounds of statistical significance; the variable yielding significant sum of coefficients is chosen.

CHAPTER 4 : Calculation of normal unit costs

4.1. Introduction.

This chapter is concerned with the calculation of unit costs that will be used further in the estimation of price equations such as target rate of return pricing, full cost pricing and normal cost pricing. A common characteristic of all these pricing models is that costs are not based on actual output as the models discussed in chapter 3, but on a notion of output that came to be known in the literature as standard or normal output.[1] Based on this notion of output it is possible to generate by means of an elaborate technique, first used by W.D. Nordhaus and W. Godley (1972) measures for normal unit costs for all input categories entering price determination models.

The chapter contains 7 sections. In section 4.2. we discuss the notion of normal or standard output and set the procedure by which normal values of the various variables will be derived. In sections 4.3, 4.4 and 4.5 we discuss the methodology for the estimation and generation of normal values for the various components of normal unit labour cost, ie normal hours, normal earnings and normal employment. Section 4.6 is concerned with the estimation of normal unit materials cost. Finally section 4.7 recapitulates the results of the previous sections in presenting the formulas for normal unit labour and normal unit materials costs.

4.2 The notion of normal output; the proceedure of normalization.

A central idea of pricing models such as full-cost, target rate of return and normal cost pricing is the notion of standard or normal output. All the above models are based on the hypothesis that businessmen understand the demand, price and average cost of their products at a normal or standard rate of output, ie the operating volume expected under demand and cost conditions considered to be normal. In other words businessmen are aware of their long-run demand and average costs but unable and unwilling to calculate the changes in demand and costs during short-run market disturbances. The firm sets its price on average cost at a normal rate of output. The cost is the standard or normal cost, ie the cost from which the effects of cyclical variations in output are purged. The price is the standard or normal price that will be changed only when businessmen consider that costs at the normal rate of output have shifted or when they believe that the normal rate of output has been changed. The normal rate of output may be set above or below the actual output rate at any point in time, and is certainly below the capacity output.

It is clear therefore that businessmen's expectations about whether a particular market disturbance is of a permanent or transitory nature are crucial for the prediction of the price response of a firm that practices full-cost, target rate or normal cost pricing. An operational definition of such expectations is required in order to give a precise statement of what is normal output, particularly in view of the fact that the estimation of unit costs depends on that definition. In practice most of the authors who have used the concept of normal cost in empirical research[2] have assumed that the standard operating volume is identical to the trend growth path of the firm's (or the industry's) output. W.D. Nordhaus and W. Godley (1972) for example define the normal value of a variable as

"the value that this variable would take, other things equal, if output were on its trend path",

and

"the trend path defining normal output is the prediction of a regression of the logarithm of output against time"

W.D. Nordhaus and W. Godley (1972) p.854.

The same convention has been followed with a slight modification. Since the period under study covers a 15-year-span during which industrial output has experienced accelerating growth rates, it is rather unreasonable to assume a constant growth rate. Denoting sectoral output by Q_t, it was decided to decompose variations in output as in (4.1) (repeating equation 3.105)

(4.1) $\ln Q_t = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + u_t \qquad u_t \sim NID(0, \sigma^2 u)$

where t is a time trend

The results of the estimation of equation (4.1) for the two digit SIC industrial sectors are presented in table 3.8. On the basis of these results, normal output (QN_t) can now be defined as (repeating equation 3.106)

(4.2) $\ln QN_t \equiv \hat{\alpha}_0 + \hat{\alpha}_1 t + \hat{\alpha}_2 t^2$

where carrets (^) denote estimates of equation (4.1).

Normal unit labour costs can now be estimated, based on QN_t. The normalization procedure that will be followed in the remaining sections refers to variable costs, labour and materials. Labour and materials bill are the product of a number of variables some of which are dependent on output utilization and some of which are not. For example the minimum rates of pay are exogenous to the firm since they are determined by national negotiations or simply set by the State. Average earnings on the other hand are subject to the firm's decision since they are affected by hours worked, overtime earnings and a number of other factors that may be considered to vary with output. The normalization procedure will therefore focus on these components of labour and materials bill that are affected by output rates, by modelling these components in order to purge the cyclical elements introduced via the cyclical fluctuations in output. The end result of this procedure will be to construct normalized series on labour and materials bill and consequently normalized series on unit labour and unit materials bill. The variables on which the normalization procedure will be applied are actual hours worked, average earnings, employment and materials volume, thus generating "normal" values of these variables. The next sections describe the methodology by which this is achieved.

4.3. Estimation of normal hours.

The first variable to be normalized is average weekly hours. Define by

HS_t = standard hours, denoting weekly hours worked that are either statutory or determined by national negotiations.

H_t = actual weekly hours worked per employee, (wage-earners, see below), equal to the sum of regular and overtime hours (see equation (2.11)).

Data on actual hours may be further decomposed into HM_t and HF_t

HM_t= average weekly hours worked per male (wage-earner) employee.

HF_t= average weekly hours worked per female (wage-earner) employee.

HN_t= normal hours worked denoting hours worked when output is at its normal (trend) path which can be decomposed into

HMN_t = normal average weekly hours worked per male (wage-earner) employee

HFN_t = normal average weekly hours worked per female (wage-earner) employee.

Following K. Coutts, W. Godley and W. Nordhaus (1978) (henceforth CGN) we will assume that actual weekly hours per employee will change after a change in output. Furthermore other factors unrelated to standard hours or output may affect actual hours such as for example the increased tendency of women's participation in industrial labour force in the form of part time work.[3] In addition technical and productivity changes will also exert an influence on actual hours worked over and above the effect of standard hours and output. A time trend is assumed to capture these influences. Denoting by CU_{t-1} a capacity utilization index defined as the ratio of actual over normal output, the hours equations can be written as (4.3.1) and (4.3.2) for males and females respectively.

$$(4.3.1)\quad HM_t = \pi_0 + \pi_1 HS_t + \pi_2 t + \sum_{i=0}^{4} \pi_{3i} CU_{t-i} + u_t$$

$$(4.3.2)\quad HF_t = \pi_0 + \pi_1 HS_t + \pi_2 t + \sum_{i=0}^{4} \pi_{3i} CU_{t-i} + u_t \qquad u_t \; NID\,(0, \sigma^2 u)$$

All coefficients in equations (4.3) have expected positive coefficients. The adjustment of average weekly hours to output is represented by a distributed lag on capacity utilization. With regard to this adjustment it should be noted that average weekly hours play the role of a buffer in the sense that they absorb variations in the labour service requirements resulting from fluctuations in capacity utilization. On the other hand the number of people employed adjust relatively slowly to changes in output because of the reluctance of employers to hire and fire employees in view of changes in output that may be regarded as temporary. Nonetheless, if and when output changes are viewed as permanent there will be some feedback from changes in employment since average weekly hours increase initially with an increase in output, only to fall back when the number of people employed changes.

The separate estimation of hours worked for males and females is dictated by the fact that wage equations (see section (4.4)) had to be estimated for both sexes since the minimum wage (which is an explanatory variable in the wage equation) was different for men and women during the period under study. A problem which arises in estimating separate models for men and women is that the data do not distinguish between output produced by men and women. It was therefore assumed that the relative proportions of total sectoral output produced by men and women remained constant over the cycle.

Data on standard hours are obtained by the National Confederation of Greek Workers (1983) and are identical for all two digit SIC sectors. The reason that we use the same data for standard hours for all sectors is that whenever there are sectoral negotiations for settting the minimum number of working hours per week, these negotiations are made between employers and unions representing various employment categories. Since we have a number of employment categories per sector, it is impossible to aggregate the different standard hours for each employment category that belongs to one sector. It was therefore assumed that the number of hours that is agreed on national negotiations and refer to total manufacturing sector, applies to all two-digit SIC sectors as well.

The results of the estimation of equations (4.3) are presented in tables 4.1 and 4.2 referring to males and females respectively. The first part of the tables presents the values of the coefficients and their respective t-statistics, as well as the value of the autoregressive coefficients, whenever first order autoregressive estimation was considered necessary. The second part of the tables presents a few summary statistics and a number of diagnostic tests. These are

SE = standard error of the equation

$\bar{R}^2$ = multiple correlation coefficient, corrected for degrees of freedom.

D.W. = Durbin-Watson statistic.

Z1(4) = Langranze multiplier statistic, testing for up to fourth order autocorrelation that has a x^2 distribution with four degrees of freedom.[4]

$Z_{21(1)}$, $Z_{22(1)}$ = Langranze multiplier statistic to test for functional form of the equation (ie. whether it is linear or loglinear), distributed as x^2 with one degree of freedom.

Table 4.1 Equations for hours worked, male manual workers

Part 1 Individual coefficients

Sector	Π_0	Π_1	Π_2	Π_{30}	Π_{31}	Π_{32}	Π_{33}	Π_{34}	ρ
TOT	13.760	0.648				0.0839	0.0974		
	(2.225)	(4.972)				(1.843)	(2.217)		
20	8.558	0.785	−0.166	0.0475					
	(0.618)	(2.778)	(2.155)	(2.737)					
21	−5.953	1.103	−0.159	−0.0463	0.0303	0.0894			
	(0.326)	(2.950)	(1.826)	(1.396)	(1.935)	(2.473)			
22	−7.083	1.099		0.0417		0.0241			
	(0.522)	(3.845)		(1.838)		(1.057)			
23	1.189	0.932					0.0707	0.1129	
	(0.112)	(4.163)					(1.347)	(2.197)	
24	−18.622	1.188	0.495			0.0958	0.1809		
	(0.622)	(2.145)	(2.838)			(1.675)	(2.736)		
25	40.496		0.2022				0.0268	0.0241	
	(103.6)		(4.647)				(2.214)	(1.894)	
26	0.815	0.8011	0.2382	0.0362					
	(0.073)	(3.494)	(3.791)	(1.608)					
27	−17.94	1.372		0.0676					
	(1.296)	(4.603)		(2.753)					
28	14.099	0.6121	0.2191						
	(0.967)	(2.057)	(2.806)						
29	3.912	0.8088	0.2519	0.0393	0.0428				
	(0.340)	(3.443)	(3.921)	(1.408)	(1.562)				
30	5.739	0.7957		0.0432	0.0378				
	(0.612)	(4.023)		(1.913)	(1.648)				
31	25.64	0.4411							
	(1.973)	(1.611)							
32	−0.386	0.9902				0.0204	0.0208		
	(0.033)	(3.989)				(1.630)	(1.691)		
33	23.53	0.4313					0.0874		
	(3.162)	(2.750)					(3.614)		
34	−3.712	1.114			0.0284			0.0536	0.5454
	(0.150)	(2.135)			(1.540)			(2.955)	(4.729)
35	8.516	0.728	0.1134						
	(0.785)	(3.291)	(1.879)						
36	−3.530	0.979	0.1859						
	(0.251)	(3.415)	(2.281)						
37	0.6620	0.8876					0.1449		0.374
	(0.058)	(3.674)					(1.795)		(2.896)
38	9.907	0.7517						0.0237	
	(0.801)	(2.886)						(2.192)	
39	8.871	0.7344		0.0737	−0.1634	0.2035			
	(0.745)	(2.928)		(1.234)	(2.303)	(3.594)			

Table 4.1 Equations for hours worked, male manual workers

Part 2 Test statistics

Sector	SE	$\bar{R}^2$	DW	$Z_{1(4)}$	$Z_{21(1)}$	$Z_{22(1)}$	$\Pi_i - 1$ (t)	$\Sigma\Pi_{3i}$
TOT	0.9173	0.4050	1.6817	3.732	0.781	6.555	(2.699)	0.1814
20	1.7306	0.3932	2.0915	4.575	3.199	7.198	(0.761)	0.0475
21	1.6135	0.4946	1.6761	7.929	2.173	5.763	(0.276)	0.1234
22	2.2213	0.2474	2.1339	1.555	3.009	12.171	(0.348)	0.0658
23	1.9021	0.2458	2.1380	2.319	1.844	4.000	(0.303)	0.1836
24	2.5342	0.2212	1.9564	2.058	2.416	21.581	(0.340)	0.2767
25	1.2893	0.2923	1.6719	9.189	2.967	4.513		0.0510
26	1.3817	0.2349	1.8058	4.842	1.855	28.158	(0.868)	0.0363
27	2.2724	0.2636	1.4769	6.877	0.951	6.666	(1.247)	0.0676
28	1.5338	0.2836	1.9541	1.962	3.810	4.950	(0.767)	0.0355
29	1.3942	0.2479	1.7946	3.765	3.465	13.008	(0.814)	0.0821
30	1.446	0.3145	1.4749	5.165	0.711	7.413	(1.033)	0.0810
31	2.3540	0.2819	1.8321	8.383	0.289	8.999	(2.042)	
32	2.0104	0.2861	1.7402	4.793	1.084	19.019	(0.039)	0.0411
33	1.2926	0.3261	1.9220	6.558	2.000	8.111	(3.625)	0.0874
34	2.2245	0.5199	2.2403		3.777	8.173	(0.218)	0.0320
35	1.3087	0.1305	2.0741	2.287	2.518	6.198	(1.230)	0.0292
36	1.8434	0.1495	2.5001	6.556	1.462	14.144	(0.075)	
37	1.2584	0.6585	1.9724		0.358	5.183	(0.465)	0.0145
38	2.2329	0.1315	1.7758	8.032	2.917	8.892	(0.953)	0.0237
39	2.1487	0.2515	2.3578	3.265	2.867	7.799	(1.058)	0.1138

Table 4.2 Equations for hours worked, female manual workers

Part 1 Individual coefficients

Sector	Π_0^*	Π_1	Π_2	Π_{30}	Π_{31}	Π_{32}	Π_{33}	Π_{34}	ρ
TOT	7.867	0.714		0.0708		-0.0986		0.0685	
	(1.325)	(5.706)		(2.518)		(2.787)		(2.433)	
20	-9.476	1.0018				0.0455			
	(0.835)	(4.188)				(2.256)			
21	15.080	0.5199	0.1473						
	(0.814)	(2.376)	(2.371)						
22	-14.58	1.161	0.1951	0.0980		0.0440		0.03998	0.2843
	(0.538)	(2.096)	(1.255)	(3.327)		(1.540)		(1.496)	(2.105)
23	12.487	0.643				-0.0440	0.0702	0.0784	
	(2.194)	(5.360)				(1.592)	(2.048)	(2.860)	
24	0.2576	0.8618		0.09247	-0.0441	0.1090			
	(0.027)	(4.325)		(2.727)	(1.896)	(3.122)			
25	17.709	0.4264	0.1816	-0.1784	0.1826				
	(0.537)	(1.634)	(1.994)	(2.112)	(1.979)				
26	13.573	0.6133						0.0657	
	(1.034)	(2.216)						(1.777)	
27	21.398	0.4708		0.0493					
	(1.887)	(1.971)		(2.504)					
28	23.411	0.4238				0.0699		0.0782	
	(2.037)	(1.751)				(2.425)		(2.785)	
29	27.914	0.2803	0.1856			0.0302			
	(1.660)	(1.818)	(1.909)			(1.850)			
30	-4.899	0.9885		0.1125	-0.0619	0.0696			
	(0.361)	(3.454)		(3.504)	(1.696)	(2.128)			
31	9.230	0.7108					0.0365	0.0494	0.3637
	(0.630)	(2.308)					(1.220)	(1.948)	(2.855)
32	-14.721	1.0763							
	(1.903)	(4.361)							
33	27.18	0.3622					0.0242		
	(2.313)	(1.579)					(1.683)		
34	-12.168	1.0749	0.4858						
	(0.455)	(1.973)	(3.135)						
35	27.77	0.3026	0.0659					0.02314	
	(2.885)	(1.941)	(2.231)					(2.399)	
36	-4.925	0.9582	0.3125	0.0996					
	(0.236)	(2.256)	(2.591)	(1.899)					
37	1.1099	0.9149				0.0843	0.0652		0.3249
	(0.092)	(3.608)				(4.210)	(3.197)		(2.486)
38	-4.7199	1.0855			0.0599				0.3458
	(0.268)	(2.923)			(2.147)				(2.715)
39	12.747	0.5988			0.0412				
	(1.397)	(3.115)			(1.735)				

Table 4.2 Equations for hours worked, female manual workers

Part 2 Test statistics

Sector	SE	$\bar{R}^2$	DW	$Z_{1(4)}$	$Z_{21(1)}$	$Z_{22(1)}$	$\Pi_1 - 1$ (t)	$\Sigma\pi_{31}$
TOT	0.8435	0.5689	1.7169	1.174	3.789	8.434	(2.288)	0.0407
20	2.0241	0.3110	2.2767	5.411	4.193	3.718	(0.008)	0.0455
21	2.4308	0.1485	1.7316	5.589	3.109	5.689	(2.194)	
22	2.5602	0.3323	1.9326		2.862	4.801	(0.210)	0.1819
23	1.0123	0.3965	1.5670	2.761	1.800	14.01	(2.981)	0.1046
24	1.4919	0.4117	1.6438	3.648	2.194	6.167	(0.694)	0.1574
25	3.1410	0.0674	1.9378	8.693	1.819	9.736	(2.199)	0.0042
26	2.2777	0.0729	1.7056	1.299	2.620	21.03	(1.397)	0.0657
27	1.8219	0.0851	1.5449	4.849	0.056	8.970	(2.215)	0.0493
28	1.7993	0.1478	1.8419	12.87	1.690	4.463	(2.381)	0.1401
29	2.1638	0.2456	1.9102	1.436	3.618	5.182	(4.667)	0.0302
30	2.0400	0.3347	2.1223	3.658	1.394	10.283	(0.040)	0.1202
31	1.6099	0.5737	2.0626		2.012	9.505	(0.898)	0.0860
32	3.3050	0.2468	1.5233	3.849	3.513	9.474	(0.309)	
33	1.8908	0.3320	1.8352	8.734	3.049	10.494	(2.780)	0.0242
34	3.5053	0.1249	1.9885	2.597	3.276	8.888	(0.138)	
35	1.1613	0.2955	2.0878	2.222	2.085	7.317	(4.473)	0.0231
36	2.7295	0.2982	1.8589	3.287	2.486	4.476	(0.099)	0.0996
37	1.3785	0.6599	1.8936		3.357	5.880	(0.336)	0.1495
38	2.2289	0.5125	2.0035		1.961	16.80	(0.230)	0.0599
39	1.6513	0.1449	1.5589	3.725	16.502	1.852	(2.097)	0.0412

$\pi_1 - 1$ (t) = a-t-statistic testing whether the coefficient on standard hours (π_1) is different from unity, and

$\sum\Pi_{3i}$ = the sum of coefficients on the capacity utilization variable.

Since the theory does not specify whether models (4.3) should be linear or loglinear we tested on the choice of functional form by using the L.G. Godfrey and M.R. Wickens (1981) statistic against functional mispecification that is based on the Langranze multiplier principle and is derived as a special case of a mispecification testing procedure described in L.G. Godfrey and M.R. Wickens (1982). This test has the advantage over other commonly used tests such as Box-Cox[5] of allowing the hypothesis of linear or longlinear specification to be tested against a general alternative one; when both specifications are rejected we have a clear indication that the model should be respecified. Application of the test on the general form of equations (4.3) suprisingly provided a one sided picture.

The results of the statistics Z_2 that follow a x^2 distribution with one degree of freedom are given on the 4th and 5th columns of the second part of tables (4.1) and (4.2), the $Z_{21(1)}$ statistic referring to the linear and $Z_{22(1)}$ statistic to the loglinear specifications. Inspection of the tables reveals that in almost all cases the value of the $Z_{21(1)}$ statistic was less than the critical at the 5% significance level, thus implying that the linear specification should be accepted. Exceptions were observed in sectors 20 and 39 for hours worked by female mannual workers, where a loglinear specification is required.

The results of the regression with regard to weekly hours worked by male manual workers are on the whole satisfactory. Apart from the low coefficient of determination ranging from .13 to .66 which can be partly attributed to the fact that HS_t does not exactly match the true standard sectoral hours, the diagnostic tests indicate that the equations perform well. The $Z_{1(4)}$ tests reject the hypothesis of up to fourth order autocorrelation in the residuals and the D.W statistic does not indicate the presence of first order autocorrelation except, possibly, for sectors SIC:21-25-27-30-36-39, where the D.W. is in the inconclusive region. The coefficients on HS_t are always positive and significant and in most of the cases not significantly different from unity apart from sectors SIC: TOT-31-33. Even in the total total manufacturing sector the coefficient on the HS_t is 0.65 implying that cuts in negotiated standard hours have been 65% effective, in the sense that for every hour cut per week as a result of national bargaining, 0.65 hour reduction actually occurred. The HS_t coefficients for individual sectors range from 0.43 for sector 33 to 1.372 for sector 27. In most of the cases the time trend variable failed to capture the effects of technology and external factors. Finally the sum of the coefficients on the capacity utilization variable ranged from 0.0145 for sector 37 to 0.277 for sector 24.

Weekly hours regressions for female manual workers are again on the whole quite satifactory. $\bar{R}^2$ does not reach high scores, but the coefficients are well behaved with expected signs and on the whole significant. D.W. statistic is in the inconclusive region in 5 of 21 sectors (SIC:23-24-27-32-39) and the Z1(4) statistic indicates that we cannot reject that the residuals are autocorrelated apart from SIC:28. The coefficient on standard hours is everywhere positive and almost always significant (exceptions are sectors 25 (t=1.634) and 33 (t=1.579)) but contrary to the male-hours equations is insignificantly different from unity in 10 out of 21 sectors (SIC: TOT-21-23-25-27-28-29-33-35-39). The time trend variable is found to be significant in 7 out of 21 sectors and finally the sum of coefficients on the capacity utilization variable range from 0.0042 for SIC:25 to 0.182 for SIC:22.

In the light of the above results normal hours can now be defined for males and females respevtively by equations (4.4.1) and (4.4.2)

$$(4.4.1) \qquad HMN_t \equiv \hat{\pi}_0 + \hat{\pi}_1 HS_t + \hat{\pi}_2 t + \sum_{i=o}^{4} \hat{\pi}_{3i}$$

$$(4.4.2) \qquad HFN_t \equiv \hat{\pi}_0 + \hat{\pi}_1 HS_t + \hat{\pi}_2 t + \sum_{i=o}^{4} \hat{\pi}_{3i}$$

Note that the last term includes only the sum of coefficients on CU_t, since if output is on its trend path, ie. $Q_t = QN_t$ then $Q_t/QN_t = 1$.

4.4 Estimation of normal earnings.

The next step in the calculation of variables required for the generation of normal labour costs is to estimate normal earnings per worker. CGN assume that earnings refer to manual workers only, thus excluding the earnings of administrative, technical and clerical personnel (ATC) from the analysis. In what follows we will present two separate models; one for the earnings of wage earners that broadly correspond to manual workers and one for salaried earners that correspond to ATC staff. Prior to that however a small digression on the institutional background of the Greek labour market is required. Such a digression will help in elucidating some of the issues discussed in this and subsequent sectors.

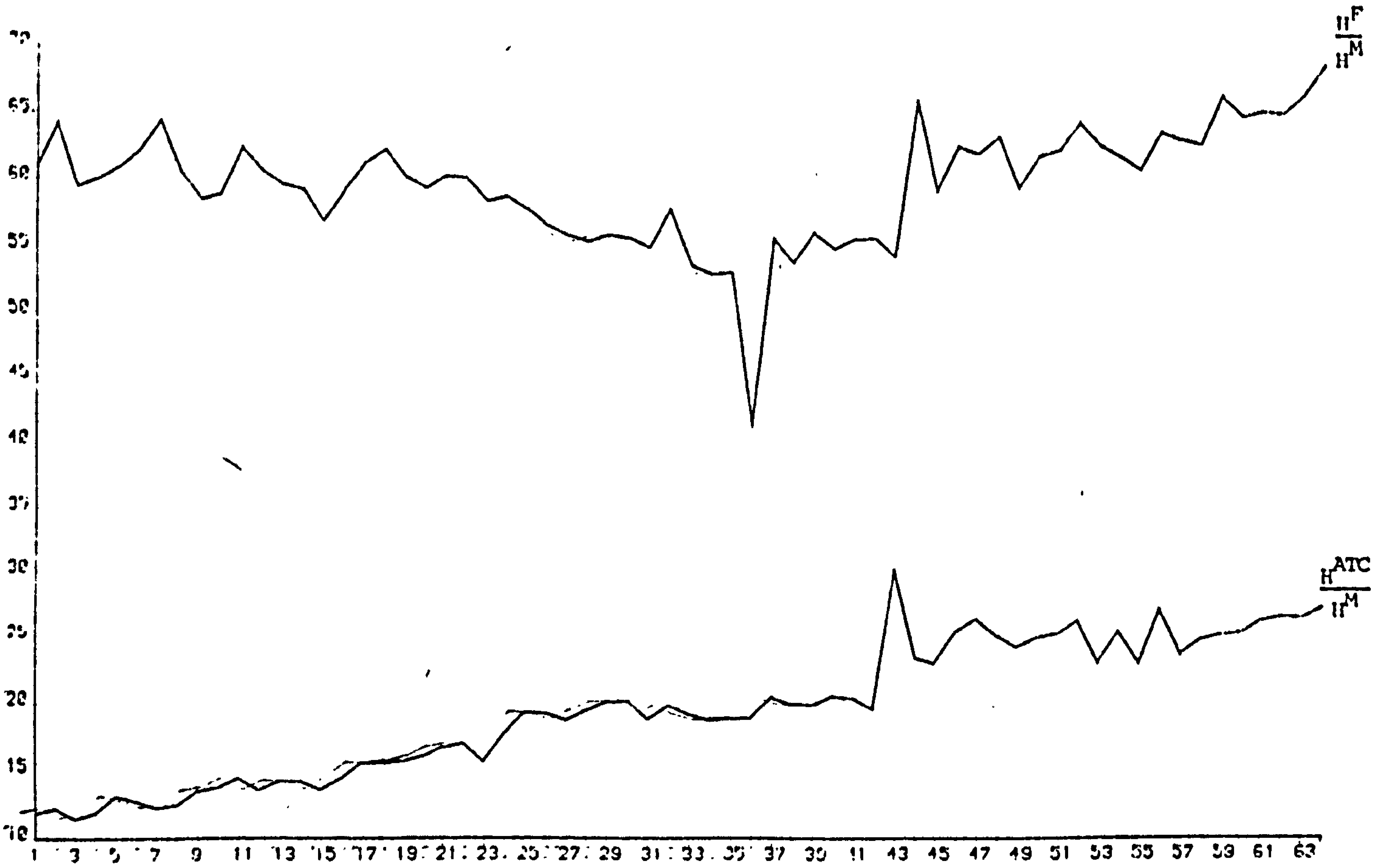
4.4.1. Characteristics of the Greek (industrial) Labour Market.

One of the first characteristics that has to be noted is that the ratio between manual and non-manual workers in the Greek industry has declined considerably during the period under examination. In 1963 5.59 manual workers corresponded to one ATC employee, while in

1977 the ratio was 3.07. This pattern in the ratio of ATC's to manual workers can be followed up in figure 4.1 where by H^{ATC}/H^{M} we denote the hours worked by ATC personnel to male manual workers (and by H^{F}/H^{M} the ratio of hours worked by female to male workers). The increasing trend in H^{ATC}/H^{M} can only be partly explained by the industrialization process and the introduction of new technology that requires more and specialized ATC staff. International comparisons[6] show that the state of Greek industry does not justify such a small ratio between ATC and male manual workers. The main reason for such a growth should be attributed to the fact that the Greek labour market has experienced an extensive state of Government intervention which has institutionalized the market to such an extent that demand and supply forces play a minor role. As a result the interrelationships between the two categories of labour under examination have changed compared to what they should have been under free market mobility with regard to employment and earnings.

The Greek legal system, under various means of labour legislature and court rulings allows the ATC personnel to enjoy various non-pecuniary benefits over manual workers. These include for example the maximum leave (where there is a 60% difference) and the maximum compensation in case of firing or retirement (where there can be a maximum effective difference of 1200%). As a result there has been pressure by various, usually highly unionised manual professions to be awarded the status of ATC personnel, with considerable success. This in turn increases artificially the unit labour cost and distorts the pricture of the market since firms are reluctant to fire employees in periods of recession because of the high compensations imposed upon them by such legal rulings.[7] Apart from the various non-pecuniary benefits ATC personnel also enjoy considerably higher income compared to manual workers as shown in figure 4.2, where

Figure 4.1: Hours worked by male and female manual workers and ATC personnel, Greek manufacturing sector (TOT)



by W^{ATC}/W^{M} we denote the ratio of hourly earnings of ATC personnel to hourly ratings of male manual workers (and W^{F}/W^{M} the ratio of hourly earnings of female manuals to male manuals).

As a consequence, there has been a tendency in the Greek labour force, particularly during the seventies, to concentrate on non-manual professions. Because of that and partly due to the extensive industrialization process, there is an excess supply of educated people competing in the labour market for clerical and administrative jobs, while the reverse is true for lower-paid and less-prestiged manual professions.

A clear picture of the significance of the salary bill paid in by firms is given in table 4.3 where labour expenditure is disaggregated into 5 categories, namely male wage-earners expenditure, female wage-earners expenditure, male salaried-earners expenditure, female salaried earners expenditure and working proprietors and family members (notional) remuneration. It is obvious from table 4.3 that the relative significance of the salary bill is equal to that of the wage bill since there are sectors where salaries account for more that 50% of the total labour bill.

<u>4.4.2. Estimation of normal wage earnings</u>. The literature of wage earnings is mainly reflected on cross-section studies dealing with the explanation of wages or earnings differentials,[8] or time series studies proporting to explain how hourly earnings are determined through a stochastic equation that incorporates both wage drift factors as well as variables which determine the negotiated wage rates.[9] An alternative view proposed by GCN is to treat the earnings variable as derivable from the wage rate and hours variables, ie. to consider the movement in earnings as the reflection of joint movements in wage rates and average hours worked.

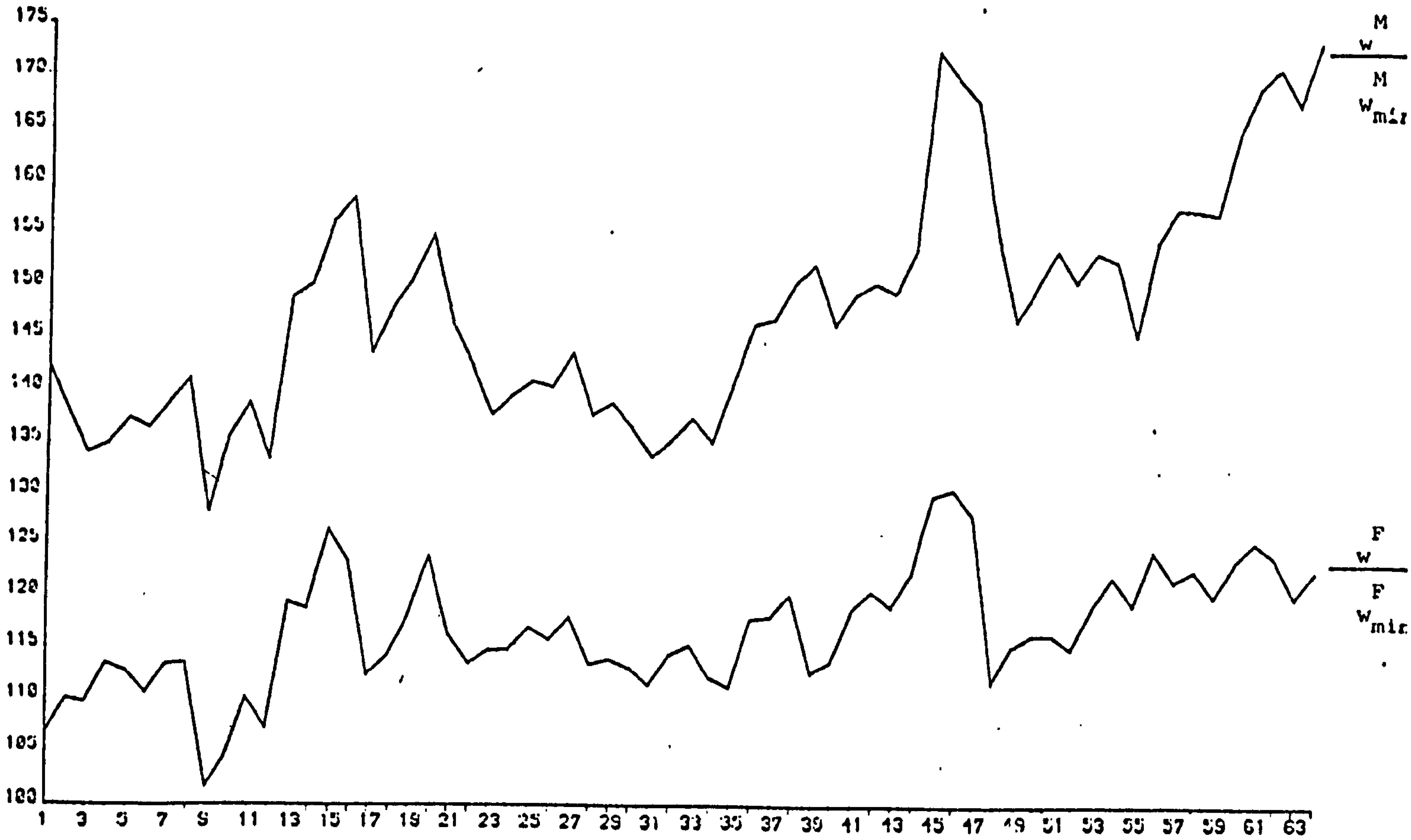
Table 4.3 Shares of labour expenditure on (1) Male Wage Earners (WM), (2) Female Wage Earners (WF) (3) Male Salaried Employees (SM) (4) Female Salaried Employees (SF) (5) Working proprietors and family members (EMP) Two digit sectors, Greek manufacturing, mean values 1963_{i}-1977_{iv}

Sector	WM%	WF%	SM%	SF%	EMP%
TOT	0.4430	0.1732	0.2910	0.0432	0.0496
20	0.3785	0.1808	0.3306	0.0531	0.0570
21	0.3416	0.0860	0.5001	0.0414	0.0309
22	0.3554	0.3825	0.2263	0.0232	0.0125
23	0.3026	0.4278	0.1959	0.0393	0.0344
24	0.3253	0.4309	0.0876	0.0529	0.1012
25	0.5912	0.1104	0.1726	0.0196	0.1062
26	0.6850	0.0391	0.1276	0.0440	0.1044
27	0.4504	0.1713	0.3116	0.0371	0.0296
28	0.4545	0.0816	0.3562	0.0691	0.0387
29	0.5950	0.1305	0.1154	0.0224	0.1368
30	0.4395	0.1851	0.2791	0.0524	0.0439
31	0.3399	0.0904	0.4107	0.1369	0.0221
32	0.2016	0.0039	0.7205	0.0671	0.0072
33	0.5363	0.0732	0.2963	0.0307	0.0635
34	0.6075	0.0049	0.3648	0.0209	0.0019
35	0.5843	0.1013	0.2214	0.0363	0.0566
36	0.6651	0.0089	0.2185	0.0270	0.0805
37	0.4516	0.1041	0.3530	0.0625	0.0288
38	0.6140	0.0050	0.3314	0.0226	0.0270
39	0.4545	0.1924	0.1815	0.0552	0.1163

equal to standard hours, then the earnings equation would become an identity equalling the product of hourly wage rate and the number of hours worked. In dealing with a non-homogenous aggregate however, one has to allow for the changing distribution in the age, sex and skills composition of workers and mainly for the effect of wage-drift. Accounting for these factors the earnings equation would still very much reflect the joint behaviour of wage rates and average hours per man.

Using as the dependent variable average weekly earnings (AWE_t), CGN assume that the main determining factors of AWE_t are the basic hourly wage rates (BHR_t), the number of hours worked (H_t) and the size of the overtime premium. In addition there are other factors affecting average weekly earnings, notably wage drift. The tendency of wage earnings to exceed wage rates gives rise to the earnings drift which is measured as the difference between wage earnings and wage rates. The difference mainly consists of overtime earnings and special bonuses (fringe benefits) which are provided by firms to workers in excess of the general agreements, national, sectoral or plant which provide the settlement for wage rates for various classes of workers. In the Greek industry the earnings drift constitutes an important part of total pay deals, particularly with reference to male manual workers. Unfortunately data on the frequency distribution of earnings and workers are non-existent and consequently we don't know how many workers are paid the minimum wage. Some tentative conclusions however can be drawn from figure 4.3, where we compare the average actual earnings of male and female manual workers to their respective minimum wages (W^M/W^M_{min} and W^F/W^F_{min} respectively). It is clear that W^F/W^F_{min} moves closer to the horizontal axis than W^M/W^M_{min} and the average values of these ratios for the period examined are 1.480 for males compared to 1.168 for females. This does not constitute of course solid evidence that female manuals are paid the minimum wage,

Figure 4.3: Minimum ahd actual wages for male and female mannal workers, Grek mannfactusihg sector (TOT)



but it shows that a comparatively larger number of women are paid the minimum wage and occupied in unskilled jobs than men.[10]

Modelling their hypothesis CGN assume first that (contrary to reality) overtime and standard hours are all paid at the same rate and that there are no other payments apart from the nationally negotiated minima. The earnings relationship can be formally expressed in (4.5)

$$(4.5) \qquad AWE_t = BHR_t^{b_1} \; H_t^{b_2} \; e^u$$

Modification of the above hypothesis in order to allow for the existence of an overtime premium and for payments in excess of basic rates, requires a coefficient on overtime hours $(H_t - HS_t)$ that will represent the overtime premium. This is expressed in (4.5)'

$$(4.5)' \qquad AWE_t = BHR_t^{\,b_1} \, [HS_t + \; b_4 . (H_t - HS_t)]^{b_2} \; e^u$$

Overtime earnings however are only a part of earnings drift. Fringe benefits and extra bonuses are primarily determined by productivity effects and therefore a second modification is required to allow for earnings drift in the form of a time trend. Equation (4.5)' therefore becomes

$$(4.6) \qquad AWE_t = e^{b_0 + b_1 t} \; BHR_t^{\,b_2} \, [HS_t + b_4 \; (H_t - HS_t)]^{b_3} \; e^u$$

The expected signs of the coefficients b_1, b_2, b_3, b_4 are all positive. Moreover the elasticities of basic hourly rates (b_2) and actual hours, measured in standard hour equivalent units (b_3) are expected to have a value of unity. In practice however b_2 is likely to be less than one since (a) basic hourly rates is an index of minimum rates of hourly pay and not actual hourly pay and (b) it is quite possible that the basic hourly rates index may contain an amount of gains in earnings made in some previous periods and consolidated in BHR. The coefficient b_3 represents the proportional impact of actual hours, measured in standard hour equivalent units, on average weekly earnings. Yet again, in practice there are grounds for expecting b_3 to have a value less than unity, the most important reason being that a proportion of earnings takes the form of supplements (fringe benefits and extra bonuses) that are insensitive to changes in hours. Finally b_4 represents the overtime premium so that $HS_t + b_4\ (H_t - HS_t)$ measures actual hours in terms of standard hour equivalent units.

Note that equation (4.6) becomes an identity if $b_0 = b_1 = 0$, actual hours are equal to standard hours $(H_t = HS_t)$ and $b_2 = b_3 = 1$, since in that case $AWE_t = BHR_t * HS_t$

By taking logs of equation (4.6) we have

$$(4.7) \quad \ln AWE_t = b_0 + b_1 t + b_2 \ln BHR_t + b_3 \ln[HS_t + b_4\ (H_t - HS_t)] + u_t$$

Equation (4.7) is non-linear in the parameters to be estimated (b_4). However as it will be seen below this parameter will not be estimated but instead its values will be imposed. Decomposing equation (4.7) into two separate equations for male and female manual workers we have

$$(4.8.1) \quad \ln AWEM_t = \pi_0 + \pi_1 t + \pi_2 \ln BHRM_t + \pi_3 \ln[HS_t + \pi_4\ (HM_t - HS_t)] + u_t$$

$$(4.8.2) \quad \ln AWEF_t = \pi_0 + \pi_1 t + \pi_2 \ln BHRF_t + \pi_3 \ln[HS_t + \pi_4\ (HF_t - HS_t)] + u_t$$

where $u_t \sim NID\ (0, \sigma^2 u)$

AWEM = average weekly earnings of male wage earners

AWEF = average weekly earnings of female wage earners

BHRM = basic hourly rate of male wage earners

BHRF = basic hourly rates of female wage earners

The major objection in CGN's specification of the earnings equation in the form of (4.8.1) and (4.8.2) is the treatment of the earnings drift which is proxied by a time trend. Implicitly models (4.8) consider only those manual workers paid according to time. Although precise figures are not available it is fairly reasonable to assume that throughout the period under study a significant proportion of manual workers in Greek manufacturing were paid - to some extent at least-according to results. Had the necessary information been available, then a model along the lines proposed by O. Ashenfelter and J. Pencavel (1974) would probably be the best choice. Two implications of this model are of relevance here: (a) that the overtime variable should be connected only to time-rate workers and (b) an excess demand variable would probably be required to capture the effects of fluctuations in demand on workers paid by results. Nonetheless in the absence of such information we should at least approximate the earnings drift variable adequately. Apart from the structural factors affecting drift such as changes in the structure of employment (in the sense of changes in the age-sex and skills mix) and which of course cannot be measured, other factors such as bonuses, merit payments etc, and also payments according to results can be regarded as being a function of productivity. Furthermore and following H. Lydall (1958) and H.A. Turner (1960) we will assume that drift lies behind productivity. In firms with a high proportion of piece workers an increase in output leads to an increase in their earnings and hence to an increase in the earnings drift. In such firms the earnings of time workers are tied to those of piece workers and so time workers earnings rise but only after a lag. G.W. Smith (1982) has incorporated the above points in modelling drift as a function of productivity as in (4.9)

$$(4.9)\qquad AWE_t = e^{b_0} \left(\frac{Q_t}{LW_t \cdot H_t}\right)_{t-i}^{b_{1i}} BHR_t^{b_2} \left[HS_t + b_4 (H_t - HS_t)\right]^{b_3} e^{u}$$

where LW is employment of manual workers

Taking logarithms on (4.9) and constraining the lags on the productivity variable up to year, equation (4.9) becomes

$$(4.10)\qquad \ln AWE_t = b_0 + \sum_{i=0}^{3} b_{1i} \ln \left(\frac{Q_t}{LW_t \cdot H_t}\right)_{t-i} + b_2 \ln BHR_t + b_3 \ln[HS_t + b_4 (H_t - HS_t)] + u_t$$

Decomposing equation (4.10) into two separate equations for male and female manual workers we have

$$(4.11.1)\qquad \ln AWEM_t = \pi_0 + \sum_{i=0}^{3} \pi_{1i} \ln \left(\frac{Q_t}{LWM_t \cdot HM_t}\right)_{t-i} + \pi_2 \ln BHRM_t + \pi_3 \ln[HS_t + \pi_4 (HM_t - HS_t)] + u_t$$

$$(4.11.2)\qquad \ln AWEF_t = \pi_0 + \sum_{i=0}^{3} \pi_{1i} \ln \left(\frac{Q_t}{LWF_t \cdot HF_t}\right)_{t-i} + \pi_2 \ln BHRF_t + \pi_3 \ln[HS_t + \pi_4 (HF_t - HS_t)] + u_t$$

Equations (4.8) and (4.11) are the basis for the estimation of average weekly earnings. The procedure followed is to assume drift to be a function of productivity (equations (4.11)). In cases where the productivity variables are found to be insignificant the time trend equations will be tried (4.7). The generation of "corrected" quarterly series for average weekly earnings is described in Appendix 3. Data on minimum wages are published in the Government Gazzette after the completion of every pay round that usually takes place once a year and are obtained by T. Katsanevas (1983) and Confederation of Greek Industries (1974).

The estimation of the overtime premium (π_4) is faced with a number of difficulties. An obvious possibility is to constrain π_4 to equal the statutory overtime rate which is 1.5 times the regular hourly rate.[11] However it is possible that π_4 may take values higher or lower than 1.5. CGN as well as H.M. Pesaran (1973) estimate equations (4.8) for all possible values of π_4 ranging on a grid-from 1 to 2 and choose that value that maximizes the likelihood function. A similar procedure is followed here. With regard to the minimum and maximum values of the grid on the overtime premium we used information provided by Labour Statistics on regular hours and regular weekly earnings and overtime hours and overtime weekly earnings for male and female manual workers that was published occasionally for a number of quarters. (17 observations in all; information was published for approximately one quarter per year of the period under examination). Overtime premium was calculated as the ratio of regular hourly earnings (equal to the ratio of regular weekly earnings over regular hours) to overtime hourly earnings (equal to the ratio of overtime weekly earnings over overtime hours). By obtaining the mean and standard deviation on the series of the overtime premium it is possible to construct a 95% confidence interval around the mean. This interval determines the minimum and maximum values of the grid on π_4 . These values together with the means for male and female overtime premia are given in table 4.4. The grid on overtime premium was constructed by dividing the interval into 17 equidistant observations.

The procedure for the estimation of equations (4.11) is as follows: A maximum lag of 4 (inclusive of the current quarter) was imposed on the productivity variables and the equations were estimated for all 17 values of π_4. The value of π_4 that maximized the likelihood function was chosen and equations were re-estimated by dropping all insignificant lags on the productivity variables and constraining the value of π_4

Table 4.4 Minimum, maximum and mean values of overtime premium for male and female manual workers two digit SIC sectors, Greek manufacturing

	Males			Females		
Sector	minimum	mean	maximum	minimum	mean	maximum
TOT	1.5627	1.7119	1.8611	1.3943	1.5409	1.6875
20	1.1012	1.4438	1.7864	1.2007	1.4269	1.6531
21	1.3429	1.6187	1.8945	1.2307	1.6031	1.9755
22	1.6393	1.9331	2.2269	1.4133	1.7171	2.0209
23	1.3301	1.6291	1.9281	1.2132	1.5468	1.8804
24	0.9569	1.4849	2.0129	0.9569	1.4403	1.9071
25	1.1870	1.6410	2.0950	0.9579	1.6533	2.3487
26	1.0752	1.7662	2.4572	0.8325	1.6255	2.4185
27	1.0557	1.5539	2.0521	0.8850	1.5946	2.3042
28	1.1723	1.5373	1.9023	1.2948	1.6808	2.0668
29	1.4694	1.8870	2.3046	0.9677	1.8559	2.7441
30	1.1051	1.4837	1.8623	0.9287	1.5129	2.0971
31	1.2569	1.5165	1.7762	1.0840	1.5540	2.0240
32	1.4044	1.6998	1.9952	1.0085	1.7423	2.4761
33	1.3132	1.6620	2.0108	1.2207	1.6512	2.0817
34	1.1979	1.4845	1.7711	1.1143	1.7071	2.2999
35	1.4353	1.6975	1.9597	1.2158	1.5780	1.9402
36	1.3944	1.7686	2.1428	1.0041	1.5797	2.1553
37	1.0837	1.6323	2.1809	1.1550	1.5242	1.8934
38	1.2249	1.7635	2.3021	1.1142	1.4566	1.7990
39	0.5925	2.2393	3.8861	1.0372	1.7568	2.4744

to the one that was found to maximize the likelihood function. The same procedure was repeated in the case of equations (4.8).

Estimation of equations (4.8) and (4.11) indicated the presence of first order autocorrelation in the rediduals, possibly due to the missing lagged dependent variable. Before we proceed to the discussion of the results of the wage-earnings variable a small digression on the treatment of autocorrelation is required.

4.4.3. The treatment of first-order autocorrelation.

In cases where estimation of models (4.8) indicates the presence of autocorrelation it is interesting to establish whether residual autocorrelation exists or whether the dynamic structure of the model is mispecified. If the latter proves to be the case, then the purpose of models (4.8) and (4.11) which is to generate within sample predictions of earnings if clearly not served since it requires a respecification of the equations. If on the other hand the former is true, then a method of estimation that takes into account the order of autocorrelation present is sufficient to resolve the problem. Following the D.F. Hendry (1974) consider an equation of the form

(4.12) $$Y_t = \beta' Z_t + u_t$$

and assume autocorrelation in the errors. Further assume that the autoregressive process generating u_t is of the first order, ie.

(4.13) $$u_t = \rho_1 u_{t-1} + v_t \qquad v_t \sim NID\ (0, 6^2 v)$$

where v_t is a white noise process. Transforming (4.12) to eliminate (4.13) yields (4.14), which is termed the restricted transformed equation (RTE)

(4.14) (RTE) $y_t = \rho_1 y_{t-1} - \rho_1 \beta' Z_{t-1} + \beta' Z_t + v_t$

An alternative possibility is that equation (4.12) has a mispecified dynamic structure, with autocorrelation reflecting omitted variables and the correct relationship is one between y_t and y_{t-1}, Z_{t-1}, Z_t in the form of (4.15) which is the unrestricted transformed equation (UTE)

(4.15) (UTE) $y_t = \alpha_1 y_{t-1} + \alpha_2 Z_{t-1} + \alpha_3 Z_t + v_t$

Equations (4.12) and (4.15) are estimated by ordinary least squares, while equation (4.14) by autoregressive least squares. It is possible to discriminate between the three alternatives by constructing likelihood ratio tests; for example if by SSR_1, SSR_2, SSR_3, we denote the residual sums of squares of equations (4.12)(4.14) and (4.15) respectively, then the significance of the autoregressive coefficient in (4.14) can be tested as

(4.16) $T \log \left(\frac{SSR_1}{SSR_3}\right) \sim x^2(1)$

(or by the value of the t-statistic on the autoregressive coefficient). Furthermore the validity of the autoregressive restriction in (4.14) relative to (4.15) can be tested as

(4.17) $T \log \left(\frac{SSR_3}{SSR_2}\right) \sim x^2(n)$

where n is the number of restrictions imposed on (4.15) to obtain (4.14). If the value of (4.17) is less than the critical value on $x^2(n)$ then we can safely not reject the hypothesis that autocorrelation (of the first order) in the residuals is present and therefore a method that takes that into account ("corrects" for) such an autoregressive least squares estimation is required.

The above analysis is based on the assumption that autocorrelation is of the first order. However, it can be easily extended to higher orders as well. Given that the residuals are autocorrelated, an interesting test would be to examine whether autocorrelation in the residuals is of the first order, or whether there is autocorrelation of a higher (than first) order. Since we are using quarterly data it is quite possible that autocorrelation of up to 4th order is present.[12] The test of discriminating between first and up to fourth autocorrelation is based on the Langrange multiplier principle.[13] The test will be briefly described under the general case when an autoregressive process of order p is to be tested against a $(p+r)^{th}$ order autoregression.

Assume that the model to be estimated is (4.18)

$$(4.18) \qquad y_t = \sum_{i=1}^{k} x_{ti} \beta_i + u_t$$

where x_{ti} include lagged values of y_t and u_t are generated by a p^{th} order autoregressive scheme of the form.

$$(4.19) \qquad u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \dots + \rho_p u_{t-p} + \varepsilon_t \qquad \varepsilon_t \sim NID(0, \sigma^2_\varepsilon)$$

If the model consisting of (4.18) and (4.19), is estimated by some appropriate autoregressive least squares method to obtain estimates of β_i (i=1...K) and ρ_i (i=1...p) and the associated sets of residuals

$$(4.20) \qquad \hat{u}_t = y_t - \sum_{i=1}^{k} x_{ti} \hat{\beta}_i \text{ and}$$

$$(4.21) \qquad \hat{\varepsilon}_t = \hat{u}_t - \hat{\rho}_1 \hat{u}_{t-1} - \dots \hat{\rho}_p u_{t-p} \quad ,$$

then the Langrange multiplier alternative that the u_t are generated by a $(p+r)^{th}$ order autoregression can be calculated as the product of the sample size and R^2 from the OLS estimation of

$$(4.22) \qquad \hat{\varepsilon}_t = \sum_{i=1}^{k} x_{ti}^* \gamma_i + \sum_{i=1}^{p} \hat{u}_{t-i} \rho_i + \sum_{i=1}^{\tau} \hat{\varepsilon}_{t-i} \alpha_i + u_t$$

where $\ddot{X}_{ti}^*$ is the estimated autoregressive transform of X_{ti}, ie

$$(4.23) \qquad X_{ti}^* = X_{ti} - \hat{\rho}_1 X_{t-1,i} - \hat{\rho}_2 X_{t-2,i} - \cdots \hat{\rho}_p X_{t-p,i}$$

The sample value of the test-stastic should be compared to the selected critical value of the $x^2(\tau)$ distribution with significantly large values leading to the rejection of the specification of the error autocorrelation of model (4.19). This test-stastic is denoted by $Zq(3)$ in tables (4.5),(4.6) presenting the results of the estimation of equations (4.8) and (4.11) for males and females respectively. It is apparent that in tests conducted in the rest of this chapter p is set equal to one (first order autoregressive process) and τ is set equal to three, so that $p+\tau$, follows an up to 4 autoregressive process. Note that the $Zq(3)$ statistic has 3 degrees of freedom and not 4 as the $Z_1(4)$ stastic of chapter 3 (and 5) since the test conducted here is between first and (up to) 4th order autoregressive process.

The first part of tables (4.5) and (4.6) presents the coefficients of the parameters of equations (4.8) and (4.11) for males and females respectively, while the second part a number of summary staticts. The results on the earnings equations are in general very satisfactory. The productivity variable was included in 19 sectors for male wage earnings and 9 sectors for female wage earnings. In most of these cases the productivity terms reached one quarter lag (current quarter) particularly for female wage earnings with the exception of sector 22. The lag coefficients were always positively signed (with the exception of π_{11} and π_{13} for sector TOT, males) and their sums were (see $\sum\pi_{1i}$ in part 2 of the tables) between 0.2 and o.4 for male manuals and

Table 4.5 Equations for earnings, male manual workers

Part 1 Individual coefficients

Sector	Π_0	Π_1	Π_{10}	Π_{11}	Π_{12}	Π_{13}	Π_2	Π_3	Π_4	ρ
TOT	-3.094		0.2914	-0.1530	0.2216	-0.1583	0.4171	0.5958	1.7119	0.3869
	(1.794)		(3.275)	(1.713)	(2.464)	(1.796)	(4.294)	(5.980)		(5.096)
20	1.106		0.0761				0.9730	0.6802	1.4438	0.6192
	(1.324)		(2.252)				(24.15)	(5.751)		(5.385)
21	-0.823		0.3824				0.8015	0.6144	1.6187	0.7013
	(0.941)		(4.517)				(15.41)	(5.899)		(7.312)
22	3.579	0.0791					0.3647	0.4980	1.7495	0.9439
	(9.040)	(3.483)					(2.270)	(9.643)		(13.89)
23	-0.442		0.2433	0.1008			0.9092	0.5527	1.6291	0.4449
	(0.510)		(3.341)	(1.468)			(22.58)	(6.564)		(3.601)
24	-0.557		0.3985				0.7382	0.5884	1.4849	0.6301
	(0.871)		(5.889)				(11.29)	(7.441)		(6.027)
25	-0.0489		0.1387	0.0632	0.1303		0.8835	0.5264	1.6410	0.6151
	(0.098)		(3.088)	(1.444)	(3.055)		(19.79)	(6.165)		(5.668)
26	-0.0538		0.1947	0.1263			0.8978	0.7051	1.5071	0.3595
	(0.822)		(2.997)	(1.943)			(22.87)	(6.681)		(2.730)
27	2.999						1.050	0.3223	1.5539	0.6048
	(7.187)						(31.18)	(3.208)		(5.759)
28	1.520		0.1971				0.8751	0.5082	1.5373	0.7594
	(1.475)		(2.012)				(14.09)	(3.274)		(8.138)
29	1.006		0.2774				0.8355	0.3973	1.6260	0.5741
	(1.826)		(5.214)				(20.80)	(3.839		(5.068)
30	1.465		0.1453	0.0999			0.9120	0.2976	1.4837	0.3375
	(2.326)		(3.166)	(2.142)			(21.38)	(2.214)		(2.618)
31	0.184		0.1875				0.8500	0.7991	1.6139	0.7099
	(0.327)		(7.487)				(12.52)	(9.894)		(7.317)
32	2.420						0.9352	0.6038	1.6998	0.5330
	(4.763)						(22.62)	(4.865)		(4.727)
33	3.903	0.0974					0.2392	0.4974	1.444	0.9689
	(9.043)	(5.390)					(2.062)	(5.019)		(40.32)
34	-1.341		0.3501				0.7999	0.9166	1.4845	0.8948
	(1.894)		(6.374)				(8.024)	(7.811)		(16.32)
35	0.595		0.1720	0.1267	0.1150		0.9380	0.3739	1.6975	0.6523
	(0.740)		(2.720)	(2.375)	(2.261)		(17.30)	(3.588)		(6.009)
36	0.637		0.2097				0.9471	0.5659	1.8154	0.5414
	(0.798)		(2.410)				(17.88)	(6.048)		(4.771)
37	0.308		0.2209				0.9472	0.5958	1.6323	0.7642
	(0.332)		(2.844)				(15.28)	(4.318)		(8.645)
38	-0.959		0.4062				0.9629	0.6724	1.7635	0.7473
	(0.709)		(2.670)				(12.66)	(5.263)		(8.599)
39	1.299		0.2380	0.1226			0.7327	0.2234	2.2393	0.6506
	(2.747)		(4.945)	(2.465)			(11.43)	(5.101)		(6.118)

Table 4.5 Equations for earnings, male manual workers

Part 2 Test statistics

Sector	SE	$\bar{R}^2$	$\Sigma\Pi_{1i}(t)$	$\Pi_2-1_{(t)}$	$\Pi_3-1_{(t)}$	$z_{8(1)}$	$z_{9(3)}$	$z_{5(11)}$
TOT	0.03133	0.9358	0.2017 (3.865)	(4.162)	(6.001)	0.996 (3)	3.410	1.857
20	0.05187	0.9803	0.0761 (2.252)	(0.670)	(2.704)	4.385 (3)	3.038	0.049
21	0.05296	0.9777	0.3824 (4.517)	(3.815)	(3.702)	0.225 (3)	7.702	1.220
22	0.04717	0.9695		(3.955)	(9.721)	9.012 (3)	2.385	0.352
23	0.03779	0.9888	0.3441 (4.065)	(2.53)	(5.311)	1.448 (3)	1.752	1.592
24	0.04196	0.9864	0.3985 (5.889)	(4.003)	(5.205)	0.914 (3)	0.824	1.085
25	0.03593	0.9893	0.3321 (5.013)	(2.611)	(5.546)	0.056 (3)	2.189	0.200
26	0.04760	0.9830	0.3211 (3.772)	(3.399)	(2.796)	1.705 (3)	0.575	0.108
27	0.05444	0.9765		(1.490)	(6.745)	10.03 (2)	2.151	1.549
28	0.05459	0.9784	0.1971 (2.012)	(2.012)	(3.168)	0.960 (3)	1.406	0.946
29	0.04440	0.9893	0.2774 (5.214)	(4.094)	(5.285)	6.135 (3)	3.258	9.354
30	0.04746	0.9845	0.2453 (4.296)	(2.064)	(5.224)	2.323 (3)	6.522	1.622
31	0.05129	0.9789	0.1875 (3.847)	(2.209)	(2.438)	9.545 (3)	2.428	2.107
32	0.07822	0.9536		(1.568)	(3.192)	2.689 (2)	5.322	2.046
33	0.03400	0.9628		(6.558)	(5.072)	14.416 (3)	3.088	0.960
34	0.06009	0.9614	0.3501 (6.374)	(2.008)	(0.711)	4.659 (3)	0.967	1.244
35	0.03857	0.9879	0.2997 (3.322)	(1.143)	(6.008)	0.802 (3)	2.834	1.380
36	0.05161	0.9794	0.2097 (2.411)	(0.998)	(4.640)	0.281 (3)	1.862	1.553
37	0.05084	0.9770	0.2209 (2.845)	(0.851)	(2.930)	2.322 (3)	1.390	1.977
38	0.06540	0.9655	0.4062 (2.670)	(0.488)	(2.564)	0.090 (3)	3.053	1.580
39	0.04737	0.9811	0.3605 (4.980)	(3.389)	(17.73)	0.0864 (3)	3.181	0.325

Table 4.6 Equations for earnings, female manual workers

Part 1 Individual coefficients

Sector	π_0	π_1	π_{10}	π_{11}	π_{12}	π_{13}	π_2	π_3	π_4	ρ
TOT	1.304		0.1776				0.9354	0.3662	1.5409	0.6191
	(1.838)		(3.066)				(32.43)	(3.005)		(5.922)
20	1.401		0.0584				0.9994	0.5472	1.4269	0.7107
	(2.887)		(1.851)				(32.99)	(9.443)		(7.389)
21	0.9464		0.1297				0.9379	0.5502	1.6031	0.5047
	(1.240)		(2.061)				(28.82)	(6.454)		(4.283)
22	1.2379		0.0503	0.0661	0.0445		0.9738	0.4195	1.7171	0.5245
	(2.031)		(1.459)	(1.944)	(1.248)		(17.04)	(5.903)		(4.477)
23	0.9348		0.2207				0.9068	0.4559	1.5468	0.4816
	(1.544)		(4.144)				(28.42)	(3.909)		(4.073)
24	2.558						1.0209	0.3756	1.4403	0.4488
	(6.490)						(52.24)	(3.571)		(3.845)
25	0.7221	0.0385					0.7951	0.9299	1.0448	0.5905
	(2.212)	(2.900)					(7.799)	(12.11)		(5.607)
26	2.929	0.0253					0.8118	0.3892	1.6255	0.2641
	(8.335)	(2.565)					(10.57)	(4.258)		(2.032)
27	2.774	0.0365					0.8015	0.4032	1.5946	0.5187
	(6.159)	(2.773)					(7.892)	(3.541)		(4.755)
28	2.944	0.0783					0.4748	0.5119	1.6808	0.9227
	(12.46)	(4.787)					(4.457)	(10.53)		(20.16)
29	3.084	0.0352					0.7490	0.3487	1.8559	0.2874
	(10.57)	(3.750)					(10.33)	(4.735)		(2.242)
30	3.369						0.9660	0.2140	1.5129	0.2885
	(10.77)						(55.80)	(2.619)		(2.286)
31	2.831	0.0378					0.7196	0.4698	1.554	0.6084
	(6.38)	(2.675)					(6.674)	(4.154)		(5.744)
32	1.290						0.8951	0.8347	1.1003	0.5164
	(1.934)						(19.42)	(5.155)		(4.582)
33	4.426	0.0638					0.5714	0.0738	1.6512	0.9019
	(11.99)	(3.107)					(4.115)	(0.837)		(17.38)
34	2.657						1.0741	0.3690	1.7071	0.7007
	(11.38)						(18.56)	(6.945)		(7.585)
35	2.646						1.0319	0.3517	1.5780	0.1983
	(4.336)						(59.32)	(2.104)		(1.507)
36	1.867		0.04211				0.9933	0.4904	2.083	0.630
	(7.019)		(2.399)				(27.12)	(10.60)		(5.849)
37	3.284	0.0340					0.8292	0.2961	1.5242	0.3181
	(7.905)	(4.111)					(12.84)	(2.541)		(2.535)
38	−0.678		0.2096				0.9498	0.6795	1.4566	0.6884
	(0.712)		(3.279)				(23.01)	(6.297)		(7.147)
39	1.442		0.0931				1.0013	0.4516	2.1156	0.7503
	(2.823)		(1.913)				(23.40)	(7.422)		(9.615)

Table 4.6 Equations for earnings, female manual workers

Part 2 Test statistics

Sector	SE	$\bar{R}^2$	$\Sigma\pi_{11}$	Π_2-1(t)	Π_3-1(t)	$Z_{8(1)}$	$Z_{9(3)}$	$Z_{5(11)}$
TOT	0.03364	0.9899	0.19765 (3.066)	(2.239)	(5.199)	0.346 (3)	6.442	0.475
20	0.04108	0.9839	0.05838 (1.551)	(0.0214)	(7.183)	0.802 (3)	0.882	1.418
21	0.00623	0.9712	0.12968 (2.061)	(1.908)	(5.350)	0.522 (3)	3.395	0.750
22	0.06998	0.9637	0.16091 (1.906)	(0.460)	(8.167)	2.807 (3)	2.619	1.438
23	0.03499	0.9905	0.22075 (4.144)	(2.920)	(4.655)	0.106 (3)	0.399	1.057
24	0.04779	0.9830		(1.072)	(5.937)	9.207 (2)	2.244	2.006
25	0.05621	0.9757		(2.010)	(0.914)	4.262 (3)	1.539	18.03
26	0.06541	0.9758		(2.450)	(6.682)	12.11 (3)	2.205	2.138
27	0.06228	0.9714		(1.955)	(5.243)	3.324 (3)	3.310	1.272
28	0.03743	0.9741		(4.930)	(10.04)	1.962 (3)	3.755	0.322
29	0.06011	0.9798		(3.462)	(8.845)	0.745 (3)	0.424	0.423
30	0.05248	0.9825		(1.961)	(9.622)	3.743 (2)	7.794	2.090
31	0.05769	0.9702		(2.601)	(4.689)	3.548 (3)	4.897	1.158
32	0.09449	0.9246		(2.276)	(1.021)	2.613 (2)	2.274	1.770
33	0.04963	0.9603		(3.087)	(10.50)	9.533 (3)	3.814	0.510
34	0.08540	0.9454		(1.281)	(11.88)	2.256 (2)	6.550	0.702
35	0.05983	0.9838		(1.839)	(3.879)	7.652 (2)	1.144	7.409
36	0.06129	0.9754	0.04211 (2.399)	(0.183)	(11.00)	0.337 (3)	0.021	1.795
37	0.05149	0.9854		(2.645)	(6.900)	6.220 (3)	0.428	2.209
38	0.05813	0.9722	0.20962 (3.279)	(2.970)	(2.970)	0.428 (3)	6.258	1.413
39	0.05191	0.9750	0.09307 (1.9134)	(0.029)	(7.989)	0.228 (3)	3.844	0.714

between 0.06 and 0.22 for female manuals.

The elasticity of earnings over basic wage rates (π_2) was always positive and ranged between 1.050 (SIC:27) to 0.239 (SIC:33) for males. The same coefficient for females wage earnings took significantly higher values than the corresponding coefficients for males indicating that a significant part of women across industrial sectors are more or less paid the basic rates. π_2 was insignificantly different from unity in only 7 cases for males and 9 for females, as this is indicated by the t-statistic on the π_2-1 columns of the second part of tables (4.5) and (4.6).

The values of the overtime premium π_4 were on the whole within reasonable range. Exceptions are sectors 25 ($\pi 4$= 1.0448) and 32 ($\pi 4$= 1.1003) for females and also sector 39 for females where the overtime premium is very high ($\pi 4$= 2.1156) It should be noted that in few cases we could not establish a maximum likelihood on the grid on π_4.[14] In these cases we imposed the mean value of the grid as this is given in table (4.4).

The elasticity of earnings with respect to hours worked, π_3 which is conditional on the values imposed on the overtime premium, was always positive, but significantly less than unity. In only two cases π_3 was insignificantly different from unity (see t-statistics on π_3-1 on the second part of tables (4.5) and (4.6)), ie. in sectors 25 and 32 for females.

The comparison of the unrestricted form with the restricted transformed equation is indicated by the Z8(i) statistic having a chi-square distribution with i degrees of freedom. The results strongly favour the estimation by autoregressive least squares with the following exceptions: for males SIC:22-27-31-33 and for females SIC:24-26-33-35.

Furthermore the Z9(3) statistic is the Langrange multiplier test of testing against higher than first order autocorrelation (up to fourth order) and has a chi-square distribution with 3 degrees of freedom. In none of the sectors the Z9(3) statistic took values higher than the critical value (=7.81 at the 5% significance level), indicating that the error autocorrelation of first order is a correct specification. The equations were therefore estimated by autoregressive least squares. The values of the autoregressive parameter are given in the last column of the first part of tables (4.5) and (4.6).

Finally the last column of the second part of the tables gives the values of the Z5(ij) statistic which is a Chow-test statistic with an exact F-distribution with i=4 and j degrees of freedom and tests for parameter stability.[15] For reasons of economy of space we present the values of the F-statistic without the critical values which are different for each sector due to different degrees of freedom. Indications of mispecification are observed in sectors 29 for males and sectors 25 and 35 for females.

4.4.4. The estimation of normal salary earnings.

The necessity to model salary earnings stems basically from the need to construct a measure of unit labour cost purged from all cyclical elements. Table 4.3 gives a clear picture of how an important part salary earnings are in the total labour bill, particularly in some sectors, where for various reasons explained before, there is a considerably high ratio of ATC's to manual workers. It was also mentioned that through various legal interventions the ATC workers enjoy a number of non-pecuniary benefits vis-a-vis manual workers. Furthermore an important amount of wage drift in the form of fringe benefits (most of which are not directly related to productivity) and overtime earnings is also evident in ATC workers. Labour Stastics provide information for selected quarters with regard to monthly earnings of ATC personnel classified in regular monthly earnings, overtime pay and other payments. Based on this information we present in table 4.7 the percentages of regular, overtime and other earnings on male and female ATC workers for the two-digit sectors. As can be seen from this table there is a ground for "normalising" salary bill since there is a significant cyclical element in the salary pay that has to be purged.

The main factors affecting average monthly earnings (AME_t) are the basic monthly salaries (BME_t) approximated by the minimum nationally negotiated salary rates, a factor measuring drift and a demand pressure variable to account for overtime pay. In the absence of a better choice a time trend variable was used to measure drift. A distinction however should be made concerning non-manual workers drift. Although drift for manuals is more or less related to productivity, since it is offered in the form of production bonuses, attendance bonuses etc, drift in the case of ATC's has almost always been unrelated to productivity and is less of a problem compared to manual workers drift.[16] National settlements with regard to minimum salaries, particularly during the sixties tended to reflect more closely the movement in salary earnings than the minimum wage settlements did with wage earnings, possibly because of the pressure by strongly unionized labour force in the public and banking sectors most of which are ATC workers. During the seventies however, there was a proliferation of pecuniary and non-percuniary elements offered in the total job package particularly for higher paid ATC's that significantly increased the difference between basic rates and earnings. Finally the demand pressure variable is measured by the ratio of actual to normal output. It should be repeated that the model is purely statistical in the sense that it's sole purpose is to generate within sample predictions of salary earnings. Formally the model can be written as (4.24).

Table 4.7 Average shares of "regular earnings", "overtime earnings" and "other earnings" of administrative technical and clerical personnel, male and female workers, two digit SIC sectors, Greek manufacturing

Sector	Male ATC's			Female ATC's		
	Regular %	Overtime %	Other %	Regular %	Overtime %	Other %
TOT	89.37	5.65	4.98	96.49	1.85	1.66
20	88.46	6.20	5.34	95.93	2.19	1.88
21	85.74	8.58	5.68	93.95	3.69	2.36
22	94.24	4.83	0.93	98.14	1.31	0.55
23	93.54	3.84	2.62	97.52	1.48	1.00
24	95.36	2.31	2.33	98.07	0.75	1.18
25	88.37	7.45	4.18	97.29	1.36	1.35
26	92.00	5.00	3.00	96.73	2.22	1.05
27	90.60	3.92	5.48	98.02	0.78	1.20
28	88.34	5.68	5.98	93.11	2.58	4.31
29	91.21	6.43	2.36	97.65	1.44	0.91
30	92.01	4.93	3.06	97.69	1.14	1.17
31	90.59	4.56	4.85	96.98	1.59	1.43
32	86.76	6.26	6.98	96.22	2.78	1.00
33	87.05	5.88	7.07	95.35	1.60	3.05
34	83.57	6.98	9.45	91.43	2.14	6.43
35	90.04	6.32	3.64	97.03	1.56	1.41
36	91.17	6.50	2.33	97.82	1.07	1.11
37	92.74	4.95	2.31	96.73	2.30	0.97
38	87.44	6.80	5.76	96.07	2.44	1.49
39	91.70	3.57	4.73	96.88	0.29	2.83

$$(4.24) \quad AME_t = C_0 + C_1 \; BME_t + C_2 \, t + \sum_{i=0}^{4} C_{3i} \, CU_{t-i} + u_t \qquad u_t \sim NID(0, 6^2 u)$$

Since the Langranze Multiplier test on functional form indicated a logarithmic transformation (see $Z_{21(1)}$ and $Z_{22(1)}$ in tables (4.8) and (4.9), equation (4.24) was specified in logs. Furthermore there was a separate estimation for male and female ATC's salary earnings since information is available on both male and female minimum salaries and male and female average salary earnings.[17] With these modifications equation (4.24) may be rewritten as

$$(4.25.1) \quad \ln AMEM_t = \pi_0 + \pi_1 BMEM_t + \pi_2 t + \sum_{i=0}^{4} \pi_{3i} CU_{t-i} + u_t \qquad u_t \sim NID(0, 6^2 u)$$

$$(4.25.2) \quad \ln AMEF_t = \pi_0 + \pi_1 BMEF_t + \pi_2 t + \sum_{i=0}^{4} \pi_{3i} CU_{t-i} + u_t \qquad u_t \; NID(0, 6^2 u)$$

where AMEM = average monthly earnings, salaried employees males

AMEF = average monthly earnings, salaried employees females

BMEM = basic monthly earnings, salaried employees, males

BMEF = basic monthly earnings, salaried employees, females

The results of equations (4.25) are presented in tables (4.8) and (4.9) for males and females respectively. The first part of the tables presents the estimated coefficients and the second part a number of summary statistics and diagnostic tests. The Langranze Multiplier statistics $Z_{21(1)}$ and $Z_{22(1)}$ with regard to males strongly favour the logarithmic transformation since in only two sectors (SIC:TOT,23) the $Z_{21(1)}$ and $Z_{22(1)}$ were higher that the critical value at the 5% significance level (3.84). The same pattern is also observed for female ATC's since only two sectors (SIC:35,38) had values of the Z_{21} and Z_{22} statistics higher that the critical, indicating that equations (4.25.2) are mispecified for these sectors.

Table 4.8 Equations for earnings, male ATC's

Part 1 Individual coefficients

Sector	π_0	π_1	π_2	π_{30}	π_{31}	π_{32}	π_{33}	π_{34}	ρ
TOT	0.2413	1.133		0.00302		0.00303		0.00233	0.6753
	(0.828)	(30.55)		(1.655)		(1.715)		(1.272)	(6.651)
20	3.777	0.604	0.0593		-0.00099		0.00094	0.000599	0.6751
	(5.639)	(6.382)	(6.097)		(1.898)		(1.808)	(1.686)	(6.517)
21	0.168	1.135		0.00150		0.00175			0.3552
	(0.574)	(30.59)		(1.639)		(1.891)			(2.741)
22	4.226	0.588	0.0408		0.00060		0.00035	-0.00024	0.2947
	(11.49)	(11.32)	(7.781)		(2.155)		(1.278)	(1.235)	(2.194)
23	4.746	0.494	0.0636	0.00087			0.00144		0.5658
	(13.05)	(9.613)	(12.09)	(1.276)			(2.029)		(4.693)
24	5.672	0.303	0.0979		0.00248			0.00196	0.6988
	(7.352)	(2.750)	(8.871)		(2.410)			(1.663)	(7.181)
25	5.117	0.392	0.0951	0.00410	-0.00234				0.5639
	(4.361)	(2.366)	(5.943)	(2.413)	(1.412)				(5.003)
26	5.119	0.404	0.0743	-0.00241	-0.00291				0.5071
	(5.368)	(3.154	(5.714	(1.855)	(2.306)				(4.090)
27	3.125	0.726	0.0307						0.6796
	(3.140)	(5.165)	(2.114)						(6.770)
28	4.497	0.488	0.0865	0.00234					0.3804
	(7.747)	(5.947)	(10.50)	(2.256)					(2.861)
29	4.196	0.578	0.0503		-0.00238		0.00254		0.4440
	(5.171)	(5.048)	(4.332)		(1.696)		(1.759		(3.544)
30	3.699	0.650	0.0510	0.00084	0.00125	0.00104	0.00035	0.00104	
	(7.767)	(9.656)	(7.772)	(1.603)	(2.196)	(1.823)	(1.217)	(1.990)	
31	3.296	0.727	0.0339	0.00140				-0.00114	0.3674
	(8.099)	(12.679)	(6.047	(2.225)				(1.950)	(2.750)
32	3.567	0.707	0.0216						0.5682
	(3.403)	(4.781)	(1.429)						(5.085)
33	1.067	1.030							0.7026
	(2.841)	(21.55)							(7.404)
34	6.203	0.346	0.0683	-0.00084				-0.00100	0.3569
	(7.351)	(2.902)	(5.712)	(1.832)				(1.907)	(2.758)
35	3.903	0.613	0.0526	-0.00190	0.00271				0.6881
	(5.965)	(6.635)	(5.531)	(1.801)	(2.511)				(6.653)
36	-0.210	1.175		0.00370					0.6950
	(0.399)	(17.60)		(2.087)					(7.368)
37	4.954	0.462	0.0716	-0.00129			-0.00111		0.6667
	(6.223)	(4.114)	(6.487)	(1.871)			(1.525)		(6.334)
38	3.117	0.7174	0.0516			0.00189			0.5796
	(5.033)	(8.205)	(5.789)			(2.711)			(4.937)
39	3.894	0.6153	0.0534				0.00378	-0.00275	0.4800
	(3.099)	(3.469)	(2.969)				(2.767)	(2.006)	(3.803)

Table 4.8 Equations for earnings, male ATC's

Part 2 Test statistics

Sector	SE	$\bar{R}^2$	$\Sigma\pi_{31}$	$\Pi_1-1(t)$	$Z_{8(1)}$	$Z_{9(3)}$	$Z_{5(1j)}$	$Z_{21(1)}$	$Z_{22(1)}$
TOT	0.0795	0.9927	0.00837	(3.584)	18.34 (4)	2.150	11.968	6.209	11.208
20	0.0731	0.9930	0.00055	(4.189)	5.99 (3)	0.948	1.978	4.208	3.000
21	0.2658	0.9699	0.00326	(3.639)	3.65 (3)	4.669	5.235	4.791	3.009
22	0.0820	0.9878	0.00069	(7.942)	7.52 (4)	1.232	1.578	6.109	1.006
23	0.0346	0.9766	0.00230	(9.843)	22.42 (4)	3.904	10.12	5.402	9.821
24	0.0792	0.9923	0.00443	(6.393)	3.45 (4)	0.534	0.949	13.06	2.719
25	0.1773	0.9815	0.00175	(3.677)	1.95 (3)	0.841	1.801	4.159	0.793
26	0.2084	0.9785	-0.00532	(4.653)	6.91 (3)	1.918	1.807	9.812	1.831
27	0.1880	0.9840		(1.953)	9.44 (2)	2.407	1.469	7.817	3.185
28	0.1270	0.9873	0.00234	(6.247)	4.23 (3)	0.542	1.720	5.683	2.721
29	0.2700	0.9677	0.00015	(3.579	0.32 (4)	7.114	0.198	16.00	0.076
30	0.0388	0.9928	0.00452	(5.206)			2.002	12.79	0.697
31	0.0499	0.9935	0.00026	(4.760)	1.768 (4)	3.630	1.293	9.615	3.121
32	0.3145	0.9733		(1.977)	5.97 (2)	3.280	1.632	6.735	2.991
33	0.1368	0.9884		(1.616)	10.33 (1)	3.672	0.319	5.800	3.800
34	0.1834	0.9777	-0.00184	(5.475)	0.55 (4)	5.458	1.105	11.07	1.362
35	0.0707	0.9936	0.00080	(4.192)	10.84 (3)	0.474	2.291	19.09	0.967
36	0.2724	0.9763	0.00370	(2.615)	30.18 (2)	2.308	1.122	7.019	1.864
37	0.0549	0.9950	-0.00240	(4.791)	8.35 (4)	2.642	1.957	7.163	2.912
38	0.1018	0.9909	0.00190	(3.233)	2.59 (3)	2.020	0.720	8.544	3.568
39	0.5762	0.9326	-0.00103	(2.169)	5.11 (3)	4.030	1.281	6.443	0.888

Table 4.9 Equations for earnings, Female ATC's

Part 1 Individual coefficients

Sector	Π_0	Π_1	Π_2	Π_{30}	Π_{31}	Π_{32}	Π_{33}	Π_{34}	ρ
TOT	5.139	0.4491							0.4862
	(0.879)	(8.621)							(4.874)
20	-0.0956	1.0923		0.00295		0.00138			0.7048
	(0.248)	(22.13)		(2.441)		(1.175)			(7.042)
21	1.0893	0.9538							0.7163
	(2.585)	(17.68)							(7.660)
22	3.675	0.5968	0.0422	-0.00095			-0.00120	0.00092	0.3036
	(6.183)	(6.691)	(4.436)	(1.201)			(1.671)	(1.256)	(2.269)
23	4.967	0.4798		0.00146					0.4901
	(5.049)	(4.023)		(1.436)					(5.787)
24	2.892	0.6723	0.0415	0.00113		-0.00276		0.00613	0.4102
	(5.228)	(8.446)	(4.895)	(1.843)		(2.227)		(4.892)	(3.224)
25	4.976	0.3558	0.0798	0.00109					0.6839
	(4.823)	(2.396)	(4.818)	(2.163)					(6.841)
26	0.900	0.9451	0.0187	-0.00184				0.00383	0.3342
	(1.443)	(10.50)	(1.887)	(1.623)				(3.115)	(2.563)
27	1.334	0.9352					0.00234	0.00136	0.7687
	(2.437)	(13.34)					(2.051)	(1.181)	(8.832)
28	3.791	0.5534	0.0629			-0.00236	-0.00193		0.5060
	(6.289)	(6.373)	(6.584)			(2.378)	(1.931)		(3.979)
29	5.395	0.3009	0.0738		0.00285				0.7435
	(3.862)	(2.497)	(3.204)		(1.849)				(8.253)
30	4.339	0.4808	0.0584	0.00189					0.3810
	(7.536)	(5.805)	(6.554)	(2.191)					(3.007)
31	3.359	0.6566	0.0281		-0.00193			0.00244	0.5755
	(6.062)	(8.239)	(3.194)		(2.294)			(3.399)	(5.126)
32	3.191	0.7165						0.00081	0.6273
	(6.618)	(11.59)						(1.658)	(5.962)
33	2.686	0.7386	0.0169					0.00153	0.6067
	(3.630)	(6.297)	(1.410)					(1.819)	(5.462)
34	3.870	0.5762	0.0543			0.00197			0.2889
	(3.684)	(3.805)	(3.306)			(3.056)			(2.204)
35	3.633	0.5799	0.0428	-0.00305	0.00259	0.00271	-0.00244	-0.00210	0.6001
	(5.062)	(5.616)	(3.723)	(1.957)	(1.627)	(1.679)	(1.562)	(1.353)	(5.073)
36	4.780	0.4835							0.7637
	(3.637)	(3.009)							(6.023)
37	5.751	0.2718	0.0862		-0.00162		-0.00171		0.7314
	(6.713)	(2.204)	(6.279)		(2.404)		(2.526)		(7.698)
38	4.047	0.5302	0.0515	0.00189					0.8816
	(3.334)	(3.045)	(2.396)	(1.845)					(14.321)
39	3.918	0.5090	0.0727		-0.00533	0.00335	-0.00487	0.00498	0.5168
	(3.380)	(3.049)	(3.902)		(1.894)	(1.169)	(1.707)	(1.825)	(4.273)

Table 4.9 Equations for earnings, Female ATC's

Part 2 Test statistics

Sector	SE	$\bar{R}^2$	$D\pi_{31}$	$\Pi_1-1(t)$	$z_{8(i)}$		$z_{9(3)}$	$z_{5(ij)}$	$z_{21(1)}$	$z_{22(1)}$
TOT	0.0531	0.9023		(10.58)	6.33	(1)	5.098	1.954	8.621	2.441
20	0.1550	0.9836	0.00433	(1.869)	1.565	(3)	1.050	1.559	23.108	1.209
21	0.1946	0.9816	-0.00123	(0.857)	4.411	(1)	0.947	2.051	22.130	1.476
22	0.2268	0.9684		(4.703)	7.65	(4)	1.660	2.067	9.461	1.849
23	0.1009	0.9034	0.00146	(4.360)	0.602	(2)	0.036	0.061	22.685	2.163
24	0.0359	0.9893	0.00449	(4.116)	9.45	(5)	2.342	2.237	14.600	1.957
25	0.2036	0.9764	0.00109	(4.338)	0.537	(3)	4.733	0.840	4.117	2.043
26	0.1702	0.9795	0.00198	(0.609)	4.708	(4)	2.410	1.896	8.512	3.471
27	0.2419	0.9753	0.00370	(0.923)	12.07	(2)	0.635	1.529	13.471	1.749
28	0.1163	0.9871	-0.00429	(5.142)	2.56	(2)	1.331	1.939	7.896	3.007
29	0.3410	0.9649	0.00285	(5.801)	0.156	(3)	5.907	0.578	9.108	2.204
30	0.1363	0.9829	0.00189	(6.268)	4.412	(3)	2.942	1.419	11.071	3.045
31	0.0774	0.9922	0.00051	(4.308)	8.52	(4)	5.311	1.850	10.377	3.049
32	0.3882	0.9666	0.00081	(4.585)	3.447	(3)	2.861	1.340	26.150	3.179
33	0.1533	0.9849	0.00153	(2.229)	6.421	(3)	3.518	1.800	30.185	2.585
34	0.4522	0.9484	0.00197	(2.799)	4.917	(3)	1.478	1.702	5.458	3.630
35	0.1328	0.9853	-0.00229	(4.068)	17.34	(3)	0.995	0.472	11.422	7.831
36	0.1950	0.8500		(3.214)	26.71	(1)	6.818	1.410	5.062	3.684
37	0.0929	0.9904	-0.00333	(5.906)	9.09	(4)	2.375	1.453	5.751	0.998
38	0.1548	0.9787	0.00189	(2.698)	19.56	(3)	2.319	1.323	19.612	26.733
39	0.5080	0.9446	-0.00188	(2.949)	3.609	(3)	5.927	1.554	6.289	3.637

The coefficient on basic monthly salaries was positive and well-determined throughout the sectors. However the assumption of a unitary elasticity on basic monthly rates does not hold since only one sector (SIC:33) on males and three on females (SIC:21,26,27) had t-statistics less than 1.96 (see Π_1 - 1(t) columns on part (2) of tables (4.8) and (4.9).

Drift, as proxied by the time trend seems to be an important factor since it was found positive and significant in 17 and 14 sectors for males and females respectively. On the whole drift seems to be more important for male than for female salary earnings.

The results on the coefficient of the capacity utilization variable indicate that a significant amount of the variation in average monthly salaries is accounted by variations in the demand for the product. Lags up to four were used on the CU variable and all insignificant variables were dropped. The third column of the second part of tables (4.8) and (4.9) present the sums of the significant coefficients on the CU term. For male ATC's 18 sectors indicated a significant effect of the demand pressure variable, but only 14 had the proper positive sign, while for females ATC's only 13 out of 18 sectors.

All equations with the exception of sector 30 for male ATC's were estimated by autoregressive least squares. The comparison of the unrestricted form with the restricted transformed equation on the whole indicated that error autocorrelation is generated by autocorrelation in the residuals and is not due to systematic dynamic mispecification. The Z8(i) statistic that has a chi-square distribution with i degrees of freedom presents these results. Exceptions are sectors where the value of the Z8(i) is higher than the critical, ie for male ATC's, SIC:TOT,23,27,33,35,36, while for female ATC's SIC:TOT,20,21,27,35,36,38. In these sectors autocorrelation is due to dynamic mispecification.

The Z9(3) statistic indicates that autocorrelation is properly specified to be of first order, since the value of this statistic is never higher than the critical value at the 5% significance level. Finally the Z5(ij) is a Chow F-test with i(=4), j degrees of freedom testing for post-parameter stability. Only in sectors SIC:TOT,21, 23 for male ATC's the statistic took values higher than the critical indicating mispecification of equation (4.25.1) for these sectors.

4.5. Estimation of normal employment.

The final step in the calculation of normal unit labour cost is the estimation of normal employment. Previous econometric work designed to explain variations in employment has provided some support to the view that adjustment to output changes may be singled out as the main source of short-run movements in employment. R.C. Fair's (1969) work, summarising all existing models during the sixties seems to confirm that at least with regard to manual workers, output plays the dominant role in the specification of employment functions.[18] More recently attention has been drawn to the choice of the utilization rates of inputs open to the decision maker and the possible impact of variations in the intensity of utilization of input on the behaviour of the inputs themselves.[19] The model presented here follows closely CGN and is a purely statistical model in the sense that its sole purpose is to generate within sample predictions of normal employment. Separate equations are estimated for manual workers on the one hand and ATC's on the other for each two-digit SIC sectors, further disaggregated by sex. The model estimated in log-linear and formally presented in (4.26)

$$L_t = e^{c_0 + c_1 t + c_2 t^2 + u_t} \cdot Q_{t-i}^{c_3 t-i} \cdot HN_{t-j}^{c_4 t-j} \qquad u_t \sim NID\,(0, \sigma^2 u) \tag{4.26}$$

where L_t refers to employment of male wage earners (LWM), female wage earners (LWF), employment of male salaried employees (LSM) and employment of female salaried employees (LSF) respectively.

Q_t is output

HN_t is normal hours that can be either male normal hours HMN_t or female normal hours HFN_t

Taking logs on both sides of (4.26) we have

$$(4.27) \quad \ln L_t = c_0 + c_1 t + c_2 t^2 + \sum_{i=o}^{4} c_{3t-i} \ln Q_{t-i} + c'_{4t-j} \ln HN_{t-j} + + u_t \quad u_t \sim NID\ (0, 6^2 u)$$

Output is entered as usually with a four-quarter lag. Normal hours are also included in the manual workers employment equations. It was established in section 4.2 that changes in standard hours have a significant effect on the number of hours actually worked. Therefore a reduction in standard hours is expected to raise employment irrespective of fluctuations in output. Furthermore a quadratic time trend was entered to take hold of the fact that productivity was accelerated particularly during the first half of the period under study. Expectations about the signs of the parameters of equation (4.27) are as follows

$$(4.28) \quad c_1,\ c_2 < o\ ,\ \Sigma c_{3t-i} > o\ ,\ \Sigma c_{4t-j} < o$$

Decomposing equation (4.27) into separate equations for wage-earners (males and females) and ATC's (males and females) we have

$$(4.29.1) \quad \ln LWM_t = \pi_0 + \pi_1 t + \pi_2 t^2 + \pi_2 \sum_{i=o}^{4} \pi_{3i} \ln Q_{t-i} + \sum_{i=o}^{4} \pi_{4j} \ln HMN_{t-j} + u_t$$

Table 4.10 Equations for employment, male manual workers

Part 1 Individual coefficients

Sector	Π_0	Π_1	Π_2	Π_{30}	Π_{31}	Π_{32}	Π_{33}	Π_{34}	Π_4	ρ
TOT	-2.620 (0.507)	-0.0561 (2.238)	0.00169 (1.911)	0.3618 (4.317)	0.1394 (1.908)	0.1472 (1.748)			-0.2104 (1.325)	0.7228 (7.194)
20	5.242 (1.049)	0.0336 (1.961)	-0.00328 (3.049)	0.2086 (2.486)	0.0649 (2.103)	0.2159 (2.526)			-1.7191 (2.029)	0.2237 (1.542)
21	1.348 (0.588)	0.0626 (2.125)	-0.00205 (1.482)	0.3042 (2.608)						0.5734 (4.918)
22	4.462 (4.132)	-0.0897 (2.775)	0.00210 (1.114)	0.2017 (3.962)						0.4476 (3.513)
23	-12.103 (3.221)	-0.0734 (4.247)	0.00250 (2.535)	0.2694 (3.400)	0.1587 (2.017)	0.2058 (2.391)	0.2216 (2.560)		-0.8247 (1.576)	0.6484 (5.277)
24	-4.499 (0.865)	0.0602 (1.277)	-0.00806 (3.242)	0.8205 (3.699)					-1.016 (2.049)	0.6562 (6.148)
25	1.568 (2.007)			0.1420 (1.614)						0.6366 (5.988)
26	3.494 (1.187)			0.3636 (3.397)					-1.584 (1.912)	0.6210 (5.520)
27	8.672 (5.420)			0.1367 (3.468)					-0.8741 (3.012)	0.6170 (5.147)
28	-7.954 (1.404)	-0.0664 (2.154)	0.0025 (1.948)	0.2497 (1.596)	0.2725 (1.725)				-1.5790 (1.466)	0.5495 (4.506)
29	14.393 (4.219)	-0.0602 (2.724)	0.0034 (2.553)	0.3267 (1.836)						0.3506 (2.583)
30	9.631 (3.000)			0.1697 (2.797)	0.1309 (2.254)				-0.954 (2.667)	0.3825 (2.447)
31	1.602 (0.451)	-0.0849 (2.147)	0.00295 (1.931)	0.3420 (1.941)						0.6827 (6.342)
32	0.9797 (0.515)			0.2619 (2.841)						0.7767 (9.014)
33	7.419 (1.211)	-0.0638 (2.419)	0.00183 (1.995)	0.3899 (2.877)	0.1987 (1.540)	0.0941 (1.709)	-0.3167 (2.523)	0.3534 (2.654)	-1.175 (1.921)	0.4352 (3.277)
34	1.593 (0.489)			0.4353 (13.77)					-0.624 (1.837)	0.5908 (4.988)
35	4.410 (2.506)			0.0545 (1.826)	0.0462 (1.855)	0.1304 (2.405)				0.8853 (14.89)
36	4.570 (4.756)			0.2119 (4.507)						0.6642 (6.210)
37	-0.8392 (0.335)	-0.0539 (2.140)	0.0019 (1.688)	0.3864 (3.746)	0.2101 (2.083)				-0.7130 (2.015)	
38	-8.364 (2.375)			0.3409 (4.937)	0.1120 (1.581)	0.2035 (2.967)			-1.151 (1.462)	0.7149 (6.807)
39	-16.92 (2.765)	-0.0660 (1.356)	0.0039 (2.306)	0.1932 (3.040)	0.1597 (2.053)	0.0505 (1.399)	0.1564 (1.702)	0.1825 (2.743)	-0.4013 (1.286)	0.4895 (3.524)

Table 4.10 Equations for employment, male manual workers

Part 2 Test statistics

Sector	SE	$\bar{R}^2$	$\Sigma\pi_{3i}$	λ	$z_{8(1)}$	$z_{9(3)}$	$z_{5(1)}$	Equations for hours HN_t
TOT	0.0246	0.9986	0.6484	0.6690	1.816 (4)	5.214	1.249	$HN_t = 13.941 + 0.648HS_t$
20	0.0552	0.9548	0.4894	1.0149	1.154 (4)	2.302	1.981	$HN_t = 8.606-0.166t+0.785\ HS_t$
21	0.0617	0.9736	0.3042		2.433 (3)	1.963	0.569	
22	0.1028	0.9475	0.2017		0.988 (3)	1.047	1.797	
23	0.0303	0.9967	0.8555	1.444	7.802 (4)	2.522	12.421	$HN_t = 1.373+0.932\ HS_t$
24	0.0767	0.9736	0.8263		0.198 (3)	4.931	1.187	$HN_t = 18.345+0.495t+1.188\ HS_t$
25	0.0507	0.9879	0.3453	0.5888	2.781 (1)	2.435	1.24	
26	0.0546	0.9859	0.5557	0.3457	3.898 (2)	1.180	1.477	$HN_t = 0.851+0.238t+0.8011\ HS_t$
27	0.0340	0.9937	0.1367		17.87 (2)	0.244	2.210	$HN_t = -17.87+1.372\ HS_t$
28	0.0415	0.9910	0.5222	0.5218	2.697 (4)	6.800	2.411	$HN_t = 14.135+0.219t+0.612\ HS_t$
29	0.0821	0.9496	0.3267		2.172 (3)	3.706	1.248	
30	0.0617	0.9725	0.3006	0.4355	0.504 (2)	3.815	1.751	$HN_t = 5.820+0.7957\ HS_t$
31	0.0534	0.9879	0.3420		4.542 (2)	2.572	9.728	
32	0.1102	0.9120	0.2619		3.030 (1)	1.849	0.479	
33	0.0358	0.9935	0.7194		0.592 (4)	4.101	1.686	$HN_t = 23.617+0.4313\ HS_t$
34	0.0673	0.9694	0.4353		3.348 (2)	2.154	1.590	$HN_t = -3.63+1.114\ HS_t$
35	0.0428	0.9909	0.2311	1.3284	0.114 (1)	4.274	1.859	
36	0.0499	0.9903	0.2119		1.921 (1)	0.734	1.732	
37	0.0573	0.9311	0.5965	0.3522				$HN_t = 1.807+0.8876\ HS_t$
38	0.0423	0.9935	0.6564	0.7907	5.954 (2)	5.463	1.699	$HN_t = 9.931+0.752\ HS_t$
39	0.0683	0.9518	0.7423	1.9667	5.323 (4)	6.307	1.158	$HN_t = 8.985+0.7344\ HS_t$

Table 4.11 Equations for employment, female manual workers

Part 1 Individual coefficients

Sector	Π_0	Π_1	Π_2	Π_{30}	Π_{31}	Π_{32}	Π_{33}	Π_{34}	Π_4	ρ
TOT	0.1042 (0.022)	-0.0975 (3.130)	0.0057 (4.484)	0.4814 (2.346)						0.6047 (3.423)
20	-1.312 (0.429)			0.1883 (2.516)	0.2897 (3.029)	0.1416 (1.865)			-0.8339 (2.490)	
21	3.166 (0.356)			0.3824 (3.278)	0.2240 (1.871)				-0.928 (2.316)	0.6462 (6.051)
22	-1.384 (0.210)	-0.2179 (4.383)	0.0098 (3.250)	0.2803 (2.141)					-0.8711 (1.367)	
23	2.708 (0.993)	-0.0872 (6.317)	0.0039 (5.027)	0.3055 (4.160)	0.1434 (1.933)				-0.5174 (1.829)	0.7462 (8.071)
24	-1.476 (0.367)	-0.1126 (2.858)	0.0093 (4.843)	0.2423 (1.816)	0.2871 (2.150)					0.7778 (8.851)
25	-8.483 (0.928)			0.2641 (2.090)	0.2187 (1.730)				-0.600 (1.649)	0.5849 (4.523)
26	-10.220 (2.000)			0.2286 (1.864)	0.5909 (2.940)					0.7937 (9.284)
27										
28	-4.477 (3.356)			0.2383 (1.377)	0.3449 (2.033)					0.4790 (3.668)
29	5.936 (0.385)			0.4948 (2.089)					-0.526 (2.353)	0.8064 (9.308)
30	5.807 (3.613)			0.2903 (5.174)					-1.688 (3.871)	0.3765 (2.546)
31	-11.05 (3.040)	-0.2336 (3.891)	0.0048 (3.808)	0.4088 (3.266)	0.3108 (2.670)					0.3114 (1.978)
32										
33	-7.516 (2.120)			0.4341 (3.604)					-0.9961 (2.213)	0.8151 (10.36)
34	-11.99 (1.417)	-0.4466 (1.641)	0.0236 (1.868)	0.7625 (1.700)					-0.889 (2.213)	0.8151 (10.36)
35	-2.680 (0.393)			0.1247 (1.756)	0.0708 (1.964)	0.1776 (2474)			-0.7243 (1.399)	0.4300 (3.048)
36	14.54 (1.653)			0.3079 (1.938)					-1.619 (4.241)	
37	-9.952 (2.587)			0.2486 (1.705)	0.1570 (1.725)	0.3420 (2.348)			-0.3120 (1.883)	0.8537 (12.34)
38	-5.063 (1.100)	0.0859 (2.756)		0.4571 (1.958)						0.7910 (9.543)
39	0.6321 (0.092)			0.5621 (4.945)	0.1511 (1.342)				-1.104 (1.937)	0.6948 (7.099)

Table 4.11 Equations for employment, female manual workers

Part 2 Test statistics

Sector	SE	$\bar{R}^2$	DW_{31}	λ	$Z_{8(1)}$	$Z_{9(3)}$	$Z_{5(ij)}$	Equations for hours HN_t
TOT	0.0546	0.9922	0.4814		0.099 (3)	4.317	0.033	
20	0.0920	0.8450	0.6196	0.9246				$HN_t = -9.431+10018\ HS_t$
21	0.1015	0.9213	0.6064	0.3694	8.566 (2)	0.994	1.014	$HN_t = 15.08+0.147t+0.520\ HS_t$
22	0.1824	0.6089	0.2803					$HN_t = -14.398+0.195t+1.161\ HS_t$
23	0.0209	0.9987	0.4489	0.3194	7.318 (4)	5.064	9.428	$HN_t = 12.582+0.643\ HS_t$
24	0.0535	0.9886	0.5294	0.5423	4.423 (3)	6.799	1.379	
25	0.1046	0.8910	0.4828	0.4530	7.589 (2)	0.509	1.116	$HN_t = 17.713+0.182t+0.426HS_t$
26	0.1572	0.7364	0.8195	0.7210	2.608 (1)	0.547	1.080	
27								
28	0.0573	0.9740	0.5832	0.5914	4.060 (1)	4.951	2.212	
29	0.1130	0.9199	0.4948		0.607 (2)	2.272	1.472	$HN_t = 27.944+0.1856t+0.2803HS_t$
30	0.1029	0.9294	0.2903		3.708 (2)	8.304	1.833	$HN_t = -4.779+0.9885\ HS_t$
31	0.0678	0.9149	0.7196	0.4319	20.04 (4)	1.166	1.794	
32								
33	0.0832	0.9621	0.4341		2.902 (2)	4.928	1.196	$HN_t = 27.204+0.3622\ HS_t$
34	0.2362	0.4893	0.7625		17.42 (4)	3.137	1.991	$HN_t = -12.168+0.4858t+1.075\ HS_t$
35	0.0531	0.9793	0.3731	1.1417	5.617 (2)	0.726	1.104	$HN_t = 27.79+0.659t+0.303\ HS_t$
36	0.3685	0.4520	0.3079					$HN_t = -4.825+0.3125t+0.958\ HS_t$
37	0.1051	0.9216	0.7476	1.1249	2.031 (2)	9.489	1.607	$HN_t = 1.2594+0.915\ HS_t$
38	0.1160	0.8258	0.4571		4.672 (2)	4.695	2.594	
39	0.0893	0.9340	0.7132	0.2119	1.624 (2)	0.696	0.318	$HN_t = 12.788+0.5988\ HS_t$

$$(4.29.2) \quad \ln LWF_t = \pi_0 + \pi_1 t + \pi_2 t^2 + \sum_{i=0}^{4} \pi_{3i} \ln Q_{t-j} + \sum_{i=0}^{4} \pi_{4j} \ln HFN_{t-j} + u_t$$

$$(4.30.1) \quad \ln LSM_t = \pi_0 + \sum_{i=0}^{4} \pi_{3i} \ln Q_{t-i} + u_t$$

$$(4.30.2) \quad \ln LSF_t = \pi_0 + \sum_{i=0}^{4} \pi_{3i} \ln Q_{t-i} + u_t$$

The results of equations (4.29) for male and female manual workers employment are presented in tables (4.10) and (4.11) respectively. The first part of the tables gives the estimated coefficients with their respective t-statistics, while the second part summarizes a number of statistics and diagnostic tests. The results are on the whole quite satisfactory.

With regard to male manuals equations, output took in most cases the expected signs. It should be noted that the distribution of the parameters on output is completely unconstrained without any polynomial form imposed on them. As previously all insignificant parameters have been dropped. The sum of output coefficients ($\Sigma\pi_{3i}$) that can be interpreted as the long-run elasticity of manual (males) employment with respect to output is reported on the third column of the second part of table (4.10). The elasticity took values ranging from 0.1367 for sector 27 indicating a low response of employment to output to 0.8555 for sector 23. Furthermore the mean lag (λ), reported in the fourth column of the second part of table (4.10), was in most of the sectors below unity, with the exception of sector 39 where it took the value 1.9667.

The results on the productivity variables (π_1 and π_2) are rather mixed. In 12 sectors the trend coefficient was significant. Out of these in 9 sectors the trend variable had a negative sign as expected. However the coefficient on the quadratic term was positive in all 9 sectors, indicating perhaps that even though productivity was increasing, it was increasing with a decreasing rate. The opposite pattern of alternating signs is reported in sectors 20, 21 and 24.

Finally the coefficent on normal hours is found significant in 13 sectors. Experimentation with various lags on normal hours proved always insignificant. It was decided to let the hours variable to enter only with the current lag. A possible explanation of the insignificance of the hours coefficient in the remaining 8 sectors, where we do not report the results, might be that some of the effects on productivity of reductions of standard hours may be offset by greater productivity in the hours that are actually worked. In all 13 sectors where π_{i4} was significant, it took the proper sign, but the values of the coefficients ranged significantly from 0.2104 to 1.7191.

All equations for male manual employment were estimated by autoregressive least squares with the exception of sector 27 which was estimated by OLS. The Z8(i) statistic indicates that the estimation by autoregressive least squares is the correct procedure to adopt (see before) with the exception of sector 27. Furthermore the Z9(3) statistic shows that the error autocorrelation of the first order is properly specified in the sense that it rejects a higher than first (up to fourth) autocorrelation in the residuals. Finally the post parameter stability test as given by Z5(ij) statistic indicated mispecification in only sector 23.

Equations for female manuals employment proved in general less satisfactory than males (see table (4.11)).19 equations were estimated altogether since we were unable to obtain significant results for sectors 27 and 32.[20] The coefficients on output are always positive with elasticities ranging from 0.2803 for sector 22 to 0.8195 for sector 26. The mean lag (λ) is always less than unity apart from sector 35 and 37. In 7 sectors we obtained significant results for the productivity variables but the pattern was similar to that of male manuals, ie. negative coefficients on the time trend, but positive on the quadratic term. Finally the coefficient on standard hours whenever it was found significant is always negative with elasticities ranging from 0.312 for sector 37 to 1.688 for sector 30.

Once again the estimation by autoregressive least squares is preferred, but the Z8(i) statistic favoured the unrestricted form in 5 out of 14 sectors. Furthermore the Langranze multiplier statistic of testing against an up to fourth order autocorrelation (Z9(3)) failed to pass the test on two occasions, ie. sectors 30 and 37. Finally the Z5(ij) statistic indicated mispecification for sector 23.

Turning now to the equations for non-production workers (administrative-technical and clerical personnel) it is important to note that a number of authors[21] have pointed that ATC workers are probably more like a fixed factor in the short-run. The fact that output changes do not play any role with regard to ATC employment is also observed by W. Godley and W. Nordhaus (1972) and CGN, since

"It was only when a relatively long lag-8 quarters-was imposed on the output series that the latter took on a significant coefficient and a relatively long adjustment process seems acceptable for this group of employees".

W. Godley and W. Nordhaus (1972) p.861.

Casual inspection of the series of ATC employment however indicates that their growth is sometimes faster than the output growth. A possible explanation was given in the previous section where it was noted that due to union pressure there was a progressive reclassification of employees from blue to white collar workers. Nonetheless we experimented on the basis of equation (4.30) with the employment series of ATC workers for both males and females. Suprisingly enough, output was found to play an important role, while the trend variables were on the whole insignificant. Moreover the adjustment process was longer for male ATC compared to females and the elasticities of female ATC employment to output, as measured by the sum of the coefficients on the output terms was higher than the corresponding male ATC elasticity in 17 out of 21 sectors. The result is quite reasonable if we consider that the type of work done by male and female ATC is totally different. The former constitutes a significant proportion of overhead labour being predominantly higher administrative and technical staff employed in long contract or for life, while the latter includes mainly secretarial and clerical staff whose employment fluctuates with output.

The results of employment equations for ATC employment based on equations (4.30) are reported in tables (4.12) and (4.13) for males and females respectively. All equations were estimated by autoregressive least squares with the exception of sectors 39 for males and 30 for females which were estimated by ordinary least squares. The results on the Z8(i) statistic comparing the restricted with the unrestricted form strongly favour the autoregressive least squares estimation with the following exceptions: males, SIC:25,26,32,35,37

Table 4.12 Equations for employment, male ATC workers

Part 1 Individual coefficients

Sector	Π_0	Π_1	Π_2	Π_{30}	Π_{31}	Π_{32}	Π_{33}	Π_{34}	Π_4	ρ
TOT	-6.266			0.2376	0.1506	0.1640	0.1585			0.868
	(6.064)			(5.508)	(3.763)	(4.406)	(3.841)			(18.90)
20	-1.875			0.1196	0.1414	0.1611	0.0609			0.483
	(3.307)			(4.273)	(5.328)	(5.985)	(2.194)			(18.93)
21	-5.471			0.2007	0.1400	0.1271	0.1736			0.6966
	(6.355)			(3.340)	(2.386)	(2.161)	2.873)			(6.781)
22	5.248			0.0789						0.4712
	(5.875)			(2.843)						(3.897)
23	-5.982			0.2262	0.1163	0.1743	0.1386			0.655
	(6.619)			(3.427)	(1.767)	(2.519)	(1.927)			(16.01)
24	-5.698			0.2288	0.3766					0.7500
	(5.147)			(2.120)	(3.466)					(8.014)
25	-7.699			0.0774	0.3182	0.1335	0.1515	0.2037		0.8568
	(4.157)			(1.794)	(3.639)	(1.598)	(1.771)	(2.114)		(11.77)
26	-5.549			0.2068	0.3908					0.7413
	(2.107)			(1.826)	(3.371)					(8.190)
27	-12.769			0.2421	0.2806	0.1584	0.3019			0.7036
	(7.226)			(1.977)	(2.416)	(1.385)	(2.525)			(7.095)
28	3.304			0.2217						0.8320
	(1.718)			(2.318)						(11.05)
29	-3.197			0.3817	0.3084	0.2487				0.6524
	(1.114)			(2.024)	(1.776)	(1.304)				(5.999)
30	-5.260			0.2231	0.1867	0.2012				0.2545
	(5.841)			(2.669)	(1.871)	(1.921)				(1.905)
31	-5.222			0.1469	0.3076	0.1888				0.6635
	(8.575)			(2.261)	(5.425)	(2.953)				(6.426)
32	-1.619			0.3220	0.1019					0.9850
	(0.663)			(3.854)	(1.816)					(13.75)
33	-8.435			0.3819	0.2514	0.1537				0.6355
	(10.67)			(4.872)	(2.877)	(1.963)				(5.667)
34	-6.775			0.2326	0.4342					0.5751
	(6.219)			(1.886)	(3.179)					(4.709)
35	-10.569			0.2244	0.1614	0.2752	0.1867			0.7680
	(9.206)			(4.130)	(3.137)	(5.370)	(3.392)			(8.869)
36	-8.084			0.3208	0.2074	0.2180				0.5752
	(5.580)			(2.414)	(1.822)	(1.636)				(4.959)
37	-5.724			0.3402	0.1644	0.1365				0.8566
	(2.367)			(3.168)	(1.958)	(1.817)				(12.54)
38	-2.422			0.1776	0.1910	0.1548				0.8590
	(1.234)			(2.424)	(2.552)	(2.252)				(12.66)
39	-6.758			0.2302	0.4236					
	(10.73)			(1.942)	(3.011)					

Table 4.12 Equations for employment, male MC workers

Part 2 Test statistics

Sector	SE	$\bar{R}^2$	$\Sigma\pi_{31}$	λ	$z_{8(1)}$	$z_{9(3)}$	$z_{5(ij)}$
TOT	0.0182	0.9987	0.7106	1.3426	0.872 (1)	0.188	1.613
20	0.0284	0.9958	0.4829	1.3384	0.245 (1)	5.724	1.127
21	0.0439	0.9874	0.6416	1.4266	3.579 (1)	1.404	1.547
22	0.0712	0.9559	0.0789		1.324 (1)	0.0179	1.038
23	0.0301	0.9956	0.6554	1.3438	3.586 (1)	0.240	0.243
24	0.0651	0.9644	0.6055	0.6220	3.288 (1)	2.348	1.867
25	0.0625	0.9606	0.8843	2.0971	10.18 (1)	0.556	1.619
26	0.9201	0.9169	0.5976	0.6539	7.763 (1)	3.640	2.334
27	0.0652	0.9662	0.9831	1.5289	2.703 (1)	1.949	1.113
28	0.0412	0.9899	0.2217		0.343 (1)	1.488	1.681
29	0.0858	0.9304	0.9388	0.8583	0.539 (1)	0.510	1.159
30	0.1250	0.8636	0.6109	0.9643	2.538 (1)	2.048	1.776
31	0.0391	0.9918	0.6433	1.0651	2.678 (1)	0.114	0.527
32	0.0709	0.7634	0.4239	0.2404	12.36 (1)	0.221	1.357
33	0.0445	0.9893	0.7871	0.7099	3.699 (1)	1.222	1.581
34	0.1267	0.8268	0.6668	0.6512	3.029 (1)	0.0106	1.899
35	0.0409	0.9892	0.8479	1.5000	7.570 (1)	0.188	1.895
36	0.0795	0.9564	0.7463	0.8621	1.191 (1)	2.465	0.474
37	0.0774	0.9590	0.6412	0.6822	9.504 (1)	3.732	2.294
38	0.0643	0.9750	0.5234	0.9564	0.1126 (1)	0.0126	1.941
39	0.1399	0.8790	0.6537	0.6480			0.776

Table 4.13 Equations for employment, female ATC workers

Part I Individual coefficients

Sector	Π_0	Π_1	Π_2	Π_{30}	Π_{31}	Π_{32}	Π_{33}	Π_{34}	Π_4	ρ
TOT	-10.156			0.2268	0.1090	0.1702	0.3117			0.843
	(7.342)			(3.019)	(1.873)	(2.635)	(4.338)			(11.74)
20	- 6.428			0.1334	0.2457	0.2521				0.6484
	(3.748)			(2.393)	(4.281)	(4.613)				(6.174)
21	-13.28			0.3791	0.2491	0.2974				0.5865
	(10.81)			(3.967)	(3.202)	(3.132)				(5.192)
22	-0.910			0.2904						0.2808
	(0.489)			(3.252)						(2.063)
23	- 7.599			0.1923	0.1029	0.3863				0.6331
	(11.99)			(3.239)	(1.828)	(6.016)				(5.545)
24	- 7.485			0.3132	0.3728					0.4541
	(12.25)			(1.914)	(2.291)					(3.603)
25	- 7.350			0.1595	0.2389	0.3379	0.2025			0.9447
	(1.159)			(2.187)	(1.916)	(9.580)	(1.923)			(25.12)
26	2.276			0.2772						0.8713
	(1.619)			(4.342)						(11.32)
27	- 4.760			0.2388	0.2653					0.7037
	(2.077)			(1.874)	(1.967)					(6.792)
28	-10.06			0.8259						0.5793
	(6.600)			(10.91)						(5.040)
29	-10.53			0.2496	0.5551					0.3038
	(3.834)			(1.967)	(3.321)					(2.212)
30	- 7.863			0.2698	0.4196					
	(9.220)			(1.611)	(2.536)					
31	- 8.403			0.5089	0.2333					0.5450
	(12.34)			(6.395)	(2.983)					(4.502)
32	- 9.025			0.3140	0.1802	0.1984				0.8754
	(2.878)			(2.809)	(1.935)	(1.877)				(13.57)
33	-10.08			0.2645	0.3151	0.2042				0.8896
	(3.363)			(2.121)	(2.389)	(1.644)				(14.99)
34	-12.72			0.5342	0.3056					0.6696
	(6.351)			(2.473)	(1.836)					(6.576)
35	-15.72			0.2035	0.1933	0.3731	0.2686			0.7997
	(9.837)			(2.984)	(2.980)	(5.778)	(3.888)			(9.828)
36	- 16.02			0.6998	0.3587					0.8737
	(3.710)			(4.424)	(2.254)					(13.86)
37	- 7.296			0.4223	0.2392					0.7191
	(4.503)			(3.758)	(2.107)					(7.487)
38	- 3.579			0.1391	0.2378	0.2015				0.9615
	(0.912)			(2.989)	(1.814)	(1.539)				(31.58)
39	- 5.222			0.1772	0.2865	0.2214				0.8741
	(3.164			(1.947)	(2.608)	(2.554)				(12.10)

Table 4.13 Equations for employment, female ATC workers

Part 2 Test statistics

Sector	SE.	$\bar{R}^2$	$\Sigma\pi_{31}$	λ	$z_{8(1)}$	$z_{9(3)}$	$z_{5(11)}$
TOT	0.0315	0.9952	0.8177	1.6932	2.308 (1)	5.151	0.916
20	0.0705	0.9708	0.6313	1.1879	38.56 (2)	0.309	1.820
21	0.0809	0.9267	0.9256	0.9117	2.992 (1)	0.490	0.951
22	0.1474	0.5290	0.2904		3.749 (1)	0.225	2.028
23	0.0313	0.9931	0.6814	1.2849	14.84 (1)	1.999	1.964
24	0.0711	0.9519	0.6860	0.5434	1.281 (1)	1.551	1.146
25	0.0961	0.7445	0.9389	1,6213	3,354 (1)	2.292	2.068
26	0.0878	0.8784	0.2772		7.369 (1)	11.934	1.827
27	0.0863	0.9004	0.5041	0.5263	0.095 (1)	3.449	2.063
28	0.0558	0.9736	0.8259		0.248 (1)	0.892	0.389
29	0.1547	0.5245	0.8047	0.6898	0.187 (1)	4.006	1.492
30	0.1556	0.8407	0.6894	0.6086			0.574
31	0.0564	0.9714	0.7422	0.3143	2.972 (1)	3.763	0.317
32	0.1147	0.7690	0.6926	0.8331	4.368 (1)	14.149	1.264
33	0.0737	0.9283	0.7838	0.9231	3.385 (1)	2.779	2.211
34	0.1911	0.6262	0.8398	0.3639	2.732 (1)	3.689	1.958
35	0.0518	0.9743	1.0385	1.6805	5.948 (1)	0.316	1.465
36	0.1109	0.8382	1.0585	0.3389	0.143 (1)	1.718	2.078
37	0.0854	0.9421	0.6615	0.3616	5.387 (1)	17.009	1.848
38	0.0800	0.8329	0.5784	1.1079	2.066 (1)	7.236	1.649
39	0.1272	0.5752	0.7551	1.1512	3.1062 (1)	8.390	1.523

and females SIC:20,23,26,32,35 and 37. The Z9(3) statistic showed that the first order autoregressive estimation should be abandoned for a higher than a first order estimation for sectors 26,32,37 and 39 for female ATC's. Finally the Z5(ij) statistic showed no signs of mispecification in any of the male or female ATC's equations.

The coefficients on the output terms are always properly specified, although no distributed lag is imposed. The third and fourth columns of the second part of tables (4.12) and (4.13) give the sum of the significant coefficients on output terms as well as the mean lag (λ). The elasticity of employment with respect to output for male ATC's takes values from 0.4239 (for sector 32) to 0.9831 (for sector 27) with the exceptions of sectors 22 and 28 where it was significantly lower (0.00788 and 0.2217 respectively). The corresponding numbers for female ATC's are significantly higher ranging from 0.2772 (for sector 26) to 0.9389 (for sector 25) and in two sectors values are higher than unity (sectors 35 and 36).

The estimation of employment equations concludes the arguments of unit labour cost that have to be normalized. The next section is concerned with the estimation of materials cost equations to be used for the generation of normal unit materials cost.

4.6. Estimation of normal materials cost.

Considering materials cost, the question arises on whether we should correct materials bill from cyclical fluctuations. It is generally accepted that materials prices are procyclical in the sense that they rise relatively faster than finished goods prices in expansions and fall during contractions.[22] CGN have put forward persuasive arguments to the fact that a normalization of materials bill is inappropriate.

According to CGN the firm has no means of telling what is and what is not normal about changes in the costs of its raw materials. Even if it was possible to distinguish the normal element in the materials cost, it would not necessarily mean that in periods when capacity was below normal, material costs would fall, since they may be cyclical but not reversible in the sense that labour cost is.

The above arguments are acceptable as long as they refer to materials prices and not to materials bill. Inspection of the actual data indicates that there is a similarity in the pattern of quarterly fluctuations in materials bill and the value of output. As it was shown in section 2.4 it is possible to decompose materials bill into materials prices and materials volume. Since materials prices are beyond the influence of the firm, it will be argued that a correction of the cyclical output effects should be made for the long-run trends in the "productivity" of materials. Accordingly equation (4.31) was specified in a loglinear form, where the volume of materials is a function of current and past levels of output.

$$(4.31) \qquad \ln M_t = \pi_{i0} + \sum_{i=0}^{4} \pi_{1i} \ln Q_{t-i} + u_t \qquad u_t \ \text{NID}\sim(0, \sigma^2 u)$$

Estimates of equation (4.31) are presented in table (4.14). The coefficients on output are estimated freely without imposing any polynomial form and are always positive and well determined. The sum of the coefficients is in most cases around unity ranging from 0.9329 for sector 27 to 1.3956 for sector 28. Estimation by autoregressive least squares is confirmed by the values of the statistics Z8(i), Z9(3) and Z5(ij). Finally the Z3(i) statistic is a likelihood ratio that comparing the general model (4.31) with the specific models presented in table (4.14)[23]

Table 4.14 Equations for materials bill

Part 1 Individual coefficients

Sector	Π_o	Π_{10}	Π_{11}	Π_{12}	Π_{13}	Π_{14}	ρ
TOT	0.4888	0.4871	0.1280	0.1499	0.1934		0.8388
	(0.588)	(8.415)	(2.329)	(2.892)	(3.460)		(11.69)
20	0.7558	0.9149	0.0381				0.6814
	(1.517)	(48.99)	(2.095)				(6.568)
21	0.7366	0.8483	0.0365	0.0244	0.0343		0.8351
	(1.463)	(39.36)	(1.747)	(1.157)	(1.587)		(11.37)
22	-1.280	1.0145	0.0145	0.0193			0.9057
	(3.028)	(72.29)	(2.190)	(2.125)			(16.49)
23	-0.0568	0.5803	0.1885	0.2115			0.7865
	(0.087)	(10.14)	(2.724)	(3.426)			(9.418)
24	0.8108	0.8519	0.0458	0.0386			0.7009
	(4.857)	(34.09)	(2.190)	(1.534)			(7.135)
25	-0.2795	0.6206	0.0916	0.1225	0.1539		0.8507
	(0.353)	(11.57)	(1.784)	(2.402)	(2.875)		(11.47)
26	0.2823	0.6389	0.3143				0.6005
	(0.417)	(9.632)	(4.705)				(5.444)
27	0.9646	0.6022	0.3307				0.5672
	(1.218)	(6.493)	(3.638)				(4.965)
28	-8.784	1.1843	0.2109				0.8331
	(3.128)	(7.829)	(1.416)				(11.50)
29	-3.537	1.0087	0.1522				0.5727
	(4.617)	(19.04)	(2.833)				(4.841)
30	-1.284	0.6938	0.1358	0.2007			0.6424
	(1.402)	(6.373)	(1.330)	(1.959)			(5.943)
31	-0.6046	0.6912	0.3101				0.6333
	(1.177)	(8.938)	(4.116)				(5.796)
32	0.5796	0.9591					0.6679
	(0.576)	(19.74)					(6.513)
33	-2.879	0.9301	0.1714				0.7859
	(2.418)	(9.071)	(1.689)				(9.582)
34	0.2821	0.8896	0.0760				0.8873
	(0.313)	(17.65)	(1.706)				(15.08)
35	-1.0778	0.8504	0.1139	0.0705			0.4413
	(5.110)	(30.69)	(4.002)	(2.533)			(3.504)
36	-1.690	0.6344	0.1031	0.0434	0.1509	0.1329	0.3207
	(4.110)	(9.102)	(1.889)	(1.535)	(1.991)	(1.864)	(2.323)
37	-0.9195	0.9398	0.0865				0.4705
	(3.370)	(24.35)	(2.265)				(3.680)
38	-3.960	1.1518					0.2599
	(11.86	(71.28)					(1.717)
39	-1.755	0.6346	0.3171	0.0995			0.5411
	(3.293)	(9.537)	(4.642)	(1.493)			(5.607)

Table 4.14 Equations for materials bill

Part 2 Test statistics

Sector	SE	$\bar{R}^2$	$\Sigma\eta_{11}$	$z_{8(1)}$	$z_{9(3)}$	$z_{5(1j)}$	$z_{3(1)}$
TOT	0.01929	0.9937	0.9586	8.364 (1)	2.202	2.518	0.704 (1)
20	0.02413	0.9996	0.9530	2.930 (1)	8.064	0.832	4.622 (3)
21	0.01634	0.9997	0.9437	1.172 (1)	2.486	1.675	0.264 (1)
22	0.01494	0.9997	1.0483	6.938 (1)	0.704	12.062	1.056 (2)
23	0.02068	0.9997	0.9803	1.208 (1)	2.756	1.961	1.666 (2)
24	0.01133	0.9998	0.9364	2.930 (1)	7.678	2.269	2.976 (2)
25	0.02644	0.9992	0.9887	1.926 (1)	2.880	1.965	1.778 (1)
26	0.03362	0.9988	0.9532	0.390 (1)	6.232	2.128	2.678 (3)
27	0.03916	0.9984	0.9329	1.1696(1)	2.271	1.863	1.815 (3)
28	0.05350	0.9970	1.3953	3.638 (1)	1.488	2.123	3.365 (3)
29	0.02778	0.9992	1.1609	0.144 (1)	1.034	2.376	1.022 (3)
30	0.06485	0.9961	1.0303	0.613 (1)	2.889	0.448	1.598 (2)
31	0.03527	0.9989	1.0014	4.250 (1)	1.943	1.732	0.9400(3)
32	0.07294	0.9953	0.9591	1.754 (1)	1.948	0.5857	1.262 (4)
33	0.04410	0.9983	1.1015	3.088 (1)	1.432	0.3566	1.937 (3)
34	0.04419	0.9976	0.9656	1.798 (1)	1.765	1.7204	0.1362(3)
35	0.01554	0.9997	1.0347	1.442 (1)	0.366	1.447	1.810 (2)
36	0.03581	0.9974	1.0614	1.916 (1)	5.197	2.458	
37	0.02188	0.9994	1.0264	4.186 (1)	10.054	1.660	4.270 (3)
38	0.04323	0.9956	1.1518	1.942 (1)	5.581	0.775	3.081 (4)
39	0.04702	0.9975	1.0512	5.415 (1)	2.878	2.110	1.492 (2)

4.7. The calculation of normal unit labour and normal unit materials costs.

The methodology that was followed in estimating the equations of this chapter had one purpose: To generate series of normalised unit labour and normalized unit materials costs, ie. costs that are purged from the cyclical fluctuations in output. This is achieved in the construction of normal values of the variables discussed by obtaining the fitted values of the estimated equations and substituting wherever necessary actual by normal output. Following this procedure the constructed normal cost series will be totally independent of the actual cost series.

To define unit labour (ULCN) we require the definition of the normal labour bill (LN). By dividing this by normal output we obtain normal unit labour cost as

(4.32) $$ULCN \equiv \frac{LBN}{QN}$$

(4.33) $$LBN \equiv 1.175\ [(12.25 * AWEMN * HMN * LWMN) + (3 * AMEMN * LSMN) + (12.25 * AWEFN * HFN * LWFN) + (3 * AMEFN * LSFN)]$$

where all the arguments in the rhs are the normal values of wages, salaries, employment and hours and the numbers are explained in Appendix 3.

To define normal unit materials cost we require an estimation of normal materials volume (MN). This is obtained by using the estimated coefficients of (4.31) and substituting actual by normal output. Normal unit materials cost may now be defined as

(4.34) $$UMCN = \frac{Pm .\ MN}{QN}$$

Where P_m is materials prices defined in Appendix 3.

Normal unit costs will be used as explanatory arguments in the estimation of the full-cost and target rate of return models. Furthermore they will form the basis for the calculation of normal or "predicted" price series to be used in the estimation of the normal cost model. The formulation and estimation of these models is the subject matter of chapter 5.

NOTES

1. See for example R. Hall and C. Hitch (1939), P.W.S. Andrews (1949), A. Fitzpatrick (1974) and R. Barback (1964).
2. See C.L. Schultze and J.L. Tyrone (1965), R.T. Gordon (1975), W.D. Nordhaus and W. Godley (1972) and K. Coutts, W. Godley and W. Nordhaus (1978) among others.
3. It should be noted however that part-time work is not particularly wide-spread in the Greek industry. Moreover, since we will estimate separate hours equations for male and female manual workers, women's part-time participation factor will be manifested in different coefficients for the HS_t variable compared to those obtained in the male hours equation.
4. See R.S. Breusch and L.G. Godfrey (1981). For a formal definition see also section 3.6.5.
5. See G.E.P. Box and D.R. Cox (1964) and P. Zarembka (1974).
6. See I.L.O. "Labour Statistics" various issues.
7. It should be noted that because of these legal interventions, the conventional distinction between operatives (manual workers) on the one hand, and ATC staff on the other (see GCN) does not correspond to the distinction used in this study. Here, we were obliged to follow the National Statistical Service classification that divides employees into wage and salary earners, the first being paid on a daily or weekly basis and corresponding more or less to manual workers, while the second being paid on a monthly basis and comprising of a mixture of professions a great majority of which are manual (see also Confederation of Greek Industries (1970)).
8. See for example S. Wabe and D. Leech (1978).
9. See D. Sargan (1980).

10. The number would have been even greater and therefore W^F/W^F min even smaller had we examined the industrial sectors where concentration of women manuals is large. In particular more than 75% of women manuals is concentrated in sectors that require relatively unslilled labour force such as sectors SIC:20, 22,23 and 24. Moreover information from a small sample survey conducted in 1968 by the Confederation of Greek Industries (1970) shows that 25% of male workers are paid wages less than 100 drachmas, while the corresponding figure for females is 91%. Minimum wages in 1968 were 96.30 for males and 80.25 drachmas for females.
11. See for example R.R. Neild (1963), F. Rushdy and P.S. Lund (1967) and H.M. Pesaran (1972).
12. See for example K.F. Wallis (1972).
13. See R.S. Brusch and L.G. Godfrey (1981).
14. See K. Coutts et al (1978), p.27.
15. The Z5(ij) statistic of chapter 4 is exactly the Z4(4,i) statistic of chapter 3 (and 5). See also section 3.6.5. The Z5(ij) statistic of chapter 4 should not be confused with the Z5(ij) statistic of chapter 3 (and 5). That of chapter 4 indicates a post-parameter stability test, while that of chapter 3 a Chow-test examining the hypothesis of differential pricing pattern between two samples.
16. See R.F. Elliot and J.L. Fallick (1981) chapter 9.
17. See T. Catsanevas (1983), Confederation of Greek Industries (1974) and Labour Statistics, various issues.
18. See for example F. Brechling (1965), R.J. Ball and E.B.A. St Cyr. (1966), N.J. Ireland and D.S. Smyth (1970), E. Kuh (1965), R.R. Neild (1963) and for a different approach T.A. Wilson and O. Eckstein (1964).
19. See M.I. Nadiri and S. Rosen (1969) and M.I. Nadiri (1974).
20. For these sectors actual female manual employment will be assumed to represent normal female manual employment.

21. See for example E. Kuh (1965) and P.S. Dhrymes (1966).

22. See G.E.S. Llewellyn (1974) and R.N. Cooper and R.Z. Lawrence (1975).

23. See section 3.6.5.

CHAPTER 5 : Long-run pricing theories : the full-cost, target rate of return and normal cost pricing models

5.1 Introduction

This chapter deals with the derivation, estimation and empirical testing of markup models that have been previously described as long-run models. These include the full-cost pricing model, the target rate of return pricing model and the normal cost pricing model. All models are examined as distinct alternative explanations of the price determination process followed by the Greek industrial sectors. Nonetheless, they are grouped into one entity since they share common characteristics that derive mainly from the long-run nature of the industrial price decision process implied by these models. These common features are (a) that the costs on the basis of which prices are formed are not actual costs but the costs incurred at the normal or standard degree of capacity utilization and (b) that the profit margin over normal costs does not follow any cyclical pattern related to fluctuations in demand. This implies that short-run demand will not affect the shifting of cost changes to prices, i.e. that in the price-cost equation including a short-run demand variable, the coefficient on the latter will be small and insignificant.

Section 5.2 is concerned with providing a theoretical explanation of the markup (or target rate) determination. This is achieved by relating the full cost and target rate models to the theory of limit pricing. Furthermore, the conditions whereby a change in the full-cost or target rate price occurs are also examined through the apparatus of the kinked demand curve. Section 5.3 deals with the examination and testing of the full-cost model. The full cost model is derived in an econometrically testable form and the results of such an estimation are examined. Section 5.4 is concerned with the estimation and testing of the target rate of return model. The special features of this model are discussed and emphasis is given in the specification of the target rate. The estimation and discussion of the target rate of return pricing results conclude this section. Finally, section 5.5 deals with the testing of the normal cost hypothesis. The model is formulated and the procedure by which "predicted" prices are generated is duly discussed, leaving the technical details of this procedure for Appendix 5. The estimation and testing of the normal cost model concludes this chapter.

5.2 A theoretical exposition on full cost and target rate of return models

5.2.1 Introduction

The markup pricing models examined in this study were classified into short run and long run depending on whether the firm calculated costs (and consequently price) on actual or on standard levels of output. This is an operational criterion that helps to discriminate empirically between the two types of markup models. Such a criterion however is not capable of explaining why the firm would base its price calculations on full-cost, target rate or normal cost pricing models, since it does not give a justification of why the firm would put a markup on costs based on standard output in the first place. Also there is no explanation of how the level of profit margin that is supposedly added to standard costs is determined and even more how this markup fluctuates, if it does at all, during the course of a trade cycle. Given that all pricing practices of the markup variety are not based on any kind of optimizing behaviour on the part of the firm, the purpose of this section is to provide a theoretical framework within which the above mentioned problems can be adequately answered. Prior to this however, an elaboration on the precise form of the versions of the full-cost and target rate of return pricing formulas that are adopted in this study is required.

5.2.2. Full-cost and target rate of return: A statement of the hypotheses.

In chapter 1 we presented a brief statement of the full-cost and the target rate of return pricing hypotheses. It was also mentioned that there is a controversy surrounding the precise statement of the term full-cost which can be by and large attributed to the fact that various authors understand the definition of full- cost differently or use it as a generic term implying any cost plus pricing formula. Cost puls pricing may take a number of forms of which full cost and target rate are two distinct but closely interelated issues.

Full-cost is a form of pricing whereby the price is set as a markup upon costs calculated at the standard level of output. A variety of definitions may be further arranged depending on whether the markup is flexible or fixed, whether it is additive or multiplicative etc. but the main characteristics are two:

(a) The cost basis on which the markup is applied includes all cost elements, i.e. direct or prime costs that vary directly with output plus fixed costs, and

(b) Fluctuations in demand do not play any role in the full cost price determination process unless they have such an enduring permanency of either upward direction (boom) or downward direction (recession) such that the markup or the operating rate (on which the calculation of standard cost depends) are affected.

Full cost pricing may be represented formally in equation 5.1 (repeating (1.23))

$$(5.1) \quad P_F = (1 + \pi) \frac{C\ (QN)}{QN} = \frac{(1 + \pi)\ [\beta V\ (QN) + F]}{QN}$$

where: P_F = full cost price

π = markup

QN = standard (normal) output

C = total cost

V = variable cost

F = fixed cost

and β = factor price shift parameter

Target rate of return pricing is a cost plus formula whereby the firm sets the price in order (a) to cover variable costs calculated at the standard level of output and (b) to yield a certain rate of return on the firm's assets. Formally, target rate of return pricing may be expressed by equation 5.2 (repeating equation (1.24))

$$(5.2) \quad P_T = \frac{\beta V\ (QN)}{QN} + (1 + \tau) \frac{K}{QN}$$

where: P_T = target rate of return price

τ = target rate of return

K = value of assets

The behavioural characteristics of the target rate of return pricing are the same as those of the full cost with the exception that in the former, the ratio of capital to standard output is an argument in the price equation. Which of the two principles is more appropriate depends upon a number of factors such as the production and marketing processes, the degree of concentration in the industry, the type of the product etc. This will be discussed in detail in section (5.4.3) which will clarify the differences between the two pricing methods. What is important to note here is that the firm's policy variables in both pricing models is the same; namely, the definition of standard costs and the markup, which in the case of full cost is a percentage upon costs while in the case of target return a predetermined rate upon capital invested. The following two subsections are concerned with these matters.

5.2.3 The notion of standard output and standard costs

The calculation of standard costs has been derived analytically in chapter 4. It was based on a statement of standard output which was defined operationally as that value that corresponds to output's trend path which was further evaluated as the prediction of a regression of the logarithm of output against a time trend and a quadratic time trend. Consequently, standard costs are the values of variable costs (labour and materials) calculated not on the actual output levels but on those levels of outupt resulting from the above definition. The procedure described in chapter 4 helps to generate the independent variables, i.e. standard unit labour cost and standard unit material cost that will be used in the estimation of the pricing models discussed in this chapter. What is not adequately explained however in chapter 4 is the fact tht the notion of standard output and standard costs forms an integral part of the firm's pricing decision process when this is expressed in the form of full cost, target rate of return and normal cost pricing schemes.

The fundamental difference between the above models and the short term models described in chapter 3 is that the former view the pricing process at a larger perspective than the latter, since pricing is in one way or the other tied with investment policy. The price of a company's product is one of the tools available at its disposal that helps to create a volume of sales. In that sense price is a strategic variable in the firm's budgeting and planning operations and is closely related to the firm's efforts to achieve its objectives. One of these may be to attain a specified rate of return on capital or on sales. The achievement of such an objective depends upon a number of factors of which two are of particular importance here. The first is the total capital invested which rests upon decisions taken in the past about the size and the technology of the plant. The second is the price of the firm's product that will allow the firm to earn an amount of profits corresponding to a markup over costs, or a target rate on its investment over the expected life of the plant, given the fixed and variable costs incurred during the productive process. This price depends upon the average rate of output that the firm anticipates to sell at that price. The rate of output that enters the firm's calculations cannot exceed the productive capacity on which the plant is built. If the industry is one where firms experience fluctuations in the rate of sales and output, they would base their investment plans on an average rate of output which of course is less than the maximum rate corresponding to the plant's productive capacity. The amount of this average output rate in relation to the firm's productive capacity will be different between firms and industries depending among others on the history and tradition, on the productive and marketing processes and on the degree of market power exercised by the firm. This output rate is the standard or normal output rate.

Standard or normal costs are the costs calculated at standard output. Since only variable costs vary with output, by standard costs we mean standard labour and standard material costs. The essence of the procedure for the calculation of these costs is the following: Fluctuations in demand and consequently sales and output do not enter cost calculations. Instead the entrepreneur forms expectations about a standard level of demand on the basis of which (a) he has formed the plans of his investment in plants and equipment and (b) calculates his unit costs. Consequently, all elements comprising unit labour and unit material costs are purged from cyclical fluctuations in demand. In a sense the notion of standard cost provides the link between the short run and long run as far as average costs are concerned.

Average cost comprises of fixed and variable cost. Fixed cost normally includes the salaries of the managerial staff, the wear and tear of machinery and expenses for the maintenance of land and buildings. These factors set limits to production and therefore are taken into account at the planning of investment outlay. The entrepreneur will plan with a figure of output that he anticipates he could sell and then will choose the size of the plant that will allow him to produce that level of output more efficiently and with the maximum flexibility. The plant will have a capacity larger than the capacity corresponding to the expected level of sales, since the businessman would expect to have some reserve capacity for a number of reasons. For example, reserve capacity will allow the entrepreneur to meet seasonal and cyclical fluctuations in demand which cannot always be met efficiently by stock inventory policy. It will also allow the entrepreneur more freedom to increase his output in view of unanticipated demand increases. Moreover, it gives some flexibility for minor alterations in the product in view of changing consumer tastes. In summary, the entrepreneur will not necessarily choose the plant which will give him today the lowest cost, but rather the equipment that will allow him greater possible flexibility for minor alterations of his product or his technique.

Variable cost includes the cost of direct labour that varies with output, the cost of raw materials and fuel and the running expenses of machinery. In section 3.8.9 it was argued that marginal cost is constant and consequently average variable cost should be depicted as including a flat stretch over a range of output. If this is so, then variable costs would be independent of output rates. The assumption of the flat portion of the average cost curve should be seen primarily as a differentiation from the traditional theory which rests on U-shaped curves. However, it is not a necessary assumption for price determination theories discussed in this chapter despite the fact that various full cost theorists[1] have assumed their cost curves to be of a flat-stretch type. Nonetheless, it is employed in figure 5.1 for purposes of comparison with traditional cost curves.

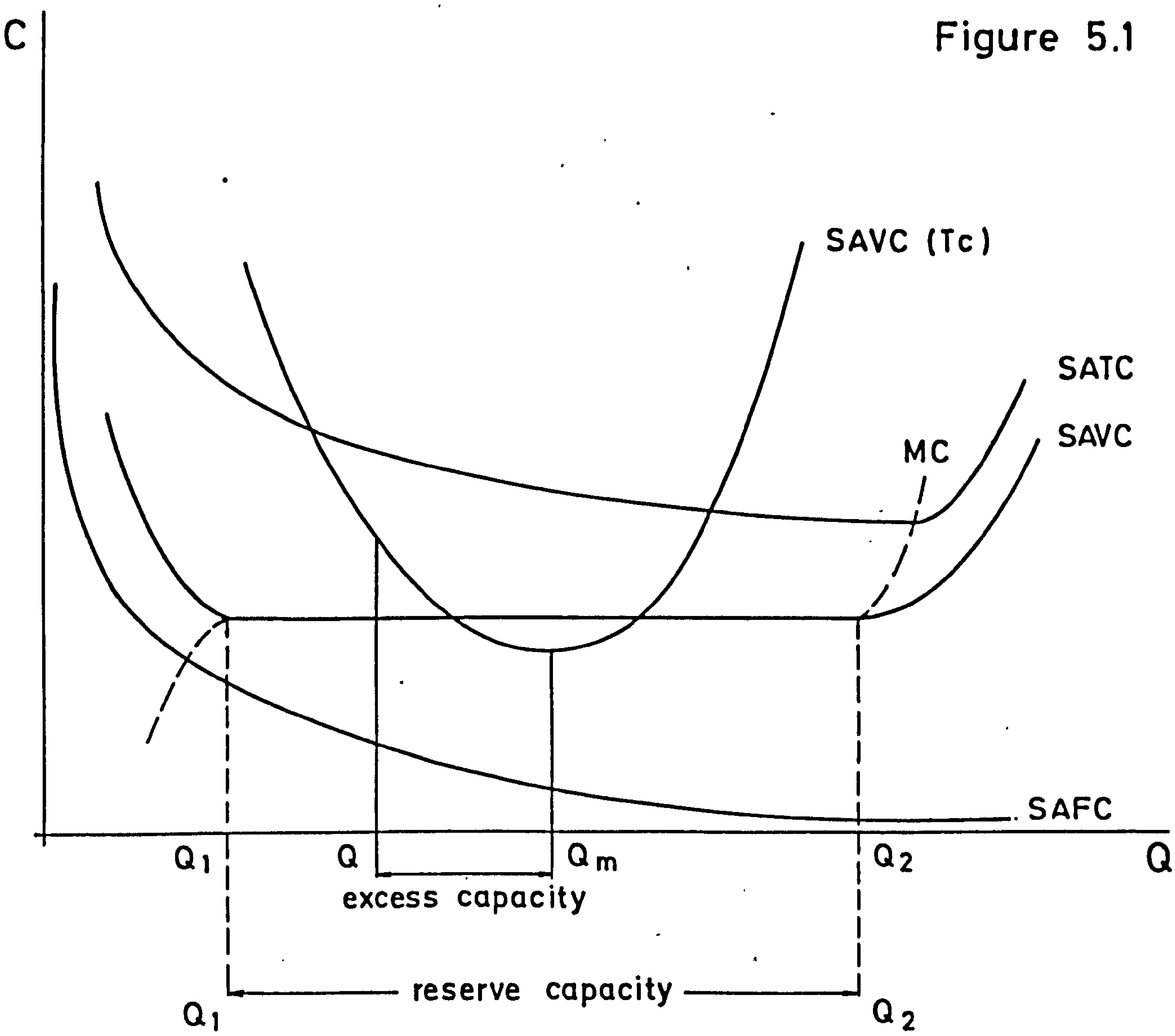
Assuming that the flat-stretch exitsts, then it corresponds to the built-in plant reserve capacity. In figure 5.1 average variable cost (SAVC), average fixed cost (SAFC) and average total cost (SATC) were drawn on the basis of this assumption. In contrast with traditional theory which assumes that the SAVC is U-shaped (SAVC(Tc)) the entrepreneur can produce efficiently within the range of output from Q_1 to Q_2. Traditional theory assumes that each plant is designed without any flexibility in order to produce optimally one level of output (Qm). If a firm produces an output Q smaller than Qm, then there is excess (unplanned) capacity equal to Qm-Q, which is undesirable since it leads to higher costs. The SATC will fall continuously up to the level of output (Q_2) at which reserve capacity is exhausted. Beyond that level SATC will start rising. The MC will intersect SATC at it's minimum point which is just right of the point corresponding to output Q_2.

The notion of standard output and costs is one of the ingredients of the pricing process of the full cost, target rate and normal cost hypotheses. The other is the determination of the markup or the target rate which is discussed in the next section in connection to the limit pricing theories.

5.2.4 Target rate or markup determination : The limit price theories

A usual argument against mark-up price determination models is that they are rules of thumb used by firms to form their price decisions and in that sense they lack any theoretical justification.

Figure 5.1


C
SAVC (Tc)
SATC
SAVC
MC
SAFC
Q1
Q
Qm
Q2
Q
excess capacity
reserve capacity
Q1
Q2

This is manifested primarily in their failure to explain the level of the profit margin that is supposedly added to standard cost. This omission is not adequately remedied by references to "fair" profits or to long run profit maximisation. A satisfactory explanation is provided by the limit pricing theories which by focusing on the conditions of entry into the industry are able to determine how the markup over costs is set. The theory of limit pricing[2] focuses on conditions of entry into an industry as the key determinant of markup over costs. The igniter came from an empirical observation by J. Bain (1949) to the effect that firms operating in a non-competitive environment do not charge the price that corresponds to maximum profits nor the price that in the long run is equal to the long run average cost. Instead, they charge the limit price which is different from both the above mentioned prices since firms are concerned with potential entry and also since entry is impeded due to barriers that exist for new comers into the industry.

J. Bain (1956) distinguishes four such barriers, namely the product — differentiation barrier, the absolute cost advantage of the established firms, the large initial capital requirement and the economies of scale. As far as the latter is concerned, however, emphasis is placed only in F. Modigliani (1958) model which is broadly similar to the analysis conducted by P. Sylos-Labini (1957). F. Modigliani's main pre-occupation is to provide an explanation to the cost-plus pricing policies by relating them to the limit pricing theories. In this sense, his analysis comes closer to the purpose of this section and this is the reason that we focus primarily on his model.

F. Modigliani relaxed the restrictive assumptions of the Sylos Labini model regarding technology and unitary elastic demand but retained the economies of scale barrier as the most important barrier to entry and the reaction pattern of the existing firms and entrants which he termed the Sylos-Postulate. According to that

"... potential entrants behave as though they expected existing firms to adopt the policy most unfavourable to them, namely, the policy of maintaining output while reducing the price (or accepting reductions) to the extent required to enforce such an output policy".

F. Modigliani (1958) p. 217

The main assumptions of the Modigliani model are the following:

(1) The price is set by the largest firm in the industry at such a level as to prevent entry. All firms are assumed to behave according to the Sylos-Postulate.

(2) The technology is the same for all firms in the industry. There is a minimum optimal plant (Qm) at which economies of scale are fully realised. Once the optimal scale is reached the L.A.C. curve becomes a straight line.

(3) Entry occurs only with the minimum plant size (Qm). Entry with suboptimal plant is precluded.

(4) The product is homogenous and the market demand is known. The point of intersection of the given demand curve with L.A.C. determines the competitive output Q_c and the competitive price P_c, i.e. the price and the quantity that can be sold in the long-run if the market were purely competitive given that in the long-run

$$P_c = L.A.C.$$

The price setting behaviour of the model can be described in the following way:

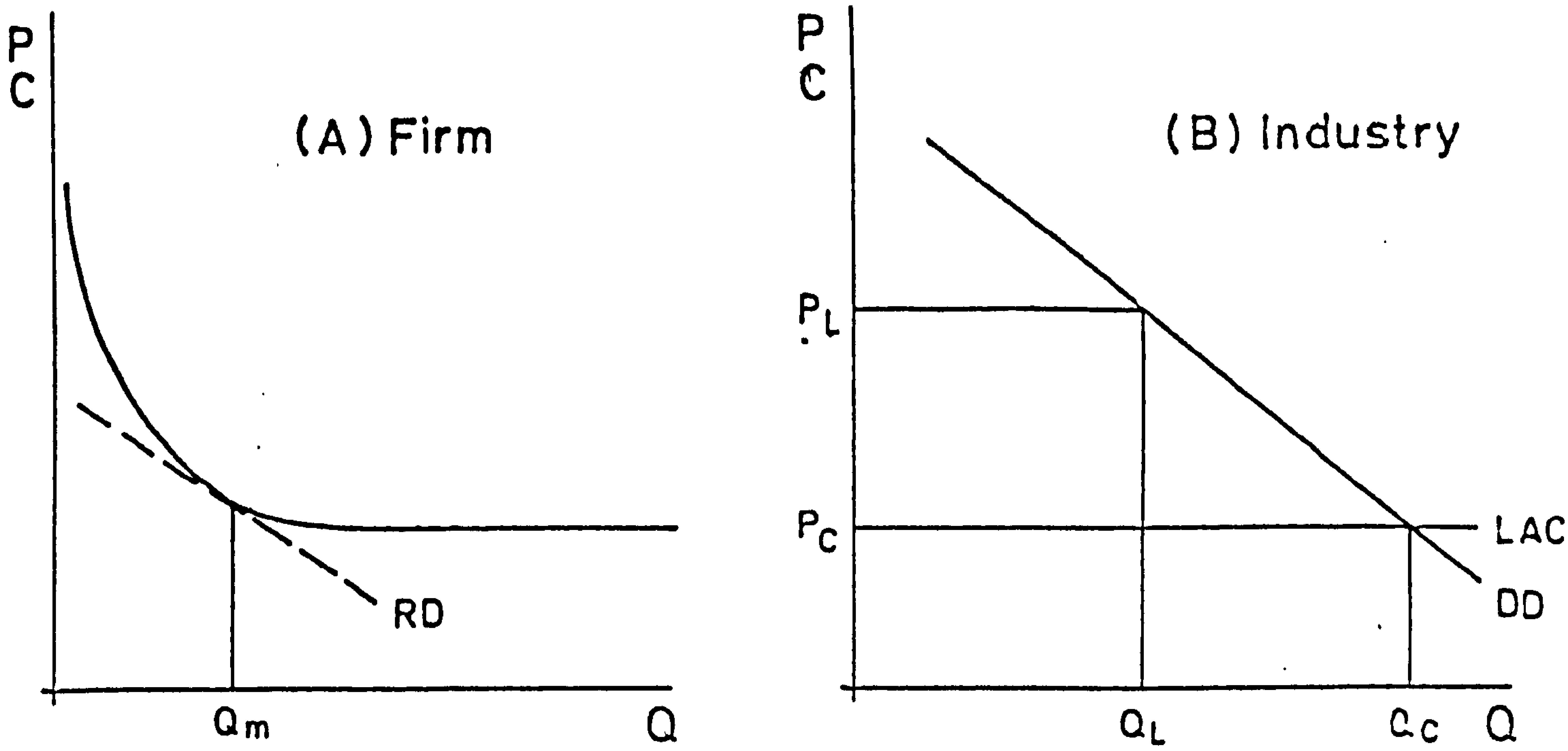
The main preoccupation of the existing firms is to set a price that will effectively prevent entry. The price is the limit price (P_L) which is determined indirectly by determining the total output which will be sold by all firms in the industry. The established firms decide to sell a quantity of Q_L such that if the entrant comes and offers an additional quantity Q_m (which by assumption (2) is the minimum quantity that he produces optimally), the total output in the market will just exceed the competitive output (Q_c) and consequently the price will just fall below P_c (= L.A.C.). This price behaviour is depicted in figure 5.2 where a (residual) demand curve is drawn representing the demand curve facing the potential entrant, and drawn in such a way that, under the behavioural assumptions outlined before RD is everywhere below the cost curve, thus making entry appear unprofitable.

Symbolically, the entry preventing output is Q_L such that

(5.3) $Q_L + Q_m > Q_c$

Given (5.3) the post entry price will fall to a level P, such that $P < P_c$ where P_c = L.A.C. Entry will be prevented as long as $Q \geq Q_L$. If $Q < Q_L$ entry will occur. The economies of scale barrier will cause P_L to be higher than P_c. The difference between P_L and P_c is the "entry gap" or "entry premium" and defines the amount by which the price can exceed L.A.C. without attracting entry. The determinants of the entry gap and the entry preventing price are the same as the Sylos-Labini model, namely the absolute market

Figure 5.2



Part (A) of the diagram refers to Firm, Part (B) to Industry

Q_m = minimum optimal level of output

Q_L = output that established firms should produce to prevent entry

P_L = entry preventing price

Q_c = competitive output

P_c = competitive price

DD = industry demand curve

RD = residual demand curve, facing the entrant

LAC = long run average cost-curve

size Q_c, the price elasticity of demand e, the minimum optimal scale Q_m, and the prices of factors of production which together with technology determine L.A.C. and hence the competitive price P_c. Following F. Modigliani's 2nd assumption (according to which technology in the industry is unique and such that at a size less than Q_m costs are prohibitedly high) we assume that the entrant enters the market at a size Q_m or larger. In such a case the entry preventing output will be:

$$(5.4) \quad Q_L = Q_c - Q_m = Q_c(1 - \frac{Q_m}{Q_c})$$

The aggregate output can not be smaller than Q_L; if it is then it would be profitable for a firm of size Q_m to enter the market. Indeed, the post entry output would be smaller than Q_c and hence the post entry price will be larger than P_c (which is equal to the entrant's average cost) given the demand curve. By the same reasoning, an output Q_L or larger would make entry unattractive.

The relationship between the competitive price P_c and the limit price P_L can be stated according to F. Modigliani in terms of the elasticity of demand in the neighbourhood of the competitive price. By approximating the price elasticity formula in finite differences we have:

$$(5.5) \quad e = \frac{\Delta Q}{Q} \frac{P}{\Delta P}$$

Under the Sylos Postulate all increments in demand are created by the new entrant and so:

$$(5.6) \quad \Delta Q = Q_c - Q_L = Q_m$$

In the neighborhood of P_c, the elasticity will be:

(5.7) $$e = \frac{Q_m}{Q_c} \frac{P_c}{P_L - P_c}$$

By solving the above expression for P_L we obtain:

(5.8) $$P_L = P_c \left[1 + \frac{Q_m}{e.Q_c} \right]$$

The limit price will be higher, the higher the minimum optimal plant scale Q_m, the less elastic the demand curve, the smaller the absolute market size Q_c and the higher the average cost (P_c = L.A.C.). The analogy of equation (5.8) to the definitions of full-cost and target rate of return price (5.1) and (5.2) is obvious. The C(QN)/QN part in (5.1) corresponds to the competitive price P_c, while the markup $(1 + \pi)$ corresponds to the entry premium $\left[1 + \frac{Q_m}{Q_{c.e}} \right]$

The Modigliani analysis is restrictive in a number of respects; First the assumption that the entrant can enter only with the minimum optimal scale is applicable to new firms only. An already established firm may enter at scales which although suboptimal for new firms may be profitable for it. Second, although Modigliani states that the large firms typically set the pace in the market and they set the price by applying the full cost principles he does not fully explain how the price is defined in the sense that he does not discuss how the interaction of firms with different costs and different shares leads to a stable market equilibrium. The analysis can really be applicable to a monopoly situation. With an oligopolistic market the limit price provides the upper limit on the price to be charged, provided that there is an agreement tacit or otherwise that the pricing purpose is to prevent entry. How this can be achieved depends on the effectiveness of collusion between firms. Third, it is also assumed that the potential entrant calculates the effects of his entry as if he is the only candidate to enter the market. The case of many possible entrants (at the Q_m scale) is not considered. Fourth, economies of scale are considered as the only barrier to entry. However, a general view of limit pricing would indicate other barriers such as advertising and loyalty brand, absolte cost advantage, excess capacity etc., some of which describe an existing state of affairs while others are determined by the actions of the existing firms.[3]

Despite its shortcomings, the Modigliani analysis provides a useful tool as far as the markup (or target rate) determination is concerned. Figure 5.2 is quite useful: the markup is exactly the difference between P_L and P_c (formally P_L/P_c). Given that in the long run the competitive price equals the long run average cost below which the firm will not usually produce, any amount above the long run average cost will accrue as excess profit. This is exactly the price cost margin that the firm will charge. Assuming that the firm is a long run profit maximiser, it would like to charge the highest possible markup to achieve such an aim. The contribution of the limit price analysis is that it determines an upper limit to the level of the markup by specifying that price can not exceed P_L which is the maximum that firms can charge without inducing entry into the industry.

The limit price determination theory allows a restatement of the definitions of the full cost pricing and target rate of return pricing given in section 5.2.2.

Full cost is a form of pricing whereby the price is set as a markup upon costs calculated at the standard level of output. The markup is the highest possible that could be charged upon standard costs without allowing entry into the industry.

Target rate of return pricing is a cost plus formula whereby the firm sets the price in order to cover variable costs calculated at the standard level of output and to yield a certain rate of return on firm's assets. The target rate of return is the highest which in view of the existing firms can be obtained without attracting new firms into the industry.

The additional statements in the two pricing hypotheses should be treated with caution in the following respect. The entry preventing theory provides an explanation of how the markup is being set, but it is not testable. If the firms in an industry priced according to equation (5.8) because they have an idea of fairness in mind or because of religious beliefs, the test results as far as the full cost and target rate hypotheses are concerned would be the same as it would be if these firms were concerned with entry prevention. Tests of the latter assumption combined with the full cost and target rate models would require different data and techniques from the ones employed in this study.

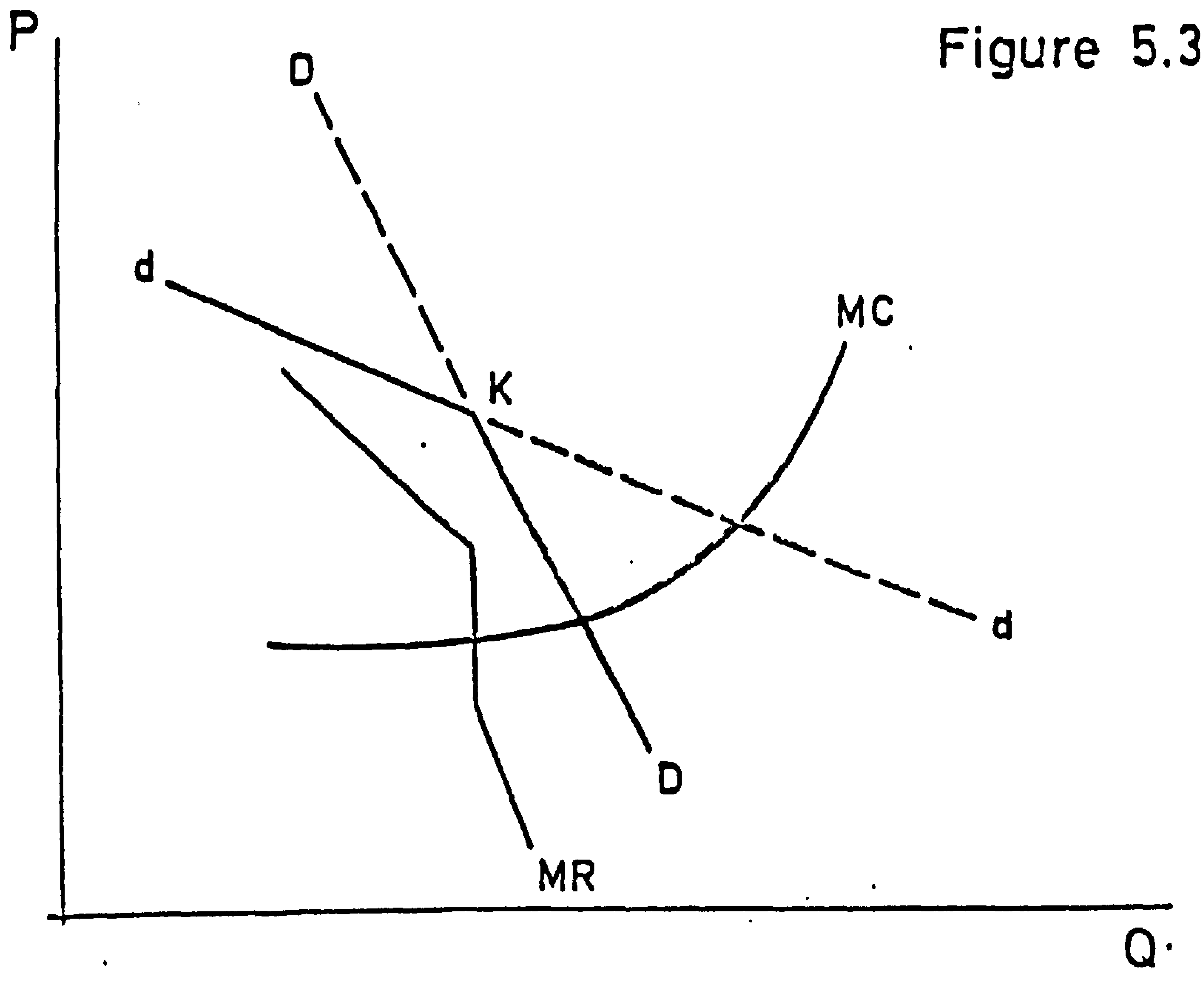
A final question that remains to be answered is how the full cost or target rate price fluctuate during the course of a trade cycle. The limit price theory provides an explanation of how the markup is set in the above pricing models and consequently how the price level is determined. However, it does not offer an explanation of how this price changes in response to changes in economic conditions: Hall-Hitch (1939) provide an answer to this problem by using the apparatus of the kinked-demand curve.

5.2.5. The full cost and target rate prices in the trade cycle: the Kinked demand curve.

Among the several findings of the Hall-Hitch paper was an empirical observation that prices in oligopolistic markets once determined on the basis of the full cost principle showed a tendency to remain sticky. Stickiness in prices was rationalized by the use of the Kinked demand curve which was introduced almost simultaneously by Hall-Hitch and P. Sweezy (1939).

The demand curve of the oligopolist is assumed to have a kink (at point K in figure 5.3)) that reflects the following pattern of the firm's behaviour as far as the expected reactions of its competitors are concerned. If the businessman reduces his price he expects that his competitors will follow suit by matching the price cut so that although the demand in the market has increased, the shares of the competitors have remained unchanged. Thus for price reductions below the price P that corresponds to the point of the kink K, the market share demand curve is the relevant curve for decision making (KD part of the DD curve). If the businessman increases his price he expects that his competitors will not follow him and so he will lose a considerable part of his custom. Thus for price increases above P the relevant demand curve is the section dK of the dd curve which is the individual demand curve of the firm.

Figure 5.3



DD = Market share demand curve

dd = individual demand curve

MR = marginal revenue curve

MC = marginal cost curve

The demand curve (dD) therefore does not have a constant elasticity, being relatively elastic on the upper section and relatively inelastic on the downward section. The profit maximising strategy of the firm is to maintain price at the existing level P. Variations in marginal cost will not affect this price since marginal revenue is discontinuous reflecting the two demand curves with different elasticities. The price is set at a level P and would remain there. Variations in demand will be met by variations in production, the kinked demand curve effectively shifting horizontally to the right at the same price level.

The kinked demand theory is not a theory of price determination; it can not explain the price and output decisions of the firm since there is no justification of why the existing price is at the level that it is. It is merely a theory of price stability; why a price once set does not change. Moreover, it has been offered as a theoretic explanation to the observed phenomenon of price rigidities in oligopolistic markets particularly during the thirties. Whatever the validity of this observation, there is a significant concern as far as the kinked demand theory's fit with reality.[4] A strict interpretation of the theory implies that prices should be more rigid under oligopoly conditions than in pure monopolies or in industries dominated by a single firm, for monopolists or dominant firms need have little or no concern over whether their pricing initiatives are followed by other rivals. Various studies however have shown prices to be as rigid in markets approximating monopolies as in oligopolistic markets. It is obvious therefore that the kinked demand apparatus is not the sole reason for rigidity in prices in markets where sellers enjoy some monopoly power. Monopolists as well as oligopolists may set prices at levels satisfying long run strategy goals and not deviate from their announced price structure when demand or cost-changes, thought to be of a short run nature occur.

In summary, the standard cost notion provides the basis for the full cost and target rate of return pricing models. The markup and target rate are determined at such levels that will effectively prevent entry into the industry. The full cost or target rate price is above the competitive and below the monopoly price because of barriers to entry and fear of potential entry. The full cost and target rate of return price is the limit price. The limit price once set shows a tendency of not responding to changes in costs or demand perceived to be of temporary duration. One possible explanation is that the demand curve shows a kink at the limit price. An increase in price will not be followed since by precipatating new entry into the industry will consequently result in a loss of market share. Price rigidity is not predicted by the full cost or target rate of return models as such. Simply short run fluctuations in cost or demand are not transmitted into price fluctuations. Demand movements that are considered to be of a permanent nature affect prices via the markup or target rate and via costs filtered through the channel of standard output.

The next two sections are concerned with the formulation, estimation and testing of the full cost and target rate of return pricing models.

5.3 Formulation estimation and testing of the full cost pricing model

5.3.1 Introduction

This section is concerned with the derivation of the full cost model, its estimation and its testing. Subsections 5.3.2 and 5.3.3 discuss the pricing process of firms excercising the full cost pricing method and derive the full cost model respectively. In section 5.3.4 we examine the specification of the variables that enter the full cost model which for the most part is based on the analysis of chapter 4. Section 5.3.5 is concerned with the econometric transformation of the full cost model while in section 5.3.6 we present and discuss the empirical application of the full cost model on the two digit SIC industrial sectors of Greece.

5.3.2 The full cost pricing process

The analysis of section 5.2 has indicated that the pricing process based on the full cost principle involves two policy instruments on the part of the firm. The first is the determination of the standard costs which the firm has to cover and the second is the determination of the markup that is applied upon these costs to yield such a price that would effectively deter entry into the industry.

The firm uses the full cost markup rule according to which the price P_f is set according to (5.9).

(5.9) $P_f = UVC + UFC + NPM$

where UVC = unit variable costs

UFC = unit fixed costs

NPM = net profit margin

The unit variable cost is assumed known to the firm with certainty. The firm will concentrate on that part of the average cost curve that represents a normal (standard) utilization of capacity. The normal utilization of the plant will be different among firms and industries. It is below capacity output but just how far below is determined by many factors such as the level and variability of demand, the structure of holding costs, the frequency and the severity of machine failure, the possibility of backlogging orders etc. F.M.Scherer (1980) gives approximate values of plant utilization at 80-90% of capacity, while W.D.Nordhaus (1974) states that businessmen customarily prefer to have capacity about 7% above normal output. The firm will look at its long run position and will aim at long run profit maximization. However, given the uncertain future the firm will base its price decisions upon short run average costs. Standard output (and costs) provide the link between short run and long run. Unit variable costs will therefore be calculated not on actual but on standard output levels (QN), while unit fixed costs will be allocated per unit of output by dividing the total fixed costs over standard output. The addition of the net profit margin (NPM) or the full cost markup $(1 + \pi)$ to the unit variable and unit fixed costs will provide the price that the firm would wish to charge if it is to cover all its costs calculated at the standard level of output and make what it thinks to be a normal profit.

The thus estimated price, the costing price according to

P.W.S. Andrews (1949) will not necessarily be applied under all situations and circumstances.[5] The differentiating factor between the costing price and the actual price charged will be the threat of potential entry. Actual competition between existing firms in the industry will be resolved either by collusion, tacit or overt or by price leadership. Since existing firms in the industry will not have the same cost structure, pricing according to the full cost method may result in market instability and trade wars. The existence of a price leader (or cullusion taking the form of trade association for that matter) will smooth out these differences by charging a price P_F of which the cost part is based on the calculations described before and the markup is influenced by:

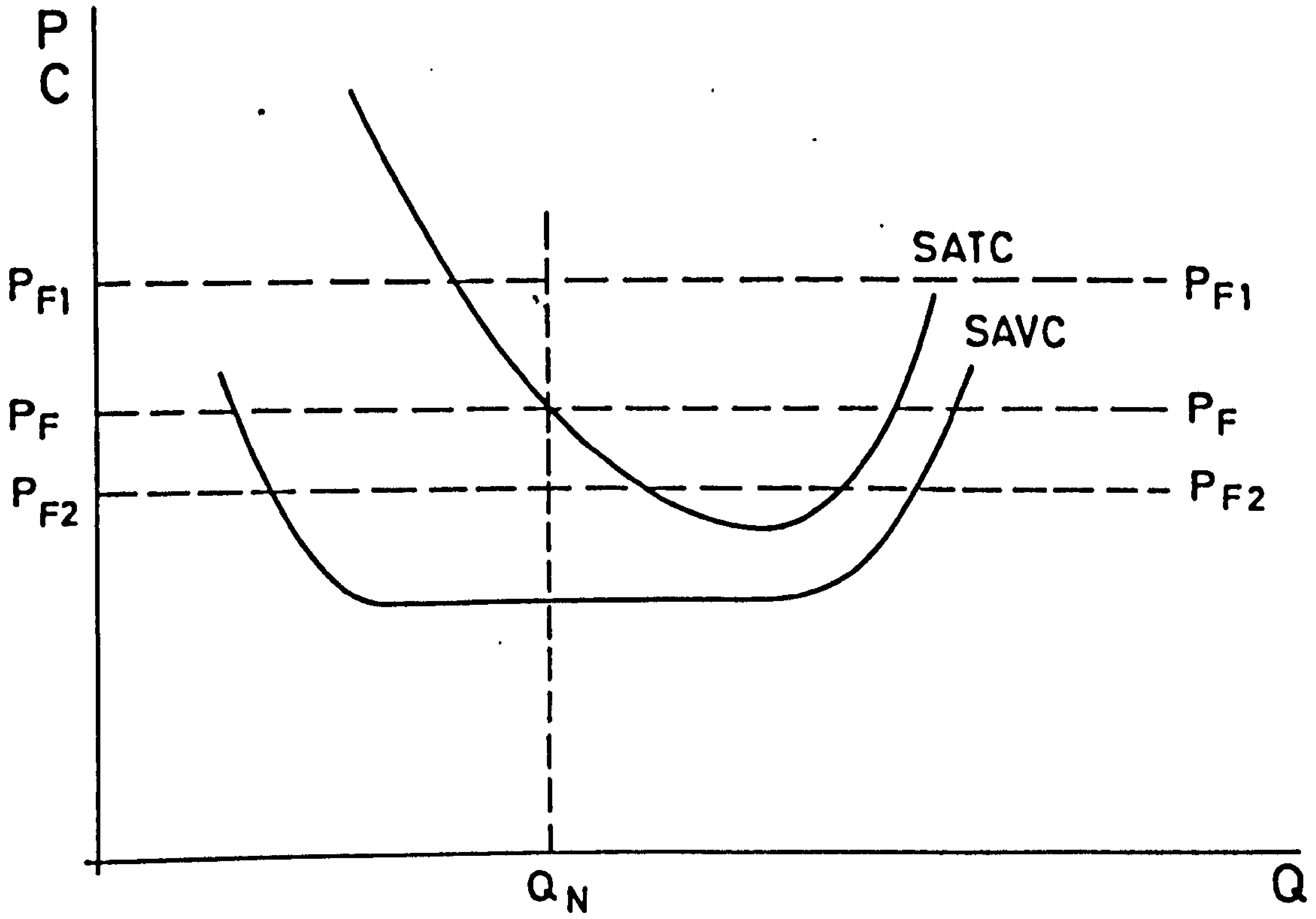
(a) the threat of potential entry and barriers to entry, and

(b) the general economic conditions.

Depending on the existence and the strength of entry barriers and the threat of potential entry the markup may be differentiated so that the price P_F which would normally cover standard full costs and normal profits may be set at the P_{F_1} or P_{F_2} levels (see figure 5.4).

The price leader given his cost structure would normally charge the P_F price covering his standard cost and normal profits and at that price he would be prepared to sell whatever the market would take. If barriers to entry exist or conditions of trade are persistently booming, the leader would charge the price P_{F_1} which would yield more than normal profits at the standard level of output. However if potential competition is strong, or conditions of trade are persistently depressed the leader would charge the price P_{F_2} which would yield less than normal profits at the standard level of output[6].

Figure 5.4



The full cost price will therefore be insensitive to changes in unit costs as long as they do not affect the firm's calculation of standard output and costs. Similarly demand fluctuations that are perceived to be of temporary nature will not affect the full cost price. If demand increases, the short run response of the firms will be to adopt a queueing policy (i.e. backlogging of orders) rather than to increase prices since they are uncertain about the persistence of the demand pressure. Moreover they would probably be afraid to damage their goodwill by exploiting a temporary sellers market. If the increase in demand is persistent, firms will expand by using their reserve capacity with which their plants are built. Persistence of demand exhausting the firm's capacity will result eventually in higher prices but only to the level of P_{F_1} since the fear of potential entry will deter firms from charging the monopolists' price.

If demand declines the short run policy of the firm that prices on the full cost rule would be to respond by reducing the output. As long as the decline in demand will not affect the firm's notion of standard output, costs will not be increased. A secular decline in demand however will eventually drive the firm to a price cutting situation from which only the most efficient firms will survive. In such a case, the fall in price would be limited because the existence of barriers to entry will deter the price of selling below the P_{F_2} level to the competitive price.

5.3.3 The full cost price determination

The definition of the full cost price is given in equation (5.1). The full cost markup$(1 + \pi)$ (or net profit margin (NPM) in terms of equation (5.9)) is applied upon all cost categories, variable $\frac{\beta V(QN)}{QN}$ and fixed $\frac{F}{QN}$

$$(5.1) \quad P = (1 + \pi) \left[\frac{\beta v(QN)}{QN} + \frac{F}{QN}\right]$$

Variable cost includes labour and materials bill. Labour bill is the price of labour multiplied by the labour input (total of hours worked) and materials bill is the price of materials multiplied by the materials input (volume of materials). The labour and materials input are a function of outupt or for the purposes of the full cost pricing model a function of standard output.

Denoting by:

Pw, the price of labour

L(QN), the labour input

Pm, the price of materials

M(QN) the materials input

then,

$$(5.10) \quad \frac{\beta V(QN)}{QN} = \frac{Pw\ L(QN)}{QN} + \frac{Pm\ (M(QN)}{QN} = ULCN + UMCN$$

where, ULCN = unit labour cost at standard output

UMCN = unit materials cost at standard output

Fixed cost include capital bill which is defined as the sum of depreciation financial and rent expenditure. Unit capital cost at standard output is the ratio of capital bill over standard output.

$$(5.11) \quad UCCN = \frac{DEP + INT + RENT}{QN}$$

Equation (5.1) can be further rewritten as (5.12)

$$(5.12) \quad P = (1 + \pi)\,[ULCN + UMCN + UCCN]$$

Taking the total differential on (5.12), dividing by P and rearranging we have:

$$(5.13) \quad \frac{dP}{P} = \frac{d(1 + \pi)}{(1 + \pi)} + \frac{(1 + \pi)}{P}\, d\,[ULCN + UMCN + UCCN]$$

or equivalently

$$(5.13)' \quad \frac{dP}{P} = \frac{d(1 + \pi)}{(1 + \pi)} + \frac{(1 + \pi)}{P}\, dULCN + \frac{(1 + \pi)}{P}\, dUMCN + \frac{(1 + \pi)}{P}\, dUCCN$$

which after some manipulation can be written as:

$$(5.14) \quad \frac{dP}{P} = \alpha_1 \frac{d(1 + \pi)}{(1 + \pi)} + \alpha_2 \frac{dULCN}{ULCN} + \alpha_3 \frac{dUMCN}{UMCN} + \alpha_4 \frac{dUCCN}{UCCN}$$

where $\alpha_1 = 1$

$$\alpha_2 = \frac{(1 + \pi)\, ULCN}{P}, \quad \alpha_3 = \frac{(1 + \pi)\, UMCN}{P}, \quad \alpha_4 = \frac{(1 + \pi)\, UCCN}{P}$$

or approximately

$$(5.15) \quad d\ln P = \alpha_1\, d\ln\,(1 + \pi) + \alpha_2\, d\ln\, ULCN + \alpha_3\, d\ln\, UMCN + \alpha_4\, d\ln\, UCCN$$

From the variables appearing on the right hand side of equation (5.15) only the markup is unobservable and has to be proxied. The limit price determination theory offers a long run solution as far as the determination of the markup is concerned, i.e. in terms of equation (5.8).

$$(5.16) \quad (1 + \pi) = 1 + Qm/Qc.e$$

Equation (5.16) however, does not qualify as a determining rule for the markup in terms of an equation explaining short-run changes in prices since:

(a) it refers to a long run relationship determining the limit price, while the full cost equation refers to a relationship between the rate of change of prices, of cost and of demand.

(b) there is no information available for measuring the arguments of the entry premium.

(c) it does not serve the purpose set out in the beginning of this study i.e. to examine how changes in prices are affected by changes in cost and demand.

Moreover, the assumption of the previous section that short-run fluctuations in demand do not affect the full cost price cannot really be tested unless a demand variable is included in equation (5.15). A way out is offered in the discussion of section 3.8.6 whereby the rate of change of the markup is seen to depend on the level of demand pressures and the speed with which these pressures fluctuate over the cycle. This can be formally represented by equation (5.17)

$$(5.17) \quad d\ln\,(1 + \pi) = \beta_1 \ln \frac{Q}{QN} + \beta_2 d\ln \frac{Q}{QN}$$

Incorporating equation (5.17) into equation (5.15) we have:

$$(5.18) \quad d\ln P = c_0 + c_1 d\ln ULCN + c_2\, d\ln UMCN + c_3\, d\ln UCCN + c_4 \ln \frac{Q}{QN} + c_5 d\ln \frac{Q}{QN}$$

Equation (5.18) is the full cost price determination equation. It includes three new variables, namely standard unit labour, standard unit material and standard unit capital cost variables. The specification of these variables is the subject matter of the next sub-section.

5.3.4 Specification of the full cost variables: the standard unit labour, unit material and unit capital costs.

The customary formulation of the full cost pricing model assumes that most firms establish prices based on some concept of unit costs at a standard level of output and neglect short run variations in demand or productivity. Generally, the literature has focused on the distinction between the long run and the short run as the key characteristics used by an industry in defining standard costs. One means of representing long run influences in price equations is to select cost measures which are invariant to cyclical variations in output. Alternatively, cost measures with cyclical variations may be smoothed. A moving average for example eliminates short run variations and hence may be a useful description of "long run" cost influences.

However, there may be circumstances in which current period measures of market conditions may be a useful predictor of pricing decisions. In some instances a large increase in demand or costs in the current quarter indicates a change which will not be reversed. A change in negotiated wage rates or a price change of a key material input are obvious examples on the cost side. Just what type of demand change can be construed as signalling a permanent shift is less obvious. In periods of large increases in demand or cost which would allow the industry to raise its price without substantially affecting output, all firms may tacitly agree that a formula based on a weighted average of past period prices is no longer relevant. During such periods short run market conditions as reflected in current quarter data on utilization rates or input prices are highly visible to all and may prove relatively easy to use as the basis for tacit agreement on prices.

The methodology adopted here for the generation of the "standard" versions of the unit cost variables is based on the work of K. Coutts W. Godley and W. Nordhaus (1978) and is described in detail in chapter 4. In principle it involves the purging of all elements of the unit labour and unit material cost variables that are subject to cyclical variations.

Standard unit labour cost is given by equation (5.19) (repeating equations 4.34) as

$$(5.19) \quad ULCN = \frac{WMN + WFN + SMN + SFN + EMP}{QN}$$

Each of the arguments on the right hand side of the equation (5.19) reflects the standardised labour bill for the five labour categories namely male manual workers bill, female manual workers bill, male administrative technical and clerical personnel (ATC) salary bill, female ATC'S salary bill and employers and family members re-numeration[7].

The standard unit material cost is defined in equation (5.20) (repeating equation (4.37)) as

$$(5.20) \quad UMCN = \frac{Pm\ MN}{QN}$$

where P_m is the materials price index

MN is the volume of materials at the standard level of output.

The standard unit capital cost is given in equation (5.11). The derivation of the DEP, INT and RENT variables has been described in Appendix 3. Similar or slightly similar specifications to the one adopted here can be found in C. Schultze and J. Tryon (1964), where UCC is constructed as the ratio of depreciation (capital consumption allowance) to normal output, the depreciation series serving as proxy for the physical price of capital. UCC has also been expressed as the long term interest rate, representing the cost of debt financing (see O. Eckstein, D. Wyss (1972)), although a better theoretical formulation in this case would be the total interest cost per unit of output.

The standardization process is supposed to result in values of the standardized series that are smoother than the actual series. As a means of testing this, the mean and standard deviations of the unit labour, unit materials and unit capital costs at the actual and standard level of output are given in table 5.1. Although the expectation is that the st. deviations of the standard unit cost series are smaller than the st deviations of the actual unit cost series, a note should be taken to the effect that standard labour and standard materials bill are divided by standard output which is also smoother than actual output. Given the definitions of ULC, ULCN and UMC, UMCN, then if the ratios

$$(5.21) \quad \frac{L(Q)}{Q} \Big/ \frac{L(QN)}{QN} \quad \text{and} \quad \frac{M(Q)}{Q} \Big/ \frac{M(QN)}{QN}$$

remain constant, the st. deviations of the actual and standard unit cost would be the same. This however, is an unlikely possibility

Table 5.1: Means and st. deviations of ULC, ULCN, UMC, UMCN, UCC, UCCN; Two digit SIC sectors, Greek industry

Sector	ULC		ULCN		UMC		UMCN		UCC		UCCN	
	mean	st.dev.	mean	st.dev.	mean	st.dev.	mean	st.dev.	mean	st.dev.	mean	st.dev.
TOT	1.403	0.5603	1.218	0.3514	1.463	0.6280	1.454	0.6014	1.371	0.4209	1.310	0.3832
20	1.330	0.5082	1.236	0.4083	1.352	0.5322	1.347	0.5135	1.353	0.4372	1.330	0.4228
21	1.254	0.4691	1.247	0.4164	1.377	0.4647	1.285	0.4112	1.257	0.4143	1.232	0.3544
22	1.167	0.4203	1.237	0.3813	1.373	0.6019	1.338	0.5104	1.080	0.2423	1.111	0.1465
23	1.298	0.4851	1.250	0.4031	1.326	0.4454	1.300	0.4310	1.429	0.4782	1.405	0.4336
24	1.330	0.4825	1.388	0.6432	1.269	0.3696	1.276	0.3779	1.381	0.2678	1.436	0.2317
25	1.309	0.4721	1.206	0.3447	1.465	0.6179	1.387	0.5542	1.190	0.5843	1.066	0.4255
26	1.425	0.5739	1.272	0.4674	1.425	0.5742	1.315	0.4612	1.456	0.4971	1.326	0.4210
27	1.536	0.6864	1.271	0.4218	1.346	0.4910	1.358	0.4908	1.196	0.3269	1.034	0.1982
28	1.433	0.6542	1.265	0.4602	1.497	0.7627	1.448	0.6629	1.477	0.6626	1.410	0.5643
29	1.225	0.3762	1.259	0.4010	1.304	0.4602	1.295	0.4503	1.299	0.4761	1.249	0.4315
30	1.249	0.3736	1.181	0.3094	1.311	0.4607	1.288	0.4277	1.075	0.3322	1.091	0.3021
31	1.218	0.3107	1.168	0.2525	1.375	0.4833	1.315	0.4315	1.073	0.1337	1.047	0.1086
32	1.543	0.8284	1.108	0.1591	2.555	2.1930	2.389	1.9620	5.054	4.8060	4.207	3.8000
33	1.193	0.3210	1.145	0.2306	1.573	0.5694	1.305	0.4607	1.300	0.3178	1.273	0.2883
34	1.439	0.4516	1.106	0.1700	1.483	0.5697	1.255	0.3646	1.287	0.2730	0.915	0.1569
35	1.250	0.4943	1.229	0.3846	1.203	0.4916	1.298	0.4935	1.218	0.3887	1.205	0.3841
36	1.218	0.3872	1.229	0.3833	1.395	0.5186	1.333	0.5077	1.236	0.3928	1.246	0.4304
37	1.478	0.7175	1.217	0.3620	1.272	0.4532	1.346	0.5110	1.555	0.5754	1.273	0.3220
38	1.576	0.6562	1.269	0.4395	1.349	0.5723	1.402	0.6002	1.567	0.5419	1.434	0.5163
39	1.160	0.3034	1.157	0.2704	1.217	0.4246	1.294	0.4681	1.621	0.4147	1.524	0.3600

as it is shown by the results of table 5.1. Indeed, ULCN has larger st. deviations in only two sectors, SIC : 24 and 28, while UMCN in five; SIC: 24, 35, 37, 38 and 38.

The next section is concerned with the econometric specification of the full cost model as given by equation (5.18).

5.3.5 Econometric specification of the full-cost model

The full cost model as it stands in equation (5.18) implicitly assumes an instantaneous adjustment between changes in unit costs and demand on the one hand and changes in prices on the other. To obtain an operational version of (5.18) a dynamic specification is required that will explain the speed at which changes in costs and demand are translated into price changes. The discussion of section 3.6.2 establishes the need of such a specification. By introducing a maximum number of lags up to four quarters on all explanatory variables with the exception of unit capital costs (where the adjustment is assumed to be completed with 8 quarters) and adding an error term equation (5.18) becomes

$$(5.22) \quad d\ell nP_t = \pi_0 + \sum_{i=o}^{4} \pi_{1i}\, d\ell n\ ULCN_{t-i} + \sum_{i=o}^{4} \pi_{2i}\, d\ell n\ UMCN_{t-i} + \sum_{i=o}^{8} \pi_{3i}\, d\ell n\ UCCN_{t-i} + \sum_{i=o}^{4} \pi_{4i}\, \ell n\left(\frac{Q}{QN}\right) + \pi_5\, d\ell n\left(\frac{Q}{QN}\right)_{t-i} + u_t$$

where $u_t \sim NID\ (0, 6^2 u)$

and the term $\sum_{i=o}^{4} \pi_{4i}\ \ell n\left(\frac{Q}{QN}\right)_{t-i} + \pi_5\, d\ell n\left(\frac{Q}{QN}\right)_t$.

can be either $\sum_{i=0}^{4}\pi_{41i}CU_{t-i} + \pi_{51}ECU_{t}$

if the trend method is used (See equation 3.107)

or $\sum_{i=0}^{4} \pi_{42i} CW_{t-i} + \pi_{52}ECW_{t}$

if the Wharton method is used (see equation (3.108))

The procedure for estimating the full cost equation has been described in detail in section 2.6. We begin from the most general form depicted by equation (5.22) and proceed by testing sequentially by means of likelihood ratio tests to the most specific models reported in table 5.2. The maximum number of lags on all the explanatory variables discussed so far is set equal to 4 for reasons explained in section 3.6.2 However, due to the long run nature of the full cost model it was assumed that the adjustment of capital cost changes into price changes would require a period of two years. Although this seemed to be a plausible assumption it was met with little success since in most industrial sectors the adjustment is completed within 4 quarters or less.

It was further mentioned in section 2.6 that the explanatory variables entering all price models considered in this thesis are regarded as exogenous and are distributed independently of the error term. These assumptions guarantee the optimal properties of the coefficients derived under the ordinary least squares method. However, the interdepencence of economic phenomena may make these assumptions unattainable and hence call for a different estimation technique. Once such possibility would be to use a simultaneous equation estimation.

Such estimation methods are broadly categorized into systems methods and individual equation methods[8]. Asymptotically efficient estimates can be obtained by using full information maximum likelihood method (FIML) or by three stage least squares method (3SLS). The advantage of full information methods is that they make maximum use of the available information and in particular the parameter restrictions in the structural equations and the variance convariance matrix of the structural errors.

An alternative estimation method is two stage least squares (2SLS) applied to individual equations. This method yields consistent estimates which, however, are asymptotically less efficient than FIML or 3SLS, since the 2SLS estimator uses less information than systems estimators.[9] Another alternative is the instrumental variable (w) estimator. This may use fewer instrumental variables than the 2SLS method and hence may be less asymptotically efficient in general. However, due to their lack of robustness to mispecification, systems estimators may be less reliable than the individual equation estimators. Instrumental variable methods have the advantage of restricting any mispecification error to the individual equation in which it occurs, contrary to systems estimators where mispecification in an individual equation can be fed into the rest of the system. Although the OLS method in a simultaneous equation context leads to inconsistent estimates it is worth noting that large. consistency is a small sample property. In small samples the property of consistency is less useful and may not even be a good guide to small sample bias. Moreover, from the many Monte-Carlo studies that have investigated the small sample properties of various estimates [10] there appears to be little consensus on the choice of the estimation technique.

To recapitulate, in the presence of endogenous explanatory variables the use of a simultaneous equation estimation would be appropriate. This would indeed be so, if the price equations were estimated at the aggregate economy level. At the two digit level disaggregation however it is unlikely that the feedback of prices on wages (and on material and capital prices for that matter) within the current period would be significant.[11] Therefore, the simultaneity problem is greatly reduced since the exogenous influence of prices outside the two digit manufacturing sector will weaken the dependence of sectoral costs (labour costs in particular) on sectoral prices. A problem of endogeneity might however exist with regard to the demand variable. Since such a variable is constructed as the ratio of sectoral output to the trend of sectoral output there might be a correlation between the demand variable and the error term due to the possible joint determination of sectoral price and output. If this were to be true, then the OLS method would yield inconsistent estimates. Such an estimation would call for an instrumental variable estimation technique.

It was therefore decided to test for a possible endogeneity bias as far as the demand variable is concerned by means of a Hausman endogeneity test.[12] The choice of the instruments for such a test however is constrained by the fact that the unrestricted model utilizes quite a number of lags. Additional lags than those used in the general model were used as instruments, i.e. 5,6,7,8 and 9 quarter lags were used as instruments for the 0,1,2,3, and 4 quarter lags on the demand variable. The test was implemented selectively in a small number of sectors that was used as a pilot for the rest and indicated the absence of significant endogeneity bias. The OLS estimation technique is therefore considered as appropriate.

The preceeding discussions of full cost pricing indicated that the acceptance of this model as a valid pricing approach rests upon the test of two hypotheses; namely that prices rise only when standard costs rise and short run fluctuations in demand play no role in the pricing process. Translating these into terms of equation (5.22) we would expect the following signs on the parameters of the full cost model

$$(5.23)\quad \sum_{i=0}^{4} \pi_{1i}\ ,\ \sum_{i=0}^{4} \pi_{2i}\ ,\ \sum_{i=0}^{8} \pi_{3i}\ >\ 0 \text{ and } \sum_{i=0}^{4} \pi_{4i},\ \pi_5\ =0$$

As far as the individual coefficients are concerned, they can assume any value given that the estimation of the lag parameters is totally unconstrained. One would of course expect positive coefficients on the cost variables, but the test of the hypothesis rests with the long run values given in table 5.2.[13].

With regard to the effect of labour productivity changes on price charges it is obvious that short run changes in productivity are considered as transitory and hence play no role in the full cost model. The effects of permanent or "standard" labour productivity on prices are captured by ULCN which by construction includes a measure of standard productivity.[14] Nonetheless, and contrary to the view taken in the average cost model we impose the restriction that the effects of standard labour productivity changes and wage rate changes on full cost price changes are the same. The presentation and discussion of the results of the full cost model is the subject matter of the next subsection.

5.3.6 Estimation and discussion of the full cost results

The results of the full cost equation are given in table 5.2. As before, the first part of the table includes the long run values of the coefficients defined in the form of $\Sigma\pi_{ji}$. The second part (Table 5.2.2) consists of a number of summary statistics and diagnostic tests all of which have been defined previously in section 3.6.5. Tables 5.2.3, 5.2.4, 5.2.5, 5.2.6 and 5.2.7 present the individual coefficients of the explanatory variables.

On the whole the performance of the full cost equation when applied to the two digit SIC sectors of Greek manufacturing during the period 1963_{i} - 1977_{iv} is rather poor, since only four sectors were able to pass the econometric and economic criteria set forth in the beginning that justify full cost as a representative pricing method. Starting from table 5.2.2 the multiple correlation coefficient takes high scores in general with the exception of sectors 25, 28, 38 and 39, which are around or less than 50%. The values of $\bar{R}^2$ are generally smaller than those of the neoclassical and average cost models but compare favourably to other full studies.[15] The hypothesis of zero autocorrelation in the residuals on the basis of $Z_{1(4)}$ statistic is rejected in three sectors SIC: 23, 24, 38. Moreover, a test of fourth order autocorrelation in the residuals suspected due to the quarterly nature of the model[16] reveals autocorrelation of this order in two more sectors: TOT ($Z_{1(1)}$= 4.869) and 20 ($Z_{1(1)}$= 4.000). The post parameter stability test given by the Z_4 (4,i) statistics indicates mi specification in sectors TOT 22, 24, 25 thus giving a total of 7 sectors in which the full cost model is rejected on the basis of econometric criteria, i.e. SIC: TOT, 20, 23, 24, 25, 30 and 38. Finally, the Chow Z_5 (ij) statistic indicates a different pricing pattern between subsamples

Table 5.2: Results on Full.cost equation (5.22)

Part 1 : Long-run coefficients

Sector	$\sum_{i=o}^{4} \Pi_{1i} d\ln ULCN_{t-i}$	$\sum_{i=o}^{4} \Pi_{2i} d\ln UMCN_{t-i}$	$\sum_{i=o}^{8} n_{3i} d\ln UCCN_{t-i}$	$\sum_{i=o}^{4} \Pi_{41i} CU_{t-i}$	$\Pi_{51} ECU_t$	$\sum_{i=o}^{4} \Pi_{42i} CW_{t-i}$	$\Pi_{52} ECW_t$
TOT	0.088682 (0.726)	0.501849 (6.185)	0.043973 (3.571)			0.000432 (0.794)	0.000125 (1.505)
20	0.091592 (1.303)	0.843037 (20.59)	0.049980 (1.500)			-0.000406 (1.753)	
21	0.115737 (1.2957)	0.815881 (7.254)	0.116844 (1.433)			0.000132 (0.626)	
22	0.106378 (0.684)	0.697847 (7.719)	-0.02096 (0.1465)			-0.000786 (2.057)	
23	0.128501 (1.239)	0.528979 (3.340)	0.176005 (2.047)				
24	0.15422 (1.702)	0.54067 (5.625)	0.17295 (2.742)			-0.00026 (1.866)	-0.00929 (6.683)
25	0.33186 (1.505)	-0.11811 (0.549)	0.19380 (2.221)			0.00248 (2.984)	
26	0.295502 (1.967)	0.563615 (5.174)	0.203105 (2.352)				-0.000425 (0.796)
27	0.235674 (2.015)	0.687834 (8.274)	0.10392 (2.282)			0.000511 (1.953)	0.000392 (2.563)
28	0.335472 (2.965)	0.573204 (3.737)	0.28382 (2.243)				
29	-0.20664 (2.160)	1.20454 (13.36)	0.19727 (1.591)				-0.000352 (3.715)
30	-0.18865 (1.857)	1.06299 (7.076)	0.30247 (1.419)				
31	0.25992 (1.620)	0.75629 (6.924	-0.07621 (1.287)			-0.000914 (2.099)	-0.000253 (1.858)
32	-0.595985 (3.323)	0.969065 (18.171)	0.021179 (1.200)	-0.000096 (1.228)			
33	0.678368 (3.162)	0.364572 (2.695)	0.163682 (2.265)	0.000181 (0.490)			
34	-0.499582 (2.374)	0.851771 (8.380)	0.090913 (1.567)	-0.000179 (1.649)	-0.05053 (3.509)		
35	0.23177 (4.242)	0.53271 (10.827)	0.158388 (3.297)			0.000887 (3.231)	-0.000475 (7.070)
36	0.22939 (1.968)	0.520139 (3.727)	0.095268 (1.974)	0.002165 (2.432)	-0.000353 (3.581)		
37	0.146787 (2.672)	0.682846 (8.543)	0.082066 (2.849)				
38	0.32925 (1.259)	0.432029 (1.821)	0.274218 (1.542)			0.001061 (0.914)	
39	0.54147 (2.607)	0.327741 (1.989)	0.165833 (3.244)			0.002072 (2.911)	

Table 5.2: Results on Full-cost equation (5.22)

Part 2 : Test statistics

Sector	SSR	SE	$\bar{R}^2$	DW	$z_{1(4)}$	$z_{3(1)}$	$z_{4(4}$	$z_{5(1}$
TOT	0.003071	0.011312	0.9208	2.427	8.403	(10) 14.270	15.31 (2.69) (4.28)	4.75 (3.22) (16.8)
20	0.003117	0.009305	0.9321	2.449	7.254	(14) 17.900	0.061 (2.61) (4.40)	1.25 (2.27) (8.28)
21	0.004024	0.011780	0.9235	2.316	6.970	(7) 6.382	0.382 (2.67) (4.33)	1.712 (2.46) (15.14)
22	0.010317	0.017420	0.8135	2.430	9.316	(12) 11.806	2.891 (2.61) (4.38)	3.008 (2.25) (10.24)
23	0.010944	0.016971	0.6398	2.444	12.178	(17) 5.318	0.191 (2.61) (4.42)	0.781 (2.42) (6.32)
24	0.004432	0.012362	0.8236	2.537	13.454	(15) 18.31	3.192 (2.67) (4.33)	4.012 (2.35) (11.18)
25	0.051022	0.038181	0.3108	1.915	1.606	(13) 7.389	7.772 (2.63) (4.37)	11.051 (2.28) (9.26)
26	0.012442	0.018590	0.6968	2.196	3.860	(14) 8.496	0.888 (2.61) (4.40)	0.951 (2.27) (8.28)
27	0.018402	0.022929	0.7488	2.3911	9.312	(13) 4.924	1.657 (2.61) (4.39)	0.793 (2.28) (9.26)
28	0.064549	0.042945	0.4186	2.209	6.826	(12) 11.56	0.777 (2.57) (4.49)	1.814 (2.53) (5.30)
29	0.006325	0.014284	0.8374	2.009	6.127	(17) 21.386	0.500 (2.65) (4.35)	3.749 (2.34) (9.22)
30	0.014773	0.021486	0.6912	2.366	7.999	(18) 22.872	0.588 (2.69) (4.32)	1.114 (2.36) (8.24)
31	0.008896	0.016419	0.7307	2.158	6.351	(11) 8.198	0.847 (2.69) (4.33)	0.519 (2.23) (11.22)
32	0.004654	0.013129	0.9697	2.283	1.483	(5) 3.318	0.553 (2.69) (4.31)	1.331 (2.85) (17.10)
33	0.003241	0.010394	0.9108	2.171	7.295	(8) 5.804	0.546 (2.65) (4.34)	0.671 (2.35) (14.16)
34	0.011209	0.018157	0.6696	2.507	5.316	(12) 9.352	2.412 (2.61) (4.38)	6.173 (2.25) (10.24)
35	0.003144	0.009760	0.9189	2.037	0.681	(19) 21.276	0.004 (2.61) (4.37)	0.852 (2.40) (7.26)
36	0.004304	0.013121	0.7992	2.234	3.703	(11) 6.086	1.736 (2.61) (4.29)	2.021 (2.85) (15.10)
37	0.004467	0.011298	0.8502	2.452	6.795	(21) 18.504	0.221 (2.61) (4.39)	1.339 (2.53) (5.30)
38	0.083048	0.050766	0.2721	2.831	11.339	(19) 17.176	0.0491 (2.61) (4.37)	0.177 (2.40) (7.26)
39	0.921737	0.024573	0.5269	2.446	5.423	(14) 12.150	0.373 (2.61) (4.40)	0.959 (2.27) (8.28)

Table 5.2: Results on Full-cost equation (5.22)

Part 3 : Individual coefficients on $d\ell nULCN_{t-i}$

Sector	Π_o	Π_{10}	Π_{11}	Π_{12}	Π_{13}	Π_{14}
TOT	0.00167 (0.308)	-0.19128 (1.786)			0.27996 (2.547)	
20	-0.00319 (1.050)			0.106032 (1.971)	0.07576 (1.357)	-0.090196 (1.869)
21	0.00289 (0.444)	-0.20495 (2.593)	0.131799 (1.884)		0.188892 (2.845)	
22	-0.01502 (1.969)				0.362442 (2.850)	-0.25606 (2.312)
23	0.00339 (0.945)		0.128501 (1.239)			
24	-0.0100 (1.314)	0.15422 (1.702)				
25	0.0538 (3.408)				0.33186 (1.505)	
26	-0.00423 (0.978)	-0.19805 (1.928)	0.25833 (2.471)	0.23522 (2.313)		
27	0.012134 (1.831)		0.23568 (2.015)			
28	0.01382 (1.172)				0.33547 (2.965)	
29	-0.01033 (2.188)				-0.20664 (2.160)	
30	-0.00822 (1.438)	-0.18869 (1.587)				
31	-0.0172 (1.700)		0.339650 (2.862)		0.186285 (1.555)	-0.266017 (2.464)
32	0.00255 (0.917)	-0.395403 (3.851)	0.429767 (4.279)	-0.302491 (2.409)	-0.327858 (3.197)	
33	-0.00034 (0.159)	0.282041 (2.132)	-0.180965 (1.687)	0.577292 (4.647)		
34	0.01214 (3.012)	-0.256791 (1.897)				-0.242791 (1.850)
35	0.01014 (1.577)	0.231774 (4.242)				
36	0.00087 (0.256)		0.179536 (2.167)	-0.101458 (1.299)	-0.189051 (2.172)	0.340366 (3.209)
37	0.00087 (0.328)				0.146787 (2.672)	
38	0.00392 (0.225)	0.329249 (1.2585)				
39	0.0259 (1.199)	0.27694 (1.981)	0.264536 (1.855)			

Table 5.2: Results on Full.cost equation (5.22)

Part 4 : Individual coefficients on $d\ell nUMCN_{t-i}$

Sector	Π_{20}	Π_{21}	Π_{22}	Π_{23}	Π_{24}
TOT	0.63211 (9.744)		−0.15303 (1.514)	0.29135 (2.372)	−0.26859 (3.119)
20	0.68673 (17.141)	0.156311 (3.782)			
21	0.552645 (5.292)	0.332984 (2.170)	−0.257174 (1.679)	0.187426 (1.681)	
22	0.697247 (7.719)				
23	0.425414 (3.1031)	0.28062 (2.0642)			−0.177458 (1.8011)
24	0.67614 (6.950)	−0.135463 (1.462)			
25		0.20966 (1.340)			−0.32777 (1.948)
26	0.56362 (5.174)				
27	0.687834 (8.274)				
28	0.573204 (3.737)				
29	1.20454 (13.357)				
30	1.45485 (6.983)	−0.391863 (2.017)			
31	0.408583 (4.734)	0.160486 (1.994)		0.187225 (2.060)	−0.076208 (1.287)
32	0.622363 (23.557)	0.125095 (4.763)			0.221607 (6.400)
33	0.719305 (10.732)		−0.27113 (3.477)	0.326165 (3.504)	−0.409785 (4.755)
34	0.851771 (8.380)				
35	0.532708 (10.827)				
36	0.660004 (7.996)			0.192373 (2.176)	−0.332974 (3.380)
37	0.796878 (14.289)				−0.114032 (1.913)
38	0.432029 (1.821)				
39	0.582943 (4.055)		−0.255202 (1.807)		

Table 5.2: Results on Full-cost equation (5.22)

Part 5 : Individual coefficients on $d\ell nUCCN_{t-1}$

Sector	Π_{30}	Π_{31}	Π_{32}	Π_{33}	Π_{34}	Π_{35}	Π_{36}	Π_{37}	Π_{38}
TOT	0.38671 (4.093)		-0.12309 (1.304)	0.2991 (2.779)	-0.17370 (1.652)		0.12702 (1.626)		0.12792 (1.475)
20	0.049980 (1.500)								
21	0.177843 (3.741)			0.076993 (1.624)	-0.13799 (2.967)				
22		-0.13135 (1.666)	0.16793 (1.966)	-0.057546 (1.735)					
23				0.176005 (2.0471)					
24	0.09510 (2.806)					-0.034188 (1.978)	0.011204 (3.113)		
25			0.0705 (1.214)	0.12331 (2.019)					
26	0.50956 (4.510)	-0.30646 (2.887)							
27	0.17572 (3.062)			-0.071806 (1.667)					
28								-0.27642 (1.684)	0.56024 (3.231)
29		-0.08968 (1.881)		0.16454 (3.184)	-0.10024 (2.114)		0.093211 (1.717)	0.12944 (2.385)	
30				0.35703 (3.200)		-0.160205 (1.605)	0.304402 (3.014)	[illegible] (1.977)	
31					-0.07621 (1.287)				
32	-0.051650 (5.650)	0.01384 (1.512)		0.017933 (1.962)	0.041057 (4.049)				
33	0.048527 (1.804)	0.098787 (3.571)		-0.11943 (3.822)	0.135794 (4.668)				
34	0.090913 (1.567)								
35		0.08993 (2.827)		0.068461 (2.145)					
36		0.126448 (2.968)						-0.067993 (2.564)	0.036813 (1.484)
37	0.082066 (2.849)								
38	0.530805 (3.159)								-0.256587 (1.760)
39	0.087241 (2.707)				0.078593 (2.391)				

Table 5.2: Results on Full-cost equation (5.22)

Part 6 : Individual coefficients on CU_{t-i}

Sector	Π_{410}	Π_{411}	Π_{412}	Π_{413}	Π_{414}
TOT					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32	-0.000668 (5.969)	0.000994 (7.489)	-0.000736 (5.047)	0.000448 (3.320)	-0.000135 (1.389)
33				0.001159 (2.880)	-0.000978 (2.296)
34	0.001063 (3.820)	-0.001739 (4.731)	0.00086 (2.269)	-0.000359 (1.432)	
35					
36			0.001358 (2.028)	-0.001469 (1.941)	0.002276 (3.131)
37					
38					
39					

Table 5.2: Results on Full-cost equation (5.22)

Part 7 : Individual coefficients on CW_{t-i}

Sector	Π_{420}	Π_{421}	Π_{422}	Π_{423}	Π_{424}
TOT				0.003757 (3.918)	-0.003325 (3.371)
20					-0.000406 (1.573)
21	-0.00080481 (2.634)	0.000931773 (2.283)	-0.00053963 (1.458)	0.000544395 (1.757)	
22	-0.016338 (6.793)	0.0014043 (5.231)		-0.000556 (2.292)	
23					
24		0.001129 (2.996)	-0.002599 (5.150)	0.001208 (3.113)	
25		0.0026311 (1.919	-0.002794 (1.685)		0.0026434 (2.408)
26					
27		-0.000883 (1.908)	0.002466 (3.942)	-0.001072 (2.364)	
28					
29					
30					
31			0.000491 (1.155)		-0.001405 (3.121)
32					
33					
34					
35		0.0008875 (3.231)			
36					
37					
38	-0.0012955 (1.267)	0.001402 (1.223)			
39					0.0020722 (2.911)

1963_{i} - 1970_{ii} and 1970_{iii} - 1977_{iv} in sectors TOT, 22, 24, 25, 29 and 34.

Turning to the long run values of the explanatory variables given in table 5.2.1 a clear picture is drawn with regard to standard unit labour costs. Of the 21 sectors only 8 are positive and significant (SIC: 26, 27, 28, 33, 35, 36, 37 and 39), compared to 15 sectors of the neoclassical model and 21 sectors of the average cost model. At first glance this is a good indication of the fact that prices are set on the basis of actual rather than standard unit labour cost, although it is quite possible that a different normalization method could produce different results as far as labour costs are concerned [17]. Standard unit material costs take the expected sign in all sectors but one (SIC: 25) and are significant at the 5% level everywhere except sector 38. The standard unit capital cost performs well in general and is more or less in line with the results obtained in the average cost model. This is not surprising given that the construction of standard unit capital cost is differentiated from actual unit capital cost only by the fact that the former is divided by standard output while the latter by actual output. Expected signs on U.CN are obtained in 19 sectors of which only 12 are significant at the 5% level (SIC: TOT 23, 24, 25, 26, 27, 28, 33, 35, 36, 37, 39). Finally, and rather unexpectedly, given the results of the previous two models, demand variables are found to play a significant role in sectors 22, 25, 27, 31, 35, 36 and 39. This coupled with the fact of the poor results on ULCN is the main reason for the rejection of the full cost model in the majority of the sectors as it will be seen further in table 5.4.

The individual coefficients present on the whole a rather mixed pattern. The ULCN coefficients are concentrated on the 0 (current), 1st and 3rd quarter lags, a pattern significantly different from the corresponding pattern on the wage variables of the neoclassical and average cost models. The same is not true for the lag structure of the UMCN variable which is concentrated on the current quarter; it is more or less the same with the two previous models. The adjustment of price changes to standard unit capital cost changes was assumed to be completed within a time span of 8 quarters. The addition of the 4 extra quarters compared to the average cost model seems to add little in the explanation of price changes since the distribution of sectors per lag on UCCN was concentrated at the first 4 quarters:

<u>lags on UCCN</u>:	0	1	2	3	4	5	6	7	8
<u>SIC sectors</u>	(12)	(7)	(3)	(11)	(7)	(2)	(4)	(4)	(4)

As far as the demand variables are concerned the Wharton method proved superior to the trend method since the latter was preferred in only four sectors. Individual coefficients on demand seem to cover the period with an almost equal concentration per quarter contrary to the belief that demand should be entered currently or with one quarter lag.[18] Similar specifications as far as the distribution of demand is concerned can be found in Coutts et al (1978) and F.P.R. Brechling (1972).

A question might further be asked on how the long-run values given in Table 5.2.1 compare with the "theoretical" values of equation 5.14 which correspond to the shares of normalized labour, materials and

Table 5.3: Sums of coefficients of cost variables Comparison with theoretical values Full-cost equation (5.22) Two digit SIC sectors, Greek manufacturing

Sector	$\sum_{i=o}^{4} \Pi_{1i}$-LSHN (t)	$\sum_{i=o}^{4} \Pi_{2i}$-MSHN (t)	$\sum_{i=o}^{8} \Pi_{3i}$-CSHN (t)
TOT	-0.0997 (0.816)	-0.2458 (3.029)	0.5800 (3.216)
20	-0.0281 (0.400)	0.0039 (0.095)	0.0088 (0.264)
21	-0.0388 (0.367)	0.0246 (0.219)	0.0627 (0.769)
22	-0.0271 (0.174)	-0.1065 (1.179)	-0.0837 (0.585)
23	-0.0707 (0.681)	-0.1954 (1.234)	0.0996 (1.158)
24	-0.0975 (1.076)	-0.1461 (1.520)	0.1115 (1.768)
25	0.1144 (0.518)	-0.8339 (3.876)	0.1271 (1.457)
26	0.0079 (0.053)	-0.0446 (0.409)	0.0989 (1.145)
27	0.0676 (0.578)	-0.0662 (0.796)	0.0260 (0.571)
28	-0.0462 (0.408)	0.0109 (0.071)	0.2278 (1.800)
29	-0.4113 (4.298)	0.4516 (5.008)	0.1549 (1.249)
30	-0.4283 (4.216)	0.3785 (2.579)	0.2266 (1.063)
31	0.0516 (0.322)	0.0724 (0.663)	-0.1840 (3.107)
32	-0.6473 (3.609)	0.0468 (0.878)	-0.0053 (0.300)
33	0.3887 (1.812)	-0.2616 (1.934)	0.0795 (1.164)
34	-0.6254 (2.971)	0.0870 (0.856)	-0.0185 (0.319)
35	0.0835 (1.528)	-0.2789 (5.668)	0.1183 (2.463)
36	0.0268 (0.290)	-0.2315 (1.660)	0.0437 (0.905)
37	0.0106 (0.193)	-0.1331 (1.665)	0.0342 (1.187)
38	-0.0910 (0.348)	-0.0587 (0.247)	0.1852 (1.041)
39	0.1876 (0.903)	-0.2518 (1.528)	0.0992 (1.941)

Table 5.4: Summary of sectoral Results. Full cost equation (5.22) Two digit SIC sectors, Greek manufacturing

Sector	Results				
TOT	AUTO,	dℓnULCN=o		Z_4,	
20		dℓnULCN=o,	dℓnUCCN=o		
21		dℓnULCN=o,	dℓnUCCN=o		
22		dℓnULCN=o,	dℓnUCCN=o,	Z_4,	
23	AUTO,	dℓnULCN=o			
24	AUTO,	dℓnULCN=o		Z_4,	
25		dℓnULCN=o		Z_4,	
26	Accepted				
27					ΣCW ≠ o, ECW ≠ o
28	Accepted				
29		dℓnULCN<o,	dℓnUCCN=o		
30	AUTO,	dℓnULCN<o,	dℓnUCCN=o		
31		dℓnULCN=o,	dℓnUCCN=o		
32		dℓnULCN<o,	dℓnUCCN=o		
33	Accepted				
34		dℓnULCN<o,	dℓnUCCN=o		
35					ΣCW ≠ o, ECW ≠ o
36					ΣCU ≠ o, ECU ≠ o
37	Accepted				
38	AUTO,	dℓnULCN=o,	dℓnUCCN=o		
39					ΣCW ≠ o

capital bill in standard ouptut. Denoting by LSHN, MSHN, CSHN, the ratios of the standardized input bills for labour, materials and capital over standard output respectively it is possible to test if the long run value of ULCN, UMCN and UCCN deviate significantly from their respective shares by forming the differences:

$$(5.24) \quad \sum_{i=0}^{4} \pi_{1i} - LSHN, \qquad \sum_{i=0}^{4} \pi_{2i} - MSHN, \qquad \sum_{i=0}^{8} \pi_{3i} - CSHN$$

and calculating their t - statistics. The results of these tests are given in table 5.3 and on the basis of the t - tests it can be seen that in general there are no significant differences between the long run coefficients and their "theoretical" values.

Finally a summary of the preceeding discussion on the results of the full cost model is given in table 5.4, where the performance of each sector is shown. In conclusion, the full cost model is consistent with the data in only four two digit SIC sectors and inconsistent in the rest. The cost factors on the whole behave poorly, particularly standard unit labour costs, but overwhelm the performance of the demand variables. The next pricing model of the long run variety is the target rate of return pricing model. This is the subject matter of the next section.

5.4 Formulation, estimation and testing of the target rate of return pricing model

5.4.1 Introduction

This section deals with the derivation, estimation and testing of the target rate of return pricing model. Subsection 5.4.2 describes the pricing process of firms exercising target rate of return pricing and derives such a model. In section 5.4.3 we discuss some of the characteristics of target return pricing as for example the type of firms where target rate is applicable, the determinants of the target rate, the relationship of this model with full cost pricing, the role of demand factors in target rate pricing etc. Section 5.4.4 is concerned with the specification of the variables that measure target return on capital. Finally, in section 5.4.5 we derive a testable hypothesis of the target rate model and discuss the results of the application of this model on the two digit SIC manufacturing sectors of Greece.

5.4.2 The target rate of return pricing model

Although target rate of return pricing has been known to businesses for quite a number of years,[19] its first systematic treatment appeared in the economic literature relatively recently with the publication of a Brookings study by A.D.H. Kaplan, J.B Dirlam and R.F. Lanzilotti (1955) in which the pricing methods of a number of very large corporations were examined. Summarising information developed in this study, one of its authors, R.E. Lanzilotti (1958) wrote that the principal pricing goal of oligopolists who were dominant in their industries was to secure a target rate on capital invested.

Under this system, both costs and profit goals are based not upon the volume level which is necessarily expected over a short period but rather on standard volume; moreover, the margins added to standard costs are designed to produce the target profit rate on investment assuming that standard volume is the long run average rate of plant utilization. This pricing method effectively prevents cyclical or short run changes in volume or product mix from affecting the price.

In rationalizing the use of target rate of return as a pricing objective R.F. Langilotti (1958) as well as N.W. Chamberlain (1962), E. Mansfield (1970) and J.M. Clark (1961) among others, produced a number of reasons as for example the achievement of a fair or reasonable return, the desire to equal or better the corporation average return over a recent period, the use of a specific profit target as a means of stabilizing industry prices etc. None of the above objectives however is able to provide an answer as far as the setting of the level of target rate is concerned. By connecting the target rate hypothesis with limit price theories, such a determination has been possible, since, as it was mentioned in section 5.2, the target rate is determined at such a level that, given standard costs, target price will be the one that effectively prevents entry.

Whatever the ultimate objective of the firm that employs target rate as a pricing method and whatever the relation of such an objective to long run profit maximization, the essential characteristics of this hypothesis are the following: (a) the implementation of the notions of standard output and standard costs (b) the use of a target rate on capital invested and (c) the small number of firms exercising considerable market power. The first two characteristics are testable within the formulation of the target rate of return pricing model presented in this study. The third, although an essential feature of the hypothesis is not incorporated in the price model developed. A formulation in which market structure is an argument of target rate pricing would require a different methodology and probably time series data on concentration ratios of a considerable precision that are not available at the two digit SIC level disaggregation.

The hypothetical target return pricing procedure may be considered to run as follows: The firms in a given industry determine from their knowledge of demand and cost conditions and also perhaps by trial and error a price P_T which will just prevent entry of new firms into the industry. They then determine the rate of return which will satisfy equation (5.25) (repeating equation (5.2)), given P_T and their costs.

$$(5.25) \qquad P_T = \frac{\beta V(QN)}{QN} + (1 + \tau)\frac{K}{QN}$$

Having once determined the target rate, τ , firms treat it as a long term constant and in future periods calculate the prices to be charged from (5.25) using τ and costs. An increase in the level of wages or input prices would result into an increase of standard unit variable costs and so by formula (5.25) prices will rise. Fluctuations in demand will play no role in the determination of the target rate of return price. The discussion of section 5.2 establishes that this process will lead to an approximate attainment of the entry preventing price at all times.

There is quite a number of issues that are left unresolved from he above procedure as for example, the determinants of the target rate, the type of firms to which target rate is applicable, the differences of the target rate approach from full cost, etc. These matters together with others will be examined in section 5.4.3. Before that however, the transformation of equation (5.25) into an equation explaining changes in the target rate prices according tothe spirit of the previous models is required.

Standard variable costs comprise of standard unit labour cost and standard unit materials cost. Equation (5.25) can therefore be re-written as:

$$(5.26)' \quad P_T = ULCN + UMCN + (1 + \tau)\frac{K}{QN}$$

By dropping the T subscript, differentiating totally and dividing by P we get:

$$(5.27) \quad \frac{dP}{P} = \frac{dULCN}{P} + \frac{dUMCN}{P} + \frac{K}{QN}\frac{d(1 + \tau)}{P} + \frac{(1 + \tau)}{P} d\left(\frac{K}{QN}\right)$$

which after some rearrangement can be further written as:

$$(5.28) \quad \frac{dP}{P} = \alpha_1 \frac{dULCN}{ULCN} + \alpha_2 \frac{dUMCN}{UMCN} + \alpha_3 \frac{d(1 + \tau)}{(1 + \tau)} + \alpha_4 \frac{d(K/QN)}{K/QN}$$

where: $\alpha_1 = ULCN/P$

$\alpha_2 = UMCN/P$

$\alpha_3 = \alpha_4 (1 + \tau) K/(P.QN)$

Equation (5.28) is approximately equal to

$$(5.28)' \quad d\ell nP = \alpha_1 d\ell nULCN + \alpha_2 d\ell nUMCN + \alpha_3 d\ell n(1 + \tau) + \alpha_4 d\ell n(K/QN)$$

in which every argument on the right hand side is observable and can be approximated with the exception of $(1 + \tau)$. Anticipating future discussions on target rate determination and in a spirit similar to the full cost markup (see equation (5.17)) we assume that target rate is a function of short run demand changes as in (5.29).

$$(5.29) \quad d\ell n(1 + \tau) = \beta_1 \ell n\left(\frac{Q}{QN}\right) + \beta_2 d\ell n\left(\frac{Q}{QN}\right)$$

By introducing equation (5.29) into (5.28)' we get the target rate of return price equation in a rate of change form as in (5.30).

$$(5.30) \quad d\ell nP = c_0 + c_1 d\ell nULCN + c_2 d\ell nUMCN + c_3 d\ell n\left(\frac{K}{QN}\right) + c_4\, \ell n\left(\frac{Q}{QN}\right) + c_5\, d\ell n\left(\frac{Q}{QN}\right)$$

where: $c_1 = ULCN/P$

$c_2 = UMCN/P$

$c_3 = (1 + \tau)K/P.QN$

As far as the coefficients of demand variables are concerned the expectation is that $c_4 = c_5 = 0$. The fact that fluctuations in demand play no role in a target rate of return price determination is guaranteed by such an assumption. In that sense, formulation (5.29) helps in determining a test of this assumption.

5.4.3 Features of the target rate of return pricing model

In this subsection we discuss a number of issues related to the target rate price determination model. These are, the type of firms where target rate of return is applicable, the determinants of the target rate, the deviations of actual from target rates, the role of demand factors in target rate pricing and finally the relationship between the target rate and full cost models.

5.4.3 (1) Type of firms where target rate of return is applicable.

One of the essential characteristics of the target rate of return hypothesis is that it prevails in highly concentrated oligopolistic industries. The fact that the firms must exercise some discretion over the price to be charged is a common characteristic of all markup models discussed in this study. The target rate of return hypothesis however goes a step beyond that in ascerting that firms expected to price under this model should be dominant (leaders) in their respective markets. This may be probably attributed to the fact that empirical evidence on the target rate hypothesis refers primarily to firms (and not industries) all of which are among the largest U.S. Corporations (see A.D.H. Kaplan et all (1955)). Moreover one would expect target rate of return pricing to prevail in capital intensive industries since the hypothesis pays emphasis on investment decisions; prices are set in order to achieve a rate on invested capital.

However, given the diverse goals of the various managerial levels, target return pricing is rarely found in pure forms. The more decentralized the enterprise is, the more target prices will be influenced by other factors such as market conditions and special customer relationships. Target rate of return pricing can perhaps be found in a pure form in a regulated monopoly (public utility). The regulated firm is assumed to be allowed by the regulatory agency (The State) to set a price that achieves a certain minimum rate of return and in the absence of regulation the firm would increase its profits by charging a higher price. The regulated firm has every incentive to induce the regulatory agency to allow it to increase its price when its profit rate falls below the allowed limit and the agency will try to hold prices down so that the firm's rate of return does not exceed the allowed level. H. Averech and L.L. Johnson (1969) have argued that the regulated firm will attempt to circumvent regulation by increasing its fixed capital stock (rate-base) so as to increase total profits keeping the same rate of return on the rate base.

Target rate of return pricing has a number of advantages for large corporations; (1) it provides internal consistency with the criterion of investment. If investment is undertaken only at the promise of yielding a target rate of return, then investment decisions have a pricing scheme implicit in them which should yield the target rate at the actual price. If prices in the market are different from those calculated to achieve the target rate then adjustments should be made but the critical consideration in all such adjustments is that the net effect should be to leave the return on investment untouched. Whatever prices are finally set, times the volume which is anticiated that can be realised at these prices should yield a sales revenue which minus the costs of output thus calculated gives the profit which has been set as a goal. (2) Target rate of return pricing yields stable prices since standard costs fluctuate less than actual costs. Large corporations prefer stable prices since they reduce uncertainty and facilitate long term corporate planning. Price stability can be achieved through quasi agreements based on understanding derived from common experience about the limits of price changes which can be made without inviting retaliatory actions. Minor price reductions not disturbing relative competitive positions can be made within these limits without provoking offsetting price adjustments from rivals, but any price cuts outside these limits will be met by retaliatory price cuts leaving none of the producers as well off as before. Under these circumstances, the target rate formula makes good sense. (3) Target rate formula is particularly suitable as far as new products are concerned. Since they have no close substitutes, new products are usually expected to produce a predetermined level of profit rate on investment required. Sometimes a higher price may be charged in the beginning to capture the market's reponse, but the price will finally settle to the price requred to cover developmental costs plus a rate on capital invested.

5.4.3 (2) Determinants of the target rate, Deviations of acutal from target rates, the role of demand factors in target rate pricing.

The assumption of long run constancy of the target rate in firms practicing target rate pricing has been questioned by many. A.E. Kahn (1959) for example, assailed R.F. Lanzilotti (1958) and his colleagues claiming that the Brookings evidence

"lends support to [the]... conclusion: that these large corporations typically price to maximise monetary profits, not day to day, but to a large extent year by year and certainly over a fairly brief period of years"

A.E. Kahn (1959) p. 671

His argument was based (1) on the differences between the targets set by various companies, (2) on the widely varying investment return components of these companies prices on different products and (3) on the divergencies of actual company returns from their competitive targets, above it for extended periods of time where the market permits, below it where the market requires.

Since by equation (5.8) the highest rate of return which will fail to attract entry depends in magnitude upon demand and cost conditions, our version of the hypothesis does not suggest that the target rates should be the same for all sellers of a given product (see also R.F. Lanzilotti (1959)). With respect to multiproduct firms further, the hypothesis does not suggest that the target rate should be the same for all products sold by a particular firm. Also cost differences among firms in an industry should not seriously hamper the workings of the target return scheme of implicit collusion since the nature of the hypothesis is such that costs are defined to include normal profits.

Even if the version of the target rate hypothesis examined here does not predict the same rates among firms, sectors or products, the question still remains on what the target rate depends. O. Eckstein and G. Fromm (1968) provide a number of factors such as market structure and long run economic conditions of the industry in which they include barriers to entry, international trade barriers, concentration, product differentiation, managerial talent, long run demand elasticities etc.

Target rates may deviate from actual rates for a number of reasons.[20] Whatever these reasons may be, a distinction must be made between year to year profits and secular profit objectives. If actual prices deviate from target prices to the extent that they fail to realise the profit objective not only occasionally, but regularly, the alternative is not necessarily to adjust to reality. The profit objective may be held to and actions other than those in the field of price must be undertaken to realise it, as for example a new promotional program, a redesign of the product, substitution of one product line for another and finally cost reduction. Sometimes a target rate of return may be set at such a level that cannot possibly be achieved at the going prices, not at the expectation that the price levels can be altered, but at the expectation to induce organisational changes towards greater efficiency. In these instances, the continuing failure of price levels to yield target rates of return cannot be construed as a failure of pricing policy. Finally, if the case is that business executives base prices on the target rate formula, but the actual prices charged differ from the formula prices because of demand conditions, then in our view this cannot be considered as target rate pricing since deviations from formula levels will produce instantaneous profit maximising prices. The essence of the target rate notion is intentional abstention from price changes which due to shifts in demand would apparently be profitable in the short run but would tend to induce entry or price rivalry among existing firms.

Demand elements however may intrude in a number of ways if demand is weak. Transaction prices differ significantly from list prices as these are caluculated by the target rate formula. Secret undermining of list prices takes place usually in the form of better credit arrangements, allowances on insurance and transportation costs etc. Similarly when demand is strong a strict application of the target rate formula may lead to rationing and order backlogs. Changes in the terms of sales other than price such as extras, transportation costs, waiting times, changes in the product quality and product service are other adjustments that can be made in periods of high demand.

5.4.3. (3) The relationship between full cost and target rate models

It was mentioned in section (5.2) that the fundamental characteristics of the full cost and target rate of return pricing models are the same; namely the use of standard instead of actual output and costs and a profit objective which in the former model is expressed as a markup upon total costs, variable and fixed, while in the latter is expressed as a rate on capital invested. Yet the models are considered as two distinct pricing hypotheses, the differentiating factor being the treatment of capital and capital costs. The full cost model views capital costs in the same manner as all other costs. Unit capital cost is defined as the ratio of capital expenditure over standard outupt. The value of firm's assets plays no explicit role in the full cost price determination. Target rate hypothesis on the other hand treats capital and capital costs quite differently. Capital costs are not included in the price equation. Instead (in the formulation adopted here), capital is an explanatory argument in the target rate model in the sense that price is set to achieve a specified rate on capital.

Both models can be reduced to the same functional form if we are to use two simplifying assumptions regarding the rate of capital and capital costs, namely:

(a) that capital costs are proportional to the value of capital invested and,

(b) the ratio of capital to output (standard output) remains constant.

It is possible to rewrite the full cost model (5.1) as:

$$(5.31) \quad P = (1 + \pi) \left[\frac{\beta V(QN)}{QN}\right] + (1 + \pi) \frac{Kc}{QN}$$

where Kc = capital expenditure bill (see equation(5.11))

Assumptions (a) and (b) can be expressed formally as (5.32) and (5.33) respectively:

$$(5.32) \quad Kc = \alpha K$$

$$(5.33) \quad K = \gamma .\ P.QN$$

where K = is the value of capital assets

Incorporating assumptions (5.32) and (5.33) into (5.31) we have

$$(5.34) \quad P = (1 + \pi)\left[\frac{\beta V(QN)}{QN} + \alpha\gamma P\right]$$

which can be further expressed as

$$(5.35) \quad P = \frac{(1 + \pi)}{1-(1+\pi)\alpha\gamma}\ [ULCN + UMCN]$$

Similarly incorporating assumption (5.33) into the target rate model (5.25) we have

$$(5.36) \quad P = \frac{\beta V(QN)}{QN} + (1 + \tau)\gamma P$$

which can be further expressed as

$$(5.37) \quad P = \frac{1}{1 - (1 + \tau)\gamma}\ [ULCN + UMCN]$$

It is clear therefore from this small exercise that target-rate and full-cost models are equivalent if assumptions (5.32) and (5.33) are used. However, none of the above assumptions can be regarded as valid. As far as the first is concerned, capital cost is a function of a number of parameters and as such cannot be considered as proportional to the value of capital. As far as the second assumption is concerned, it was made possible to collect information on the means and variances of the capital over (standard) output ratios of the two digit SIC sectors which is provided in table 5.5. Inspection of this table indicates that capital output ratio shows considerable variability which guarantees that assumption (5.33) cannot be considered as reasonable and also justifies the use of K/QN as an explanatory argument in the target rate price equation.[21]

Apart from the differential treatment of capital and capital costs, the distinction between target rate of returns and full cost pricing approaches is difficult to be defined. R.F. Lanzilotti (1958) reports that:

"Some of the companies [in the Brookings survey] that clearly employ the target rate on investment in pricing new products, use cost-plus pricing for other products. The difference between the two rationalisations lies in the extent to which the company is willing to push beyond the limits of a pricing method to some average return philosophy."

R.F. Lanzilotti (1958) p. 930

Such a pricing policy does not necessarily mean that the objective should be a target rate on investment. The objective can equally be a target rate of return on sales since the latter is translatable to the former by the number of times that capital turns over. (For example, with a capital turnover of 3 times a year a 10% return on sales is equivalent to a 30% return on investment). In general, if we have to set criteria for classifying firms as candidates of target rate pricing, such criteria would be capital intensity and the size of the firm relative to the size of the market. As far as the first is concerned, target rate pricing is more likely to be applied in

Table 5.5: Means, standard deviations, minimum and maximum values of capital over standard output ratios $(\frac{K}{P.QN})$. Two digit SIC sectors, Greek manufacturing

Sector	Mean	St.deviation	Minimum	Maximum
TOT	3.839	0.3240	3.209	4.735
20	2.696	0.3075	2.081	3.338
21	3.455	0.3755	2.970	4.320
22	7.437	1.5568	4.263	11.680
23	4.811	0.4156	3.808	5.457
24	3.257	0.7588	2.543	5.171
25	4.352	0.9281	2.495	6.536
26	3.531	0.6593	2.657	5.821
27	5.271	1.3716	2.824	7.534
28	2.379	0.7684	1.163	3.661
29	3.770	0.5126	2.826	4.588
30	4.862	1.1439	2.307	9.544
31	5.640	1.0915	4.024	7.588
32	1.514	1.8273	0.135	8.952
33	5.040	0.5708	3.963	6.838
34	7.055	2.2245	2.928	10.053
35	2.695	0.3489	2.173	3.745
36	3.640	0.5423	2.645	5.226
37	3.835	1.0770	2.084	5.069
38	5.075	0.9379	3.842	7.648
39	4.037	1.0004	2.448	6.207

industries where strategic decisions focus on physical capital as opposed to industries where strategic decisions focus on the choice and design of the products. Capital intensive industries are traditionally the paper and pulp (27), chemical (31), petroleum refining (39) steel (34) and transportation industries (38). As far as the second criterion is concerned the relatively aggregate nature of the 2 digit industry classification does not permit a within-sector examination of the size distribution of firms since the subaggregates defined by the 2 digit classification still encompass a considerable variety of market structures within each one of them. Moreover, as it was mentioned previously empirical evidence on target return is basically presented for firms and not industries. Target return pricing applies to large firms, leaders in their markets, while full cost pricing may be applicable to any firms, small or large that is not a price-taker.[22]

5.4.4. Specification of the target rate

The relatively limited empirical studies on target rate of return hypothesis can probably be attributed to the lack of appropriate data on capital series, or to the difficulty in constructing a proper measure of capital to capture the effects of the target rate. In his survey of 9 empirical U.S. studies of price behaviour, W.D. Nordhaus (1972) reports that none introduced capital costs. However, most of these studies rely on markup or target rate specifications as the theoretical underpinning of their empirical work. Although it is possible to visualise a markup pricing situation where the markup is applied only on variable costs (as for example the average cost model) in target rate pricing, changes in unit capital costs are as legitimate a part of costs as unit labour and unit material costs. This section is concerned with the specification of capital costs within the framework of the target rate of return pricing model.

A strict application of the hypothesis would require data on target rates. However, such data are unavailable particularly at the sectoral level of aggregation and even if they were available they would be of little use since the expectation is that they remain constant for quite long periods. In the absence of data on target rate two options are available.

(a) The first is to use data on actual rates of return. The response of prices to profit rates on capital is taken as a reflection of target rate pricing. Such a variable has been used by O. Eckstein and G. Fromm (1968), O. Eckstein and D. Wyss (1978) and D.H. Straszheim and M.R. Straszheim (1976) and is measured as the after tax rate of return on capital. The expectation is of a negative coefficient and is met with relative success; a low, below target rate of profit at the standard level of operation calls for a price increase to achieve the target profit rate. Similarly a high, above target, rate of profit at standard output calls for a price decrease to achieve the target rate.

(b) The second option involves the calculation of a series of a capital over standard output ratio and then let the regression estimate the target rate. O. Eckstein and G. Fromm (1968) believe that such an approach should not be adopted since time series on capital are not sufficiently precise and also because such a ratio shows very small quarterly variability. This is rather surprising particularly when compared to the profit equity ratio which apart from the capital series uses data on actual profits which on the whole are less reliable. Moreover, as shown in table 5.5 the capital over standard output series shows a considerable degree of variability. This after all has to be expected over a 15 year span of experience which is characterised by high growth (See tables (2.6) and (2.7)).

By choosing the capital over standard output to measure target rate we are faced with the problem of specifying the base at which target rate is applied. Should this base be total assets or net worth? N.W. Chamberlain (1962) believes that:

"... return on net worth is more in keeping with traditional economic assumptions of profit maximising but in practice return on total assets seems to be the measure preferred by a number of major business firms."

N.W. Chamberlain (1969) p. 65

For our purpose the latter criterion would seem to be more important since we are concerned with actual business behaviour. In addition G.S. Stigler (1963) has argued that the total asset base has advantages even from the point of view of neoclassical theory. Indeed as can be seen from Appendix 3, in the calculation of the user cost of capital, the cost of capital index (τ) includes both the short and long-term interest rates as well as the rate of return on (own) capital, since (repeating equation (A3.53))

$$(5.38) \qquad \tau = \tau_1 * \frac{SB}{SB + LB + OF} + \tau_2 * \frac{LB}{SB + LB + OF} + \tau_3 * \frac{OF}{SB + LB + OF}$$

where τ_1 = short term interest rate

τ_2 = long term interest rate

τ_3 = rate of return on (own) capital

SB = short term borrowing

LB = long term borrowing

OF = own funds

We shall therefore adopt the total asset base. Finally note that since our conclusions from the empirical research depend only on the growth rate of target rate (= zero) and not on the level, the choice of the base is a relatively minor problem.

The generation of quarterly series on capital (total assets) can be described as follows. Consider the following identities:

(5.39) Total Assets = Short + Long term borrowing + net worth =
= Fixed Assets - Depreciation + Current Assets (Working Capital)

The construction of yearly data on fixed assets and depreciation, i.e. capital stock in buildings (K_B) and machinery (K_M) has been described in section A3.3.2(a) of Appendix 3. Data on working capital are not available from the Annual Industrial Surveys (AIS) and have to be approximated. The yearly publications of the Confederation of Greek Industries (CGI) bulletin provide data on working capital as well as data on net capital stock. On the assumption that the ratio of working capital to capital stock for the CGI sample is the same with that of the AIS sample, it is possible to generate yearly data on working capital that correspond to the AIS sample, as follows:

$$(5.40) \quad WK = \frac{WK_{CGI}}{K_{B+M(CGI)}} * K_{B+M}$$

and consequently total assets (K) can be generated as:

$$(5.41) \quad K = K_{B+M} + WK$$

Quarterly data on total assets can be approximated as follows: The Bank of Greece Monthly Statistical Bulletin provides information on each two digit SIC sector's analysis of credits for each quarter. Short term and long term data on credits are provided in the form of outstanding balances at the end of each quarter. On the assumption that (a) short term credit is used to finance working capital and long term credit to finance investment in buildings and machinery and (b) the quarterly pattern of working capital follows the quarterly pattern of short term credits and the quarterly pattern of capital stock follows the quarterly pattern of long term credits, we can then generate quarterly series on K (total assets) as follows:

$$(5.42) \quad Kq = K_{B+M} * \frac{LB_q}{LB_{q(iv)}} + WK * \frac{SB_q}{SB_{q(iv)}}$$

where subscript q refers to quarters (q = i,ii,iii,iv)

The specification of ULCN and UMCN has been described in previous sections. It is now possible to test empirically the target rate model. The econometric specification of the target rate model and the results obtained are presented in the next subsection.

5.4.5 Estimation and discussion of the target rate of return pricing results

The target rate of return model as it stands in equation (5.30) assumes an instantaneous adjustment between changes in explanatory variables and changes in prices. An operational version of the hypothesis is obtained by introducing a dynamic specification that takes into account the speed at which changes in prices adjust to changes in costs and demand. The maximum number of lags on standard unit labour cost, standard unit material cost and demand pressure variables is assumed to be 4, in line with previous models. On the capital over standard output variable it was assumed that a much slower adjustment takes place requiring a maximum time of 3 years (12 quarters) to be completed. Given the very long process by which investment decisions are incorporated into cost and hence into pricing decisions, the assumption of 12 quarter lags seems reasonable. Furthermore, such an assumption is corroborated by the results obtained on the (K/QN) variable (see below). Under the above assumptions with regard to the maximum lag and by adding an error term that has the usual properties, equation (5.30) becomes

$$(5.43) \quad d\ell nP_t = \pi_0 + \sum_{i=o}^{4}\pi_{1i}\, d\ell nULCN_{t-i} + \sum_{i=o}^{4}\pi_{2i}\, d\ell nUMCN_{t-i} + + \sum_{i=o}^{12}\pi_{3i}\, d\ell n\left(\frac{K}{QN}\right)_{t-i} + \sum_{i=o}^{4}\pi_{4i}\ell n\left(\frac{Q}{QN}\right)_{t-i} + \pi_5 d\ell n\left(\frac{Q}{QN}\right)_t + + u_t \qquad u_t \sim NID\,(0,6^2u)$$

and as before the term $\sum_{i=o}^{4}\pi_{4i}\ell n\left(\frac{Q}{QN}\right)_{t-i} + \pi_5 d\ell n\left(\frac{Q}{QN}\right)_t$

can be either $\sum_{i=o}^{4}\pi_{41i}CU_{t-i} + \pi_{51}ECU_t$

if the trend method is used (see equation (3.107))

or $\sum_{i=o}^{4}\pi_{42i}CW_{t-i} + \pi_{52}\, ECW_t$

If the Wharton method is used (see equation (3.108))

Before proceeding to the estimation methodology and the discussion of the results of the target rate pricing model it is necessary to elaborate on two issues regarding the nature of the data used for the generation of the variables entering the target rate pricing model and the exact specification of the target rate hypothesis.

The first issue is concerned with the aggregation problem that is common to all pricing models discussed so far. It is examined here since the target rate model is formulated - relative to other pricing hypotheses - more in terms of firms than in terms of industries. Both the competitive market and oligopolistic market theories and the pricing hypotheses that are derived from each are based on the behaviour of firms. However since data on firms are seldom, if at all, readily available, it isthe pricing behaviour of an industry, sector, or economy that is ultimately utilised. The larger data bodies are the aggregates that result from combining data on many firms. Substantial differences in firm's behaviour together with non-linearities present in aggregate data on firms may result in time series that do not necessarily resemble the behaviour of any firms or group of firms included in them. According to H. Theil (1954),

"if aggregate variables are defined such that their logarithms are linear combinations of the logarithms of the corresponding micro variables and if the two sets of variables are connected by a relationship having a constant elasticity, then the aggregation conditions are identical with those of linear relationships".

H. Theil (1954) p. 126

The aggregation problem that certainly exists with regard to the data used in this study cannot be overcome.

The second issue is concerned with the econometric specification of the target rate of return hypothesis. It was argued that this model implies that price is an add-on to the standard unit variable costs, the add-on being a target return on capital over standard output .. ,. It was further argued that short run changes in demand do not play any role in the target rate pricing model. All the above arguments are expressed in equation (5.30). However, a strict interpretation of the above hypothesis would include the target rate as the only regressor. By transferring all the arguments of the right hand side into the left hand side, such a specification would become:

$$(5.44) \quad d\ell nP - d\ell nULCN - d\ell nUMCN - \ell n\left(\frac{Q}{QN}\right) - d\ell n\left(\frac{Q}{QN}\right) =$$

$$= c_0 + c_3 d\ell n\left(\frac{K}{QN}\right)$$

Equation (5.44) clearly shows that the gap between price and standardized unit variable costs is only a function of the target rate of return on capital at standard output levels. The target rate is c_3 and its value along that of the constant term c_0 determines the spread between price and normal unit factor costs. Such a specification although it calls for a strict interpretation of target rate pricing is not used for two reasons: (1) it involves a number of untested restrictions vis-a-vis model (5.30) ($c_1 = c_2 = c_4 = c_5 = 1$) and (2) it is not comparable with previous price models since it cannot really test for the relative significance of the demand and cost variables.

The methodology for the estimation of the target-return hypothesis has been described in previous sections. The expected values of the coefficients of equation (5.43) are,

(5.45) $\Sigma\pi_{1i}, \Sigma\pi_{2i}, \Sigma\pi_{3i} > 0, \Sigma\pi_{4i} = \pi_5 = 0$

On the whole the performance of the target rate of return model is met with little success since the data generation process is compatible with the target rate thesis in only five sectors (SIC: 24,26, 27, 35, 36). The results are given in table 5.6. Part 1 provides the long run coefficients of the explanatory variables, part 2 gives a number of summary statistics, and parts 3,4,5,6 and 7 provide the individual coefficients of dℓnULCN, dℓnUMCN, dℓn(K/QN), CU and CW coefficients.

Starting from table 5.6.2 the values of the multiple correlation coefficient are more or less in line with the values obtained in the full cost model; Sectors 25,28 and 38 have $\bar{R}^2$ scores less or around 50% in both full cost and target rate models. Moreover, sectors 34 and to some extent 26 have values less than the sectoral average of the target rate model. The hypothesis of zero autocorrelation in the residuals on the basis of the $Z_{1(4)}$ statistic is rejected in four sectors, SIC: 21,22,37 and 39. A further test designed to detect the presence of fourth order autocorrelation confirmed the assumption of independent errors in all sectors. The post parameter stability test given by the $Z_{4(4,i)}$ statistic and based on information covering 4 extra quarters of 1978 indicates mispecification in 5 sectors, i.e. SIC: 30,32,33,38 and 39. Note that for sector 35 it has not been possible to test for post parameter stability due to the lack of sufficient degrees of freedom (For a definition of the test see equation (3.72)). Finally, the Chow $Z_{5(ij)}$ statistic indicates a different pricing pattern between subsamples $1963_i - 1970_{ii}$, and $1970_{iii} - 1977_{iv}$ in sectors 30,38

Table 5.6: Results on Target-rate equation (5.43)

Part 1 : Long-run coefficients

Sector	$\sum_{i=0}^{4} \Pi_{1i} d\ell nVLCN_{t-i}$	$\sum_{i=0}^{4} \Pi_{2i} d\ell nUMCN_{t-i}$	$\sum_{i=0}^{12} \Pi_{3i} d\ell n(\frac{K}{QN})_{t-i}$	$\sum_{i=0}^{4} \Pi_{41i} CU_{t-i}$	Π_{51} ECU	$\sum_{i=0}^{4} \Pi_{42i} CW_{t-i}$	Π_{52} ECW
TOT	0.202065	0.788295	-0.084496			0.000030	0.000168
	(3.231)	(14.584)	(0.718)			(0.0694)	(2.408)
20	0.038057	0.880616	0.070163				
	(0.586)	(15.284)	(1.816)				
21	0.035988	0.755390	0.098121	0.000038	-0.00305		
	(0.3564)	(8.885)	(2.205)	(0.157)	(2.432)		
22	-0.14536	1.42851	-0.23534	0.000135			
	(0.8395)	(7.2188)	(0.660)	(0.660)			
23	0.133891	1.13404	-0.30824	-0.000992			
	(1.903)	(11.955)	(3.240)	(3.866)			
24	0.14958	0.56645	0.25906			-0.00016	-0.00085
	(1.911)	(5.898)	(1.989)			(1.091)	(1.468)
25	0.44577	-0.073955	0.55206			0.001120	
	(2.114)	(1.038)	(4.608)			(1.024)	
26	0.400122	0.60166	0.13682				
	(3.471)	(5.476)	(2.473)				
27	0.25765	0.690138	0.157056				
	(2.226)	(6.769)	(5.002)				
28	0.466295	0.595421	0.10456				
	(1.502)	(3.752)	(0.816)				
29	0.205215	0.838567	-0.502442	-0.000234			
	(2.143)	(8.741)	(5.460)	(0.818)			
30	0.210902	0.980846	-0.222941			-0.0002309	0.000575
	(2.086)	(4.781)	(6.596)			(0.580)	(2.413)
31	0.61454	0.47762	-0.00228			-0.001264	
	(3.163)	(3.910)	(0.021)			(2.643)	
32	-0.883873	1.18128	-0.032913	-0.000098			
	(5.025)	(16.47)	(2.145)	(1.050)			
33	0.690579	0.458050	-0.12712	0.000132	-0.00278		
	(3.466)	(3.977)	(2.392)	(0.263)	(3.398)		
34	0.260812	0.618048	0.051934				
	(1.536)	(4.103)	(0.789)				
35	0.184396	0.475934	0.158522	0.001103			
	(2.0066)	(8.059)	(3.427)	(1.215)			
36	0.227941	0.498147	0.188669	0.0012612	0.000797		
	(2.345)	(4.858)	(2.878)	(1.296)	(0.829)		
37	0.155650	0.698807	0.246639				
	(1.676)	(8.639)	(2.757)				
38	0.283783	1.133809	-0.327452				
	(1.259)	(1.295)	(4.320)				
39	0.321188	0.505476	-0.087163	0.0021066	-0.0031599		
	(2.515)	(4.338)	(3.618)	(2.993)	(3.298)		

Table 5.6: Results on Target-rate equation (5.43)

Part 2 : Test statistics

Sector	SSR	SE	$\bar{R}^2$	DW	$Z_{1(4)}$	$Z_{3(1)}$	$Z_{4(4,1)}$	$Z_{5(1,1)}$
TOT	0.003026	0.009725	0.9391	2.4180	5.999	(18) 20.29	0.209 (2.65) (4.36)	1.08 (2.28) (12.20)
20	0.002204	0.008300	0.9460	2.493	6.960	(18) 15.378	1.208 (2.65) (4.36)	0.901 (2.28) (12.20)
21	0.007552	0.014484	0.7332	2.654	10.862	(22) 26.48	0.989 (2.61) (4.40)	1.444 (2.27) (8.28)
22	0.0100301	0.018265	0.7951	2.4535	11.1214	(20) 27.36	0.235 (2.68) (4.34)	1.281 (2.35) (10.24)
23	0.0011770	0.006603	0.9455	2.2501	4.533	(13) 21.88	1.672 (2.69) (4.31)	1.931 (2.83) (17.10)
24	0.006336	0.014072	0.7715	2.1139	8.456	(22) 21.59	0.491 (2.65) (4.36)	0.721 (2.27) (8.28)
25	0.035097	0.033118	0.4815	1.866	6.220	(18) 25.42	1.99 (2.65) (4.36)	2.18 (2.28) (12.20)
26	0.016355	0.021617	0.5702	2.159	4.594	(27) 32.15	1.989 (2.61) (4.40)	1.35 (2.53) (5.34)
27	0.020456	0.022902	0.7494	2.114	1.112	(24) 20.84	1.510 (2.60) (4.43)	0.816 (2.53) (5.34)
28	0.066103	0.044093	0.3871	2.411	4.363	(24) 22.32	0.787 (2.59) (4.48)	1.433 (2.42) (6.32)
29	0.004058	0.011829	0.8879	2.378	8.612	(15) 16.89	1.417 (2.68) (4.33)	1.009 (2.62) (15.14)
30	0.007265	0.016109	0.8264	2.544	7.672	(18) 28.29	2.66 (2.60) (4.42)	3.281 (2.28) (12.20)
31	0.005191	0.014409	0.8039	2.217	5.997	(15) 17.32	1.234 (2.69) (4.29)	1.621 (2.62) (15.14)
32	0.010909	0.018463	0.9402	2.394	5.086	(18) 19.842	3.131 (2.65) (4.36)	1.096 (2.62) (15.14)
33	0.005869	0.013543	0.8485	2.479	8.710	(20) 27.24	2.707 (2.60) (4.42)	1.463 (2.28) (12.20)
34	0.018345	0.023578	0.4418	2.481	6.862	(23) 23.58	0.204 (2.53) (4.30)	0.129 (2.40) (7.30)
35	0.003158	0.010814	0.9004	2.028	9.257	(17) 24.47	0.599 (2.53) (4.31)	1.687 (2.53) (13.18)
36	0.001435	0.008930	0.9069	1.888	4.953	(8) 7.03	2.058 (2.82) (4.22)	
37	0.005696	0.012085	0.8322	2.225	11.658	(25) 33.39	0.199 (2.60) (4.43)	0.503 (2.53) (5.34)
38	0.071055	0.042684	0.4392	2.123	0.699	(23) 24.46	4.129 (2.60) (4.43)	5.159 (2.53) (5.34)
39	0.014938	0.021606	0.6342	2.520	13.721	(18) 15.694	3.717 (2.65) (4.36)	4.912 (2.28) (12.20)

Table 5.6: Results on Target-rate equation (5.43)

Part 3 : Individual coefficients on $d\ln ULCN_{t-i}$

Sector	Π_0	Π_{10}	Π_{11}	Π_{12}	Π_{13}	Π_{14}
TOT	0.00348 (0.794)	0.20207 (3.231)				
20	0.00161 (0.086)			0.17075 (3.238)		−0.13629 (2.813)
21	0.00123 (0.418)			−0.102297 (1.253)	0.138285 (1.800)	
22	−0.00844 (1.933)	−0.357665 (2.434)				0.212295 (1.664)
23	−0.00270 (1.435)			0.29623 (5.245)	−0.13534 (2.510)	
24	−0.00566 (0.701)	0.14958 (1.910)				
25	0.01594 (0.951)				0.44577 (2.114)	
26	−0.00351 (0.696)		0.400122 (3.471)			
27	0.00114 (0.270)	0.27565 (2.226)				
28	−0.00196 (0.167)				0.46693 (1.502)	
29	0.00467 (1.717)		0.205215 (2.143)			
30	−0.00732 (0.660)	0.210902 (2.086)				
31	−0.01963 (2.130)		0.46880 (3.519)	0.23611 (2.046)	0.27616 (2.304)	−0.36654 (3.207)
32	0.00012 (0.032)	−0.290878 (2.211)			−0.592995 (4.178)	
33	−0.00034 (0.113)			0.25462 (1.787)	0.435956 (2.704)	
34	0.00654 (1.478)			0.260812 (1.536)		
35	0.00318 (1.069)	0.219568 (3.190)	0.206573 (2.961)			−0.241745 (3.628)
36	0.000038 (0.014)	−0.176334 (2.522)	0.180396 (2.756)		0.136473 (2.315)	0.087408 (1.592)
37	−0.000208 (0.080)			0.155650 (1.676)		
38	−0.00304 (0.340)			0.283783 (1.259)		
39	0.000811 (0.0196)	0.321188 (2.515)				

Table 5.6: Results on target-rate equation (5.43)

Part 4 : Individual coefficients on $d\ell n\ UMCN_{t-1}$

Sector	Π_{20}	Π_{21}	Π_{22}	Π_{23}	Π_{24}
TOT	0.707877 (20.250)			0.08040 (2.122)	
20	0.69835 (18.232)	0.127996 (3.181)		-0.059887 (1.525)	0.11416 (2.572)
21	0.755390 (8.885)				
22	1.17109 (9.655)			0.257418 (2.620)	
23	0.673148 (9.691)	0.245748 (2.934)	0.380655 (4.891)	-0.425292 (4.762)	0.259783 (3.245)
24	0.566452 (5.898)				
25	0.293703 (2.143)		0.192296 (1.329)		-0.559954 (3.184)
26	0.601662 (5.476)				
27	0.617085 (7.693)			0.073053 (1.9013)	
28	0.595421 (3.752)				
29	0.838576 (8.741)				
30	1.07715 (7.175)		-0.676778 (3.720)	0.580474 (3.225)	
31	0.498878 (6.718)	0.150192 (1.996)			-0.171451 (1.957)
32	0.730439 (20.471)	0.096561 (2.862)		0.188146 (5.095)	0.166142 (5.009)
33	0.841770 (10.978)		-0.246956 (2.918)		-0.13676 (1.858)
34	0.74440 (4.920)		-0.39048 (1.919)	0.26413 (1.467)	
35	0.475934 (8.059)				
36	0.896184 (11.824)	-0.154095 (1.568)	-0.364731 (2.940)	0.239546 (2.805)	-0.118757 (1.666)
37	0.822914 (14.424)				-0.124107 (1.958)
38	0.586621 (3.236)			0.547188 (2.729)	
39	0.505476 (4.338)				

Table 5.6: Results on Target-rate equation (5.43)

Part 5 : Individual coefficients on $d\ell n(\frac{K}{QN})_{t-i}$

Sector	Π_{30}	Π_{31}	Π_{32}	Π_{33}	Π_{34}	Π_{35}
TOT					0.38003 (4.578)	-0.12231 (1.637)
20					0.054995 (3.038)	0.049826 (2.609)
21						
22						
23	-0.0715226 (1.642)		0.165865 (4.732)		0.316902 (7.358)	
24	0.2590631 (1.989)					
25	0.072252 (1.709)		0.108628 (2.048)	0.298237 (4.984)		
26				0.046905 (1.817)	0.089910 (2.506)	
27	0.157056 (5.002)					
28	-0.105557 (1.589)		0.093926 (1.369)			
29	-0.06506 (2.732)	-0.05834 (1.984)	-0.015599 (1.669)		-0.101994 (5.128)	-0.0606297 (3.174)
30		0.01799 (1.318)	-0.064327 (1.327)			
31	0.13768 (2.108)				-0.17503 (2.733)	
32					0.125106 (1.846)	
33		-0.055204 (1.995)				
34		-0.052488 (1.954)				
35	-0.042604 (1.555)	0.097739 (3.344)			0.088199 (2.861)	
36	0.080284 (3.592)		0.029217 (1.633)	-0.029432 (1.746)		
37						
38						
39	0.055771 (2.287)		-0.031816 (1.859)			-0.049653 (2.192)

Table 5.6: Results on Target-rate equation (5.43)

Part 5 (CONTINUED): Individual coefficients on $d\ln(\frac{K}{QN})_{t-1}$

Sector	Π_{36}	Π_{37}	Π_{38}	Π_{39}	Π_{310}	Π_{311}	Π_{312}
TOT			-0.34221 (4.752)				
20		0.035889 (1.632)	-0.047500 (2.959)			-0.023047 (1.474)	
21							0.098121 (2.205)
22	-0.085391 (2.839)		-0.0573865 (2.070)		-0.0925662 (3.258)		
23		0.112442 (2.795)	-0.528927 (12.154)	-0.266336 (5.815)			-0.108185 (2.769)
24							
25		0.072443 (1.672)					
26							
27							
28						0.116196 (2.153)	
29		-0.053095 (2.814)	-0.086693 (3.855)	-0.040273 (2.190)			-0.020764 (1.843)
30		-0.059981 (4.438)			-0.116624 (7.434)		
31			0.16411 (2.543)			-0.12903 (2.369)	
32		-0.017289 (1.989)	-0.028134 (2.795)				
33		-0.042323 (1.644)					-0.029573 (1.813)
34					0.10442 (1.970)		
35	0.0408064 (1.592)				-0.055694 (1.985)		0.0300756 (1.634)
36	0.056116 (2.678)				0.053347 (2.650)	-0.038976 (2.093)	0.038113 (1.734)
37	0.246639 (2.757)						
38	-0.327452 (4.320)						
39		0.059936 (2.441)			-0.075364 (2.641)	-0.046036 (1.799)	

Table 5.6: Results on Target-rate equation (5.43)

Part 6 : Individual coefficients on CU_{t-i}

Sector	Π_{410}	Π_{411}	Π_{412}	Π_{413}	Π_{414}
TOT					
20					
21		-0.000515 (2.198)	0.0005471 (2.445)		
22	-0.0003449 (2.443)	0.000481 (3.485)			
23	-0.00154270 (6.043)	0.000550 (2.431)			
24					
25					
26					
27					
28					
29	-0.0013655 (3.829)	0.00165196 (3.794)	-0.000521 (1.684)		
30					
31					
32			-0.000381 (2.740)	0.000283 (2.013)	
33	-0.0026159 (4.466)	0.0027485 (4.623)			
34					
35	-0.001190 (2.880)	0.002293 (3.581)			
36	-0.000960 (3.121)	0.000802 (2.636)	0.000692 (1.745)		0.000726 (1.770)
37					
38					
39	0.0004617 (1.758)				0.001645 (4.513)

Table 5.6: Results on Target-rate equation (5.43)

Part 7 : Individual coefficients on CW_{t-i}

Sector	Π_{420}	Π_{421}	Π_{422}	Π_{423}	Π_{424}
TOT	-0.001322 (2.243)	0.001565 (1.966)	-0.001572 (1.982)	0.001359 (2.234)	
20					
21					
22					
23					
24		0.001117 (2.715)	-0.002083 (3.823)	0.000809 (1.914)	
25		-0.001699 (2.094)	0.000857 (1.723)		0.000196 (2.920)
26					
27					
28					
29					
30				0.002512 (3.981)	-0.002742 (4.106)
31	-0.001153 (2.862)		0.001367 (2.947)		-0.001479 (3.268)
32					
33					
34					
35					
36					
37					
38					
39					

and 39. On the basis of the above results the target rate hypothesis fails to be confirmed by sectoral data on the basis of econometric criteria in eight sectors altogether i.e. SIC: 21,22,30,32,33,37, 38,39.

The long-run coefficients are presented in table 5.6.1. The first important thing to be singled out from this table is the good performance of the ULCN variable, particularly when compared to the corresponding results of the full cost model. It obtains the expected positive sign in 19 of 21 sectors of which 13 are significant at the 5% level (SIC; TOT 23,24,25,26,27,29,30,31,33,35,36,39). The fact that for some sectors both the actual and standard unit labour costs may be significant should not be considered as contradictory. It is true that the use of actual and standard unit costs indicates two different pricing approaches. However, it is quite possible, and indeed the rule is that the data generation process will be described by more than one pricing models. What is important to note is that the good performance of a variable should not be judged ceteris paribus but within the context of the model in question. It does not really mean much if the model is rejected on other grounds and the ULCN variable performs well. This is particularly true for UMCN which performs well in almost all pricing models discussed so far, in the sense of having positive and significant coefficients in all sectors but one (SIC: 25).

The long run coefficients on the (K/QN) variable present a mixed pattern. Significant and positive results are obtained in 9 sectors (SIC: 20,21,24,25,26,27,35,36,37) while significant and negative long run coefficients in 8 sectors (SIC: 22,23,29,30,32,33,38,39). On the basis of these results it is not possible to verify the hypothesis advanced before and supported by the empirical evidence presented in O. Eckstein and D. Wyss (1972) namely that the target rate of return hypothesis is on the whole expected to hold in concentrated sectors. Although this hypothesis does not constitute a testable part of the target rate model, the expectation would be to find such a model prevalent in sectors like 27,31,32,34 and 38 where concentration ratios as given in table (2.4) are above the sectoral concentration average. However, with the exception of sector 27 this is not the case. Moreover, target rate of return pricing does not seem to hold in capital intensive sectors, information on which can be derived from table 5.5 (SIC: 22,27,31,33, 34,38) despite an apriori expectation to the opposite. A number of reasons may account for this. First, it should be mentioned that the evidence provided by O. Eckstein and D. Wyss (1972) to the effect that target rate pricing holds in concentrated sectors is scanty and to some extent incomplete, since (a) the sample of sectors they use is selected on the basis of data availability and does not cover the whole U.S. two digit sectors, (b), whenever target rate pricing is found to hold, the sectors have a high concentration ratio. However, there are other concentrated sectors where the price is not determined according to the target rate formula. Second as mentioned before the target rate hypothesis has been formulated in terms of firms and not of industries. Even if we are to assume that a high concentration ratio indicates an oligopolistic market where target rate of return is expected to hold, then such a market should be defined with a high degree of precision. None of the industries defined by the two digit SIC classification correspond precisely to a particular market structure and therefore will not follow any single pricing hypothesis precisely. The subaggregates defined by the two digit SIC classification still encompass sectors with a considerable variety of market structure within each one of them.[23]

Finally, the coefficients on the demand variables in general confirm the target rate hypothesis since they are statistically different from zero in only 7 sectors (SIC: TOT 21,23,30,31,33,39) and on the whole the coefficients are mixed with positive and negative values.

Tables 5.6.3 to 5.6.7 present the individual coefficients on the explanatory variables. The ULCN coefficients are concentrated on the current, second and third quarter while the UMCN coefficients on the current, third and fourth. As far as the adjustment of price changes to capital over standard output changes is concerned, the individual coefficients are distributed almost evenly amo::ng the three lagged years; 23 coefficients on the first year, 24 on the second, 19 on the third year (across-sectors). Also 10 sectors have coefficients on the current quarter. The lag distribution on the K/QN variable amo:.ng the 21 two-digit SIC sectors is as follows:

Lags on K/QN	0	1	2	3	4	5	6	7	8	9	10	11	12
No of SIC Sectors	(10)	(5)	(7)	(3)	(8)	(4)	(5)	(8)	(7)	(2)	(6)	(5)	(6)

As far as the individual coefficients on the demand variables are concerned, the trend method proves slightly superior than the Wharton method. Once again the individual coefficients seem to be distributed almost evenly among the 5 quarter lags.

The last issue refers to an examination of the size of the long term coefficients of table 5.6.1 and in particular how do these values compare with the theoretical values of equation (5.30). The coefficients c_1 and c_2 correspond to the ratio of standardized labour bill and standardized materials bill over standard output since they can be written as:

$$c_1 = \frac{ULCN}{P} = \frac{Pw.LN}{QN.P} \text{ and } c_2 = \frac{UMCN}{P} = \frac{Pm.MN}{QN.P}$$

where, Pw,Pm = Prices of Labour and Materials respectively, defined in chapter 3

LN,MN = the standardized labour and materials input, defined in chapter 4.

By denoting the shares of standard labour and materials bill to standard output by LSHN and MSHN it is possible to test if the long run coefficients on these variables deviate from their shares by forming the differences:

$$(5.46) \quad \sum_{i=o}^{4} \pi_{1i} - LSHN \quad \text{and} \quad \sum_{i=o}^{4} \pi_{2i} - MSHN$$

and calculating their respective t-statistics. Values of the t-statistics less than the critical indicate that the long-run coefficients have no statistical significant difference from their respective shares. The results are given in table 5.7 and in general there are no significant differences between the long-run coefficients and their theoretical values. Exceptions are sectors 31,39, 33 for ULCN and 29,23,32,35,36,38 for UMCN.

With regard to the target rate values, the coefficients π_{3i} of equation (5.43) corresponds to the coefficient c_3 of equation (5.30).

Table 5.7: Long-run coefficients on $d\ell n ULCN$, $d\ell n UMCN$, Comparison with theoretical values. Target rate of return equation (5.43). Two-digit SIC-sectors, Greek manufacturing

Sector	$\sum_{i=o}^{4} \Pi_{1i}$-LSHN	(t)	$\sum_{i=o}^{4} \Pi_{2i}$-MSHN	(t)
TOT	0.01367	(0.219)	0.04066	(0.752)
20	-0.08168	(1.258)	0.04145	(0.719)
21	-0.118542	(1.174)	-0.03589	(0.422)
22	-0.27884	(1.610)	0.62434	(3.157)
23	-0.065359	(0.929)	0.40967	(4.319)
24	-0.10218	(1.305)	-0.12030	(1.252)
25	0.22834	(1.083)	-0.78981	(0.406)
26	0.112482	(0.976)	-0.00651	(0.059)
27	0.08961	(0.774)	-0.06393	(0.627)
28	0.08464	(0.273)	0.03314	(0.209)
29	0.00052	(0.005)	0.08567	(0.893)
30	-0.02870	(0.284)	0.29635	(1.445)
31	0.40618	(2.090)	-0.20627	(1.689)
32	-0.93521	(5.317)	0.25905	(3.612)
33	0.400949	(2.012)	-0.16814	(1.460)
34	0.135002	(0.795)	-0.14669	(0.974)
35	0.036136	(0.393)	-0.33570	(5.684)
36	0.025361	(0.261)	-0.25358	(2.473)
37	0.01946	(0.210)	-0.11713	(1.448)
38	-0.13649	(0.606)	0.64305	(2.436)
39	-0.03270	(0.256)	-0.07405	(0.636)

Table 5.8: Calculation of target rate, τ^E, Comparison with actual rates, τ^A, Deviations between estimated and actual rates $(\tau^E-\tau^A/\tau^E)$, Two digit SIC sectors, Greek manufacturing

Sector	$\sum_{i=o}^{12} \Pi_{3i}$ (t)		$(\frac{\overline{K}}{P.QN})$	τ^E	τ^A	$\frac{\tau^E-\tau^A}{\tau^E}$
TOT						
20	0.0701627	(1.8159)	2.696	0.02602	0.03829	47.16%
21	0.098121	(2.205)	3.455	0.02840	0.02817	0.8%
22						
23						
24	0.2590631	(1.9897)	3.257	0.07954	0.07739	2.7%
25	0.552060	(4.608)	4.352	0.12685	0.05520	56.5%
26	0.13682	(2.473)	3.531	0.03875	0.03760	2.97%
27	0.157056	(5.002)	5.271	0.02980	0.02658	10.81%
28						
29						
30						
31						
32						
33						
34						
35	0.158522	(3.427)	2.695	0.05882	0.05172	12.07%
36	0.188668	(2.878)	3.640	0.05183	0.04827	6.87%
37	0.24664	(2.757)	3.835	0.06431	0.05187	19.35%
38						
39						

It is possible to calculate the value of the target rate (τ) from the K/QN.P ratio calculated at the sample mean, on which information is provided in table (5.5), as

$$(5.47) \quad c_3 = \sum_{i=o}^{12} \pi_{3i} = \frac{(1 + \tau)K}{P.QN}$$

The calculations are given in table 5.8 for the 9 two digit SIC sectors for which the variable K/QN yielded significant and positive long run coefficients. Furthermore a test of the deviation of the thus estimated target rates of return with actual rates is also conducted.[24] The actual rates of return on total assets are obtained from the yearly publications of the CGI Bulletin and refer to (yearly) averages of the period 1963-1977. Despite the difference of the CGI sample from the sampling coverage used in this study (A1S) it is possible to compare the two rates. The results show quite a surprising similarity given that we compare two totally independent estimates of rates of return. The deviations of the estimated τ from the actual τ show that in most of the sectors examined the difference is around 10%. Exceptions are sectors 20,25 and 37 in which after all, the target rate model as a representative pricing approach is not consistent with the data generation process of these sectors.

A summary of the above discussion on the target rate model is given in table 5.9 where the performance of each sector is depicted. On the whole, the target rate model behaves rather poorly in the sense that only 5 sectors are considered to have a data generation process consistent with target rate of return pricing. Contrary to the full-cost model the cost factors behave rather well and once again overwhelm the performance of the demand variables. The next section is concerned with the examination of the last pricing model

Table 5.9: Summary of sectoral Results. Target rate of return equation (5.43)
Two digit SIC sectors, Greek manufacturing

Sector	Results				
TOT					$d\ell n(K/QN) = 0$
20			$d\ell nULCN=0$,		
21	Auto,		$d\ell nULCN=0$,		
22	Auto,		$d\ell nULCN=0$,		$d\ell n(K/QN) < 0$
23					$d\ell n(K/QN) < 0$
24	Accepted				
25				$d\ell nUMCN=0$,	
26	Accepted				
27	Accepted				
28			$d\ell nULCN=0$,		$d\ell n(K/QN) = 0$
29					$d\ell n(K/QN) < 0$
30		Z_4,			$d\ell n(K/QN) < 0$
31					$d\ell n(K/QN) = 0$
32		Z_4,	$d\ell nULCN=0$,		$d\ell n(K/QN) < 0$
33		Z_4,			$d\ell n(K/QN) < 0$
34			$d\ell nULCN=0$,		$d\ell n(K/QN) = 0$
35	Accepted				
36	Accepted				
37	Auto,		$d\ell nULCN=0$,		
38		Z_4,	$d\ell nULCN=0$,		$d\ell n(K/QN) < 0$
39	Auto,	Z_4,			

considered in this study, namely the normal cost or normal price hypothesis.

5.5 Formulation, estimation and testing of the normal-cost pricing model

5.5.1 Introduction

The normal cost hypothesis is a recently developed model that bears the same essential characteristics with the full cost model, namely that prices are based on standard (normal) costs and that demand plays no (direct) influence in the price determination process. Yet it is examined as a separate price model because it provides the most comprehensive distinction between the influences of cost and demand changes on price changes.

In this section we are concerned with the formulation, derivation and empirical testing of the normal cost model. Much of the discussion draws heavily on the work by K. Coutts, W. Godley and W. Nordhaus (1978) (CGN), although in a number of respects the model presented here is differentiated from that of CGN. Section 5.5.2 is concerned with the formulation of the hypothesis. In section 5.5.3 we provide an analytic derivation of the "predicted" prices on which the normal cost model heavily depends. Finally, section 5.5.4 deals with the empirical testing of the normal cost hypothesis, the presentation and discussion of the results.

5.5.2 Formulation of the normal cost hypothesis

The normal cost hypothesis that prices are set as a markup over normal costs, this markup being insensitive to variations in demand has received considerable attention during the last 15 years, particularly among British economic scholars. The generation of the hypothesis may be considered to originate with the publication of the W. Godley and W. Nordhaus (1972) paper to be completed a number of years later with the publication of the monograph by CGN. A definition of the normal cost hypothesis may be considered to be as follows:

The normal price hypothesis asserts that the markup of price over normal costs is independent of the conditions of demand in both product and factor markets.

Several characteristics are incorporated into the above definition: (1) Firms will measure costs by reference to a "normal" level of capacity utilization which will not vary cyclically (2) Price will be determined by applying a markup over costs to account for profits, and (3) The markup is insensitive to demand fluctuations. Tests of the validity (acceptance or rejection) of the normal cost model are focused mainly on the third characteristic. In order for such a test to be performed the procedure for the formulation of the normal cost hypothesis has to be set out. Such a procedure involves the following two steps: (a) The construction of a series of normal or "predicted" prices that is based on series of normal costs, ie. costs that are totally independent from the fluctuations of actual costs and (b) The confrontation of the thus generated series with actual prices and demand.

Let PN denote normal or "predicted" prices and f(D) be a function of demand. Then the normal cost model may be written as:

(5.48) $P = \alpha PN^{b} f(D)$

There are a number of issues that require further elaboration as far as equation (5.48) is concerned. The first issue regards the process by which PN is generated. The essence of the normal cost hypothesis is to construct a series of prices, the "predicted" prices that is based on the estimates of normal costs, which in turn are totally purged from any cyclical fluctuations in demand. The aim is that "predicted" prices which are generated without any reference to actual prices (and actual costs) should be able to predict with accuracy the fluctuation of actual prices. The procedure by which predicted prices are constructed involves the following steps: (1) the estimation of normal costs (2) the specification of a normal markup, which when applied upon the generated normal costs will result to a series of "predicted" or normal prices. The methodology by which predicted prices are generated is the subject matter of section 5.5.3.

The second issue concerning equation (5.48) is the specification of the demand function. The question of how industrial prices respond to demand can in general be examined in two ways. Either one adopts the excess demand view that prices rise in periods of expansion and fall in periods of recession, or one can adopt the markup view, according to which the question becomes how prices respond to demand given costs. If the first approach is adopted, units costs are irrelevant, since supply and demand schedules are subsumed within a single excess demand function. The study is not concerned with such an approach. Instead only models of the markup variety are examined.

If one accepts the markup view, then the proposition of how prices respond to demand, becomes a question of how markup responds to demand. Two alternative assumptions have been developed in the literature: (a) It may be assumed that firms raise prices relative to (normal) costs in periods of expansion and reduce them in periods of recession in which case the level of the markup over (normal) costs depends (positively) on the level of demand.(b) It may alternatively be assumed that it is the rate of change of the markup which depends on the level of demand. Assumption (a) can be translated (expressed in a rate of change form) into saying that the rate of change of markup is a function of the rate of change of demand. Such an assumption has been used by CGN despite its main disadvantage:[25] if demand pressures are always positive at a constant rate, then the markup will not change. On the other hand, assumption (b) proposed by D.E.W. Laider and M. Parkin (1975) is equivalent in saying that if demand is significant, then prices will rise relatively to costs indefinitely as long as demand pressures are positive (and vice-versa). Clearly, both specifications are inadequate in describing the influences of demand on industrial prices, given costs.

Instead, a combination of the above assumptions might be the appropriate specification to adopt. Denoting demand pressures by the ratio of actual to normal output, then the rate of change of markup is seen to depend on the level of demand pressures and the speed at which these pressures change over the cycle i.e.

$$(5.49) \qquad d\ell nM = \beta_1 \, \ell n \frac{Q}{QN} + \beta_2 \, d\ell n \frac{Q}{QN}$$

Clearly equation (5.49) avoids the disadvantages of both previous assumptions. Combining equation (5.49) with (5.48) results after some manipulation[26] in a price equation expressed in rate of change form as in

$$(5.50) \quad d\ell nP = c_0 + c_1\, d\ell nPN + c_2\ell n\,(\frac{Q}{QN}) + c_3 d\ell n\,(\frac{Q}{QN})$$

Equation (5.50) represents the specification adopted to represent the normal cost hypothesis. For such a hypothesis to be accepted the following conditions should hold:

$$(5.51) \quad c_1 = 1, \quad c_0 = c_2 = c_3 = 0$$

The fact that the constant term should be insignificantly different from zero results from the fact that α in equation (5.48) should be (insignificantly different from) unity. The requirements set out by equation (5.51) imply a rather strict interpretation of normal cost pricing: taken together they imply that prices are based on normal costs and that the markup is fixed for eternity and invariant even to the most extraordinary events. Although such a view[27] is an extreme view, is the only view according to which a formal test of the normal cost model can be conducted. Any other assumption, particularly as far as the expected value on c_1 is concerned would open the door for any justification thus making the normal cost model clearly irrefutable.[28]

To obtain an operational version of equation (5.50) one requires a specification of the pattern of lags entering the variables on the r.h.s. and an assumption about the error term. Prior to that however, the procedure for the generation of PN should be determined.

5.5.3 The generation of "predicted" prices

The construction of normal or "predicted" prices involves a number of distinct but interrelated procedures: (1) The generation of series on normal costs and in particular normal labour and normal material costs (2) The specification of a pattern of lags between changes in costs and changes in prices and the application of this lag pattern on normal labour and normal materials costs (3) The multiplication of the thus estimated costs with a constant markup insensitive to fluctuations in demand in order to yield normal prices.

5.5.3(1) Normal unit labour and normal unit materials costs The normal value of a variable is defined as the value that this variable would take, other things equal, if output were at its normal value. The normal value of output is the value that output would take if it were on its trend path. This is defined[29] as the prediction of a regression of the logarithm of seasonaly adjusted real output on a time trend and a quadratic time trend[30] . The results of the estimation of the normal output (QN) for the two digit SIC sectors of Greek industry are given in table 3.8.

Having defined QN, then the main task of the normalisation process is to analyse and then correct for the manner in which unit labour and unit material costs respond to fluctuations in output, given the determination of wage rates, nationaly negotiated hours, material prices etc. It is assumed in other words, that the elements that constitute unit labour and and unit material costs as for example actual hours, earnings, employment and materials volume are determined among other things, as some function of output. By estimating such models and setting actual output equal to normal output it is possible to generate within sample predictions of hours, earnings, employment and materials volume conditional upon output being on its trend path (QN), ie normal values of these variables: Given these normalised variables, normal unit labour and normal unit material costs can be constructed. The process by which these variables are constructed has been the subject matter of chapter 4. Nonetheless it will be briefly repeated here in order to give a complete picture of the generation of normal prices.

The discussion of chapter 2 and most of Appendix 3 has shown that it is possible to generate quarterly series on each element of the cost composition of output, namely quarterly series on labour expenditure, materials expenditure and capital expenditure. Moreover, given the above it is also possible to obtain (residually) quarterly series on profits(losses). The normalisation process is concerned with labour (LB) and materials expenditure (MB)

(A) Labour Expenditure LB is defined as the sum of expenditure made on the five distinctive labour categories on which we have information from the two major statistical sources used in this study, AIS and LS, namely

(1) Expenditure on male wage earners (WM)

(2) Expenditure on female wage earners (WF)

(3) Expenditure on male salaried earners (SM)

(4) Expenditure on female salaried earners (SF)

(5) Expenditure (national) on employers and family working members (EMP)

The average values of the shares of the above labour expenditures on total expenditure for the period 1963i-1977iv are given in table 4.3 Actual unit labour cost is the ratio of labour expenditure (LB) to the volume of output (Q) is defined as

(5.52) $ULC = \frac{LB}{Q} = \frac{WM+WF+SM+SF+EMP}{Q}$

Each of the above labour expenditures can further be defined as

(5.53) $WM = 1.175\ (12.25*AWEM*HM*LWM)$

(5.54) $WF = 1.175\ (12.25*AWEF*HF*LWF)$

(5.55) $SM = 1.175\ (3*AMEM*LSM)$

(5.56) $SF = 1.175\ (3*AMEF*LSF)$

(5.57) $EMP = (3*AMEM*LEMP)$

where AWEM = average weekly earnings of male wage earners

AWEF = average weekly earnings of female wage earners

AMEM = average monthly earnings of male salaried earners

AMEF = average monthly earnings of female salaried earners

HM = average weekly hours worked per male (wage earner) employee

HF = average weekly hours worked per female (wage earner) employee

LWM = employment of male wage earners

LWF = employment of female wage earners

LSM = employment of male salaried earners

LSF = employment of female salaried earners

LEMP = employment of employers and family working members

The construction of series on normal unit labour costs, involves the purging of all the variables that enter equations (5.53) - (5.57) from the cyclical demand elements. Equation (5.57) is not a part of the normalisation procedure, first because of the negligible share that the EMP has on total labour expenditure (See table 4.3) and second because of the notional expenditure of this item.[31]

The procedure can be briefly described as follows

(1) Actual Hours worked are assumed to be a function of nationally negotiated hours (HS), a time trend (t) and a capacity utilisation variable (Q/QN) as in (5.58α)(5.58b)

$$(5.58\alpha) \quad HM_t = \pi_o + \pi_1 HS_t + \pi_2 t + \sum_{i=o}^{4} \pi_{3i} CU_{t-i} + u_t$$

$$(5.58b) \quad HF_t = \pi_o + \pi_i HS_t + \pi_2 t + \sum_{i=o}^{4} \pi_{3i} \ CU_{t-i} + u_t$$

Normal hours are defined as the number of hours worked, if output is at its normal level (Q=QN) as in (5.59) and (5.59b) (for males and females respectively)

$$(5.59\alpha) \quad HMN_t = \hat{\pi}_o + \hat{\pi}_1 HS_t + \hat{\pi}_2 t + \sum_{i=o}^{4} \hat{\pi}_3 i$$

$$(5.59b) \quad HFN_t = \hat{\pi}_o + \hat{\pi}_1 HS_t + \hat{\pi}_2 t + \sum_{i=o}^{4} \hat{\pi}_3 i$$

where carrets denote estimated values of the cœfficients of equations (5.58α) and (5.58b).

(2) Wages Average weekly earnings are assumed to be a function of basic hourly rates (BHR), the overtime premium (π_4) and-depending on the assumptions used about earnings drift - a time trend (t) or a productivity variable. The specifications are given in equations (5.60 α)(5.61 α) and (5.60b)(5.61b) for males and females respectively.

$$(5.60\alpha) \quad \ell nAWEM_t = \pi_o + \pi_1 t + \pi_2 \ell nBHRM_t + \pi_3 \ell n[HS_t + \pi_4(HM_t - HS_t)] + u_t$$

(5.60b) $\ell nAWEF_t = \pi_o + \pi_1 t + \pi_2 \ell nBHRF_t + \pi_3 \ell n[HS_t + \pi_4(HF_t - HS_t)] + u_t$

(5.61a) $\ell nAWEM_t = \pi_o + \sum_{i=o}^{3} \pi_{1i} \ell n\left(\frac{Q_t}{LWM_t * HM_t}\right)_{t-i} + \pi_2 \ell nBHRM_t + \pi_3 \ell n[HS_t + \pi_4(HM_t - HS_t)] + u_t$

(5.61b) $\ell nAWEF_t = \pi_o + \sum_{i=o}^{3} \pi_{1i} \ell n\left(\frac{Qt}{LWF_t * HF_t}\right)_{t-i} + \pi_2 \ell nBHRF_t + \pi_3 \ell n[HS_t + \pi_4(HF_t - HS_t)] + u_t$

Specification (5.60α) is accepted in sectors SIC:22 and 33. The rest follow specification (5.61α). Specification (5.60b) is accepted for sectors SIC:25,26,27,28,29,31,33 and 37. The rest follows specification (5.61b). Normal average weekly earnings can now be defined as follows

(5.62α) $\ell nAWEMN_t = \hat{\pi}_o + \hat{\pi}_1 t + \hat{\pi}_2 \ell nBHRM_t + \hat{\pi}_3 \ell n[HS + \pi_4(HMN_t - HS_t)]$

(5.62b) $\ell nAWEFN_t = \hat{\pi}_o + \hat{\pi}_1 t + \hat{\pi}_2 \ell nBHRF_t + \hat{\pi}_3 \ell n[HS + \pi_4(HFN_t - HS_t)]$

(5.63α) $\ell nAWEMN_t = \hat{\pi}_o + \sum_{i=o}^{3} \hat{\pi}_{1i} \ell n\left(\frac{QNt}{LWMN_t * HMN_t}\right)_{t-i} + \hat{\pi}_2 \ell nBHRM_t + \hat{\pi}_3 \ell n[HS_t +$

$\pi_4(HMN_t - HS_t)]$

(5.63b) $\ell nAWEFN_t = \hat{\pi}_o + \sum_{i=o}^{3} \hat{\pi}_{1i} \ell n\left(\frac{QNt}{LWFN_t * HFN_t}\right)_{t-i} + \hat{\pi}_2 \ell nBHRF_t + \hat{\pi}_3 \ell n[HS_t +$

$\pi_4(HFN_t - HS_t)]$

<u>(3) Salaries</u> average monthly earnings (for salaried earners) is assumed to be a function of basic monthly rates (BME_t), a time trend

measuring drift and a capacity utilization variable (CU_t) to account for overtime pay. Equations are run for males and females separately as in (5.64α) and (5.64b) respectively

$$(5.64a)\quad \ell nAMEM_t=\pi_o+\pi_1 BMEM_t+\pi_2 t+\sum_{i=o}^{4}\pi_{3i}CU_{t-i}+u_t$$

$$(5.64b)\quad \ell nAMEF_t=\pi_o+\pi_1 BMEF_t+\pi_2 t+\sum_{i=o}^{4}\pi_{3i}CU_{t-i}+u_t$$

Normal average monthly earnings are defined as (for males and females respectively)

$$(5.65a)\quad \ell nAMEMN_t=\hat{\pi}_o+\hat{\pi}_1 BMEM_t+\hat{\pi}_2 t+\sum_{i=o}^{4}\hat{\pi}_{3i}$$

$$(5.65b)\quad \ell nAMEFN_t=\hat{\pi}_o+\hat{\pi}_1 BMEF_t+\hat{\pi}_2 t+\sum_{i=o}^{4}\hat{\pi}_{3i}$$

(4) Employment of wage earners Employment is assumed to be a function of output, a time trend, a quadratic time trend and normal hours (HMN, HFN). Normal hours are included in the determination of employment equations since by (5.58a) and (5.58b) it was established that a change in standard hours has a significant effect on actual hours worked. Therefore a reduction in standard hours is expected to raise employment irrespective of fluctuations in output. Employment functions are given in (5.66a) and (5.66b) for males and females respectively

$$(5.66\alpha)\quad LWM_t=\pi_o+\pi_1 t+\pi_2 t^2+\sum_{i=o}^{4}\pi_{3i}Q_{t-i}+\sum_{j=o}^{4}\pi_{4j}HMN_{t-j}+u_t$$

$$(5.66b)\quad LWF_t=\pi_o+\pi_1 t+\pi_2 t^2+\sum_{i=o}^{4}\pi_{3i}Q_{t-i}+\sum_{j=o}^{4}\pi_{4j}HFN_{t-j}+u_t$$

Since the lag on normal hours was found to be significant, if at all, only for the current quarter, normal employment equations (for wage earners) all given by equations (5.67 α) and (5.67b) for males and females respectively

$$(5.67\alpha)\quad LWMN_t=\hat{\pi}_o+\hat{\pi}_1 t+\hat{\pi}_2 t^2+\sum_{i=o}^{4}\hat{\pi}_{3_i} QN_{t-i}+\hat{\pi}_{4_o} HMN_t$$

$$(5.67b)\quad LWFN_t=\hat{\pi}_o+\hat{\pi}_1 t+\hat{\pi}_2 t^2+\sum_{i=o}^{4}\hat{\pi}_{3_i} QN_{t-i}+\hat{\pi}_{4_o} HFN_t$$

(5) Employment of salaried earners (administrative technical and clerical personnel). It is assumed that employment of salaried earners is a function of output. Two separate regressions are run for males (5.68α) and females (5.68b)

$$(5.68\alpha)\quad LSM_t=\pi_o+\sum_{i=o}^{4}\pi_{3_i} Q_{t-i}+u_t$$

$$(5.68b)\quad LSF_t=\pi_o+\sum_{i=o}^{4}\pi_{3_i} Q_{t-i}+u_t$$

Normal ATC employment can be defined as

$$(5.69a)\quad LSMN_t=\hat{\pi}_o+\sum_{i=o}^{4}\hat{\pi}_{3_i} QN_{t-i}$$

$$(5.69b)\quad LSFN_t=\hat{\pi}_o+\sum_{i=o}^{4}\hat{\pi}_{3_i} QN_{t-i}$$

Having obtained normal values for all the elements entering equations (5.53)-(5.56), it is possible to define normal labour unit costs as follows

$$(5.70)\quad ULCN=\frac{LBN}{QN}=\frac{WMN+WFN+SMN+SFN+EMP}{QN}$$

where WMN = 1.175 (12.25 *AWEMN*HMN*LWMN)

WFN = 1.175 (12.25 *AWEFN*HFN*LWFN)

SMN = 1.175 (3*AMEMN*LSMN)

SFN = 1.175 (3*AMEFN*LSFN)

(B) Materials expenditure (MB). MB is defined as the product of materials prices, Pm, and materials volume, M. In chapter 2 and Appendix 3 it has been shown that it is possible to obtain quarterly figures on both Pm and M. Materials volume is assumed to be a function of output as in (5.71)

$$(5.71) \quad \ell nM_t=\pi_o+\sum_{i=o}^{4}\pi_{1_i}\ell nQ_{t-i}+u_t$$

from which it is possible to obtain values of normal materials volume, by substituting output with normal output as in

$$(5.72) \quad \ell nMN_t=\hat{\pi}_o+\sum_{i=o}\hat{\pi}_{1_i}\ell nQN_{t-i}$$

Normal unit materials cost can now be defined as

$$(5.73) \quad UMCN=\frac{Pm\ MN}{QN}$$

A comparison between actual and normal unit labour and unit material costs by comparing their respective means and standard deviations is given in table (5.1) In general the normal costs have a smaller variance than their actual counterparts. The next subsection is concerned with the application and the specification of a pattern of lags to be applied on the thus estimated normal costs.

<u>5.5.3. (2) The specification of the lag pattern</u>. The analysis of the relationship between prices and unit costs requires that a method is established to deal with the question of time lags. Usually in the analysis of economic time series very little if at all can be said <u>apriori</u> either about the shape or the duration of the time lag . In all previous pricing models examined, the pattern of changes between prices and unit costs was determined freely without imposing any constraints on the individual lag coefficients apart from the fact that the maximum number of lags was constrained to 4 in the case of unit labour and unit material costs. However, in the case of price determination there exists quite a strong body of information that can generate <u>apriori</u> presumptions about the pattern of lags between costs and prices. This body of information will be employed in the normal cost model in accordance with the methodology described in CGN (1978) An extensive discussion of this methodology, a statistical analysis for the estimation of the parameters involved in the calculation of the lag pattern, together with the presentation of the results for the two-digit SIC sectors of Greek manufacturing can be found in Appendix 5. The next paragraphs present a brief summary of this rather technical procedure.

Once the basic assumption that prices depend on normal costs is accepted, then the question facing the firms is how to set-up a procedure by which to attribute value to the goods produced. The problem of attributing value to a product is equivalent to the problem of attributing value to the various costs that the firm incurs in the productive process. Since at any point in time the firm will employ a number of factors that will be stocked at least temporarily, the problem of attributing value to the various productive factors is conceptually similar to the problem of stock-valuation. In principle there are two options that the firm can use in valuating its stocks; The First in First out principle by which the firm would estimate its costs by valuing the purchases of materials and labour at their historic cost. From the point of view of price behaviour this assumption is extreme and in any case unrealistic as a business practice, since under it, firms do not adjust final prices in a period of rapid inflation until stocks of inputs bought at lower prices are completely exhausted. Such a practice certainly is the exception as far as Greek industrial firms are concerned. The other possible option available to the firms is the Last in First out principle by which the firm adjusts its prices instantaneously to a change in cost, ie valuation is based on replacement cost. This practice may also be regarded as an extreme case from the point of view of pricing behaviour, since under it prices move simultaneously with costs, ie the time lag is actualy zero. An intermediate pricing strategy that certainly comes closer to reality is to assume that the firm values purchases of materials and labour at the average cost at which items in stock have been purchased. This is the average cost pricing which will be used in this study in accordance with CGN.[32,33] Moreover an evaluation of the performance of the normal cost of hypothesis under the three principles discussed will also be examined.[34]

The three valuation procedures examined are important in the construction of predicted prices only if they imply a precise distribution of lags between costs and prices. Obviously replacement cost pricing implies a precise pattern of lags (time lag equal to zero). It will be shown that the other valuation principles also imply this precise relationship. A precondition for the calculation of this relationship is the estimation of the production period (Θ). This is defined as the maximum length of time between the first purchase of an input used in the productive process and the sale of the finished product.

Table 5.10 Production period - Θ - (in quarters), 1970 values
Two digit SIC sectors, Greek manufacturing industries

Sector	Production period	Sector	Production Period	Sector	Production Period
TOT	2.11041	26	2.73099	33	2.68143
20	1.35519	27	1.90678	34	2.83801
21	1.98966	28	0.96584	35	3.00754
22	1.80909	29	2.47621	36	2.87782
23	2.12277	30	1.86595	37	2.51282
24	1.36907	31	1.49456	38	4.18372
25	1.86933	32	0.45389	39	4.23747

The derivation of Θ is described in section A5.2 and summarised here.

The valuation of a firm's product consists of value added and materials. Value added is employed progressively through the production period, while for materials a portion, b, is added initially and a portion (1-b) progressively. If we designate the share of materials in sales by a, then it is possible to derive the production period Θ as

$$(5.74) \quad \Theta = \frac{2S}{X(1+ab)}$$

where S=stocks in period t and X=sales in period t

The values for θ, expressed in quarters, based on information for year 1970 and conditional on the assumption that b=0.6666 and given in table (5.10).[35] These values are calculated, based on two arbitrary assumptions. The first is that the proportion of materials entering in the beginning is $\frac{2}{3}$ for all industries. Here we follow CGN who admit that this assumption is arbitrary. A different approach is employed by H.M. Pesaran (1972b) who used maximum likelihoodto estimate b and found the maximum likelihood estimate to be zero.[36] However in testing the normal cost hypothesis H.M. Pesaran obtained identical results irrespective of whether the proportion of materials, (1-b) entering

Table 5.11 Means and standard deviations of θ,1963-1977
Two-digit SIC sectors, Greek manufacturing industries

Sector	Mean, st.deviation	Sector	Mean, st.deviation	Sector	Mean, st.deviation
TOT	2.0040, 0.1963	26	2.8194, 0.2312	33	2.8014, 0.5917
20	1.2405, 0.1785	27	1.9650, 0.2121	34	3.1794, 1.0153
21	2.1112, 0.2755	28	0.8694, 0.1523	35	3.0180, 0.3463
22	2.1468, 0.4963	29	2.5898, 0.3429	36	2.3107, 0.7280
23	2.1499, 0.4139	30	1.5260, 0.2526	37	2.9916, 0.3381
24	1.2608, 0.2371	31	1.4085, 0.2599	38	4.8878, 1.3705
25	2.0637, 0.1904	32	0.4028, 0.0928	39	4.2025, 1.1667

the production process at the beginning is two thirds or zero. In the absense of a well-specified alternative hypothesis for the estimation of b, it was assumed that the value of $\frac{2}{3}$ is an acceptable assumption. Some reservations[37] are expressed however with regard to sectors SIC: 28,31,33,34. The second arbitrary assumption on which the calculation of the production period is based is the fact that empirical estimates of θ rest on an evaluation of the parameters for the year 1970. This year represents the median of the period analysed in this study and may be considered as a typical year from a number of aspects. However θ is not supposed to remain constant for a period span of 15 years. In principle the calculation of θ should be conducted for each year. Naturally one would expect the range of θ to differ slightly between years. Given that and the cost of calculations required to estimate series or predicted prices using values of θ for each year, it was assumed that the values presented in table 5.10 are a reasonable approximation of θ for the whole period. This is further corroborated by the evidence provided in table 5.11 that gives the means and standard deviations of θ's calculated for each year from 1963 to 1977. The results of the production period, θ, as given in table 5.10 display significand differences in the estimates for the various industries. The shortest θ's are found in sectors 32 (oil refining) and 28 (printing and publishing). The engineering industries on the whole display longer θ's, as expected, ranging from 2.51282 for sector 37 to 4.18372 for sector 38. Moreover there seems to be a remarkable similarity between the results obtained here and those obtained by CGN despite the fact that the level of aggregation between the two studies is not the same and the totally different industrial structure between Greece and Britain. [38]

The production period gives the upper bound to the plausible total lapse of time between a cost-increase and the completion of the corresponding price increase. The question of how this lag is distributed over that interval of time (θ) will depend partly on the policy that the firm is assumed to follow (historic cost, replacement cost of average cost pricing) and partly on the character of the production process (shares of value-added and materials in sales and shares of initialy and progressively added materials). Section A5.3 determines the relationship between costs and prices under the three valuation practices as follows:[39]

(5.75) Historic cost pricing $P_t=(1+m)[bUMCN_{t-\theta}+\sum_{i=0}^{\theta}(\frac{1}{\theta})ULCN_{t-i}+$

$$+(1-b)\sum_{i=0}^{\theta}(\frac{1}{\theta})UMCN_{t-i}]$$

(5.76) Replacement cost pricing $P_t=(1+m)[UMCN_t+ULCN_t]$

(5.77) Average cost pricing $P_t=(i+m)[b\sum_{i=1}^{\theta}\frac{1}{\theta}UMCN_{t-i}+(1-b)\sum_{i=0}^{\theta}\frac{2(\theta-i+1)}{\theta(\theta+i)}UMCN_{t-i}$

$$+\sum_{i=0}^{\theta}\frac{2(\theta-i+1)}{\theta(\theta+i)}ULCN_{t-i}]$$

where m=markup

ULCN,UMCN=normal unit labour and normal unit materials cost defined in equations (5.70) and (5.73) respectively

b=(0.6666)=proportion of initial entry materials to total materials

θ=production period

i=refers to quarters

Equations (5.75)(5.76) and (5.77) do not take into account the division of inputs into initially added and progressively added. If this distinction is considered, then it is possible to calculate precise time-lag relationships between costs and prices. Initially added inputs refer to materials only (more specifically to a proportion b of materials). It is possible to define a function $fk(\alpha)$[40] in which the distributed lag weights express the proportional distribution of a step-cost change in quarter zero over the succeding quarters (i.e. a change in input cost in the beginning of quarter zero which is maintained during the remainder of the quarter). Application of this distribution function provides the distriubted lag weights for initialy added material inputs. The results of these calculations for the two-digit SIC sectors of Greek manufacturing are presented in table A5.2 Following a similar but slightly more complicated procedure for progressively added inputs it is again possible to define a distribution function fk(b)[41] that gives the cumulative proportion of a (progressively added) cost increase that has been transmitted into a price increase by the end of each quarter until Θ quarters (the production period) have elapsed. Application of this distribution function provides the distributed lag weights for progressively added imputs. The results for the two digit SIC sectors of Greek manufacturing are presented in table A5.3. Obviously the lag weights presented in table A5.3 are the same for both the labour inputs and progressively added material inputs. In this respect table A5.3 provides the (final) distributed lag weights for normal unit labour cost. The final distributed lag weights for normal unit materials cost are defined as the weighted sum of the distributed lag weights of initially added material inputs (see table A5.3) where the weights are b and (1-b) respectively. The distribution of lags is presented in the table A5.4 for each two digit SIC sector of Greek manufacturing.

Using the information of tables A5.3 and A5.4 it is now possible to define a measure of normal unit labour cost and a measure of normal unit material cost that incorporate the lag distribution of these variables in the production period. These are defined as ULCN* and UMCN* respectively and the calculations are provided in table 5.12. Based on these calculations it is also possible to define a measure of normal unit variable costs that takes into account the lag distribution of the two variables as

(5.78) $UVCN^* = ULCN^* + UMCN^*$

<u>5.5.3 (3) The specification of a "normal" markup.</u> The final step in the construction of normal prices is concerned with the specification of the markup. To simplify their analysis CGN assume a constant markup although it is acknowledged at the outset that the markup has fallen substantially during the period which they consider. This seems to generate one of the major sources of criticism to the CGN study.[43] There are a number of issues that should be examined before one applies a constant markup on the normal costs derived in equation (5.78).

(1) It should be made clear that the markup in question is the markup on normal costs, ie

(5.79) $M_1 = \frac{P - UVCN^*}{P}$

This markup is different from the markup defined in equation (1.14) to the extent that actual costs are different from normal costs.

(2) A second issue regards the definition of costs (normal costs) on which the markup is applied. CGN apply the markup on normal unit variable cost although they recognize that the omission of capital costs is a disadvantage. Due to the inherent difficulties of calculating a consistent measure of capital costs subsequent studies that followed the normal cost approach have also omitted capital costs.[44] However such an omission is probably the main culprit for the below unity coefficients obtained in the predicted

Table 5.12: Calculation of ULCN* and UMCN*
Two-digit SIC sectors, Greek manufacturing

Sector	ULCN* , UMCN*
TOT	$ULCN^* = 0.3596\ ULCN + 0.4907\ ULCN_{-1} + 0.1308\ ULCN_{-2} + 0.0189\ ULCN_{-3}$ $UMCN^* = 0.1199\ UMCN + 0.1636\ UMCN_{-1} + 0.6367\ UMCN_{-2} + 0.0799\ UMCN_{-3}$
20	$ULCN^* = 0.5029\ ULCN + 0.3631\ ULCN_{-1} + 0.1340\ ULCN_{-2}$ $UMCN^* = 0.1676\ UMCN + 0.5509\ UMCN_{-1} + 0.2814\ UMCN_{-2}$
21	$ULCN^* = 0.3765\ ULCN + 0.4983\ ULCN_{-1} + 0.1252\ ULCN_{-2}$ $UMCN^* = 0.1255\ UMCN + 0.1730\ UMCN_{-1} + 0.7015\ UMCN_{-2}$
22	$ULCN^* = 0.4052\ ULCN + 0.4660\ ULCN_{-1} + 0.1288\ ULCN_{-2}$ $UMCN^* = 0.1351\ UMCN + 0.2826\ UMCN_{-1} + 0.5823\ UMCN_{-2}$
23	$ULCN^* = 0.3579\ ULCN + 0.4896\ ULCN_{-1} + 0.1330\ ULCN_{-2} + 0.0195\ ULCN_{-3}$ $UMCN^* = 0.1193\ UMCN + 0.1632\ UMCN_{-1} + 0.6291\ UMCN_{-2} + 0.0883\ UMCN_{-3}$
24	$ULCN^* = 0.4992\ ULCN + 0.3668\ ULCN_{-1} + 0.1340\ ULCN_{-2}$ $UMCN^* = 0.1664\ UMCN + 0.5329\ UMCN_{-1} + 0.2907\ UMCN_{-2}$
25	$ULCN^* = 0.3951\ ULCN + 0.4772\ ULCN_{-1} + 0.1276\ ULCN_{-2}$ $UMCN^* = 0.1317\ UMCN + 0.2462\ UMCN_{-1} + 0.6221\ UMCN_{-2}$
26	$ULCN^* = 0.2926\ ULCN + 0.4379\ ULCN_{-1} + 0.2200\ ULCN_{-2} + 0.0496\ ULCN_{-3}$ $UMCN^* = 0.0975\ UMCN + 0.1460\ UMCN_{-1} + 0.2527\ UMCN_{-2} + 0.5039\ UMCN_{-3}$
27	$ULCN^* = 0.3891\ ULCN + 0.4840\ ULCN_{-1} + 0.1269\ ULCN_{-2}$ $UMCN^* = 0.1297\ UMCN + 0.2235\ UMCN_{-1} + 0.6468\ UMCN_{-2}$
28	$ULCN^* = 0.6185\ ULCN + 0.3815\ ULCN_{-1}$ $UMCN^* = 0.2289\ UMCN + 0.7711\ UMCN_{-1}$
29	$ULCN^* = 0.3167\ ULCN + 0.4592\ ULCN_{-1} + 0.1872\ ULCN_{-2} + 0.0369\ ULCN_{-3}$ $UMCN^* = 0.1056\ UMCN + 0.1531\ UMCN_{-1} + 0.4116\ UMCN_{-2} + 0.3298\ UMCN_{-3}$
30	$ULCN^* = 0.3957\ ULCN + 0.4766\ ULCN_{-1} + 0.1277\ ULCN_{-2}$ $UMCN^* = 0.1319\ UMCN + 0.2482\ UMCN_{-1} + 0.6199\ UMCN_{-2}$
31	$ULCN^* = 0.4679\ ULCN + 0.3987\ ULCN_{-1} + 0.1334\ ULCN_{-2}$ $UMCN^* = 0.1560\ UMCN + 0.4699\ UMCN_{-1} + 0.3742\ UMCN_{-2}$
32	$ULCN^* = 0.4841\ ULCN + 0.5159\ ULCN_{-1}$ $UMCN^* = 0.5254\ UMCN + 0.4745\ UMCN_{-1}$
33	$ULCN^* = 0.2970\ ULCN + 0.4420\ ULCN_{-1} + 0.2139\ ULCN_{-2} + 0.0471\ ULCN_{-3}$ $UMCN^* = 0.0990\ UMCN + 0.1473\ UMCN_{-1} + 0.2837\ UMCN_{-2} + 0.4700\ UMCN_{-3}$
34	$ULCN^* = 0.2835\ ULCN + 0.4293\ ULCN_{-1} + 0.2324\ ULCN_{-2} + 0.0548\ ULCN_{-3}$ $UMCN^* = 0.0945\ UMCN + 0.1431\ UMCN_{-1} + 0.1855\ UMCN_{-2} + 0.5769\ UMCN_{-3}$
35	$ULCN^* = 0.2703\ ULCN + 0.4161\ ULCN_{-1} + 0.2502\ ULCN_{-2} + 0.0633\ ULCN_{-3} + 0.0002\ ULCN_{-4}$ $UMCN^* = 0.0901\ UMCN + 0.1387\ UMCN_{-1} + 0.0834\ UMCN_{-2} + 0.6827\ UMCN_{-3} + 0.0051\ UMCN_{-4}$
36	$ULCN^* = 0.2803\ ULCN + 0.4261\ ULCN_{-1} + 0.2369\ ULCN_{-2} + 0.0567\ ULCN_{-3}$ $UMCN^* = 0.0934\ UMCN + 0.1420\ UMCN_{-1} + 0.1604\ UMCN_{-2} + 0.6041\ UMCN_{-3}$
37	$ULCN^* = 0.3130\ ULCN + 0.4561\ ULCN_{-1} + 0.1922\ ULCN_{-2} + 0.0387\ ULCN_{-3}$ $UMCN^* = 0.1043\ UMCN + 0.1520\ UMCN_{-1} + 0.3889\ UMCN_{-2} + 0.3548\ UMCN_{-3}$
38	$ULCN^* = 0.2044\ ULCN + 0.3397\ ULCN_{-1} + 0.2475\ ULCN_{-2} + 0.1553\ ULCN_{-3} + 0.0528\ ULCN_{-4} + 0.0003\ ULCN_{-5}$ $UMCN^* = 0.0681\ UMCN + 0.1132\ UMCN_{-1} + 0.0.825\ UMCN_{-2} + 0.0518\ UMCN_{-3} + 0.5618\ UMCN_{-4} + 0.1226\ UMCN_{-5}$
39	$ULCN^* = 0.2022\ ULCN + 0.3368\ ULCN_{-1} + 0.2467\ ULCN_{-2} + 0.1566\ ULCN_{-3} + 0.0563\ ULCN_{-4} + 0.0014\ ULCN_{-5}$ $UMCN^* = 0.0674\ UMCN + 0.1123\ UMCN_{-1} + 0.0822\ UMCN_{-2} + 0.0522\ UMCN_{-3} + 0.5271\ UMCN_{-4} + 0.1588\ UMCN_{-5}$

price series of both Godley-Nordhaus and CGN results. Here again the difficulty in constructing a proper index of predicted prices (PN) inclusive of capital costs and the inability of obtaining coefficients on PN that are in accordance with the normal cost theory is on of the basic arguments against normal costs as expressed by D.E.W. Laidler and M. Parkin (1975), M. Parkin (1977)(1978) and G.W. Smith (1978) (1982). To overcome this difficulty a measure of unit capital costs calculated at the normal level of output, UCCN, is employed.[44]

Such an index will be added to UVCN* to give an alternative definition of the markup applied on total unit normal costs (UTCN*) as

(5.80) $M_2 = \frac{P-UTCN^*}{P}$, $UTCN^* = UVCN^* + UCCN$

Moreover and for reasons of direct comparibility with the CGN study, both markups (M_1 and M_2) will be applied to unit cost measures (UVCN*, UTCN*) to give two measures of normal prices:

(5.81) $PN_1 = M_1 . UVCN^*$, normal prices exclusive of capital costs

(5.82) $PN_2 = M_2 . UTCN^*$, normal prices inclusive of capital costs

The generation of the normal markup is probably the most controversial issue of the normal cost hypothesis. CGN have assumed the value of the markup to be fixed at the 1963 value, since this was the only year on which data on M were available. On the other hand they recognize that during the period which they examine, the markup has falled substantially with the result that the assumption of a constant M is clearly an inadequate description of the evidence. However the alternative option, ie to multiply normal costs by the markup value of each and every time series observation would probably have spoiled the whole normalization procedure since, such a markup would be bound to be influenced by demand pressures from the effect of which normal prices are assumed to be purged.

The fixed markup specification is also adopted in this study. The markup is set equal to the mean values of 1970, i.e. (1970_i + 1970_{ii} + 1970_{iii} + 1970_{iv})/4, since 1970 is a normal year from many respects and also represents the median year of the period under study. The 1970 values together with the means and standard deviations for the period 1963_i - 1977_{iv} for both M_1 and M_2 are given in table 5.13. Inspection of the table indicates that in most of the sectors the mean values are close to the 1970 values, thus giving credit to the choice of 1970 as a representative year.

The specification of the markup concludes the procedure required for the generation of normal prices. In the next section an operational version of the normal cost model is tested against the data of the two digit SIC sectors of Greek industries.

5.5.4. Estimation and testing of the normal cost hypothesis

In the pricing hypotheses discussed so far, operational versions of the models have been derived by introducing dynamics into the original equations. As far as the normal cost model is concerned the lag specification between changes in normal prices and changes in actual (observed) prices was discussed in section 5.5.3. It was assumed then, that of the three pricing practices available to the firm, i.e. replacement cost pricing, historic cost pricing

Table 5.13: "Normal" markup values M_1, M_2 for 1970; Means and standard deviations of M_1, M_2 for 1963-1977; Two-digit SIC sectors, Greek manufacturing

Sector	1970		M_1: 1963-1977		M_2: 1963-1977	
	M_1	M_2	mean	st.deviation	mean	st.deviation
TOT	0.2108	0.1097	0.2424	0.1124	0.1251	0.0751
20	0.1472	0.0738	0.1708	0.0821	0.0849	0.0510
21	0.2498	0.1234	0.2998	0.1068	0.1419	0.0647
22	0.1743	0.0857	0.1977	0.0897	0.0847	0.0725
23	0.2296	0.1398	0.2870	0.1132	0.1650	0.0749
24	0.1754	0.1113	0.2048	0.0509	0.1147	0.0513
25	0.2068	0.0932	0.2275	0.0898	0.1137	0.0683
26	0.2316	0.0909	0.2802	0.1125	0.1136	0.0630
27	0.1847	0.0377	0.2161	0.1183	0.0509	0.0463
28	0.2689	0.1127	0.1764	0.1221	0.1221	0.1089
29	0.1637	0.1025	0.1768	0.0740	0.1128	0.0569
30	0.3136	0.1861	0.4098	0.1161	0.2140	0.0651
31	0.2871	0.1312	0.3388	0.1026	0.1574	0.0739
32	0.1775	0.1342	0.2396	0.1701	0.1879	0.1558
33	0.3368	0.2201	0.4413	0.1438	0.2834	0.1068
34	0.3266	0.1846	0.3919	0.1652	0.2278	0.1426
35	0.2121	0.1437	0.2354	0.1197	0.1653	0.1027
36	0.1860	0.1028	0.2139	0.1033	0.1203	0.0753
37	0.2356	0.1519	0.2909	0.0850	0.1881	0.0708
38	0.2341	0.1298	0.2926	0.1852	0.1623	0.1270
39	0.3334	0.2566	0.3667	0.0995	0.2848	0.0856

and average cost pricing, the preferred option is average cost pricing. Since our preference for this practice is based on intuition rather than economic reasoning and since the predictions of the normal cost model depend on the choice of the pricing practice, it was decided that prior to any test of the normal cost hypothesis the performance of the predicted price series under the three pricing practices should be assessed. Consequently, an equation of the form

$$(5.83) \quad d\ell nP_t = \alpha_0 + \alpha_1 d\ell nPN_{1it} + u_t \quad u_t \sim NID\ (0,6^2u)$$

was estimated for each of the three pricing procedures, where

$i = 1,2,3$ and

PN_{11} = predicted prices under average cost pricing (see equation (5.77)

PN_{12} = predicted prices under replacement cost pricing (see equation (5.76))

PN_{13} = predicted prices under historic cost pricing (see equation (5.75))

Table 5.14 reports the results of this test for the three pricing procedures, by giving the values of α_1 and $\bar{R}^2$. In general our expectation that the performance of average cost pricing overwhelms the other two is verified, since only in 4 sectors the multiple correlation coefficient and the value of the α_1 parameter under the average cost model is smaller than the $\bar{R}^2$ of the other two pricing procedures. Replacement cost pricing seems to be preferred for sector 24, while historic cost pricing performs better in sectors 26,38 and 39. It should be noted that the results of this rather raw test should be treated with caution since they provide but only an indication of the relative performance of the three pricing practices. Again for reasons of sectoral uniformity, the average cost pricing is adopted in all sectors.

Table 5.14 Regressions of actual on predicted prices, two digit SIC sectors Greek manufacturing industries

Sector	Average Cost Pricing		Replacement Cost Pricing		Historic Cost Pricing	
	a_1	$\bar{R}^2$	a_1	$\bar{R}^2$	a_1	$\bar{R}^2$
TOT	0.6536 (5.846)	0.4928	0.6004 (4.963)	0.4414	0.6211 (5.104)	0.4701
20	0.7482 (6.165)	0.5228	0.7085 (5.989)	0.5033	0.5885 (4.616)	0.4195
21	0.6327 (4.405)	0.3243	0.4447 (2.926)	0.2205	0.4996 (3.506)	0.2530
22	0.2468 (1.167)	0.3062	0.0919 (0.724)	0.1898	0.1114 (0.986)	0.2511
23	0.6404 (4.473)	0.4401	0.3976 (2.907)	0.2861	0.5107 (4.004)	0.3996
24	0.7326 (4.683)	0.3321	0.7719 (5.408)	0.3914	0.5016 (3.199)	0.2706
25	0.4326 (2.193)	0.2305	0.3925 (1.985)	0.2146	0.4098 (2.076)	0.2218
26	0.6664 (3.241)	0.2982	0.4144 (2.031)	0.1183	0.8956 (4.755)	0.3512
27	0.7869 (4.607)	0.4110	0.6529 (3.111)	0.3621	0.6999 (3.683)	0.3852
28	0.6672 (3.347)	0.2165	0.6205 (3.197)	0.2013	0.4804 (2.109)	0.1623
29	0.9177 (4.323)	0.2888	0.5851 (2.713)	0.1819	0.8626 (4.019)	0.2719
30	0.6863 (2.153)	0.2275	0.4955 (1.762)	0.1570	0.5871 (1.945)	0.1797
31	0.7834 (5.045)	0.3946	0.7051 (4.594)	0.3545	0.6868 (4.137)	0.3086
32	0.7879 (9.065)	0.6745	0.7001 (8.136)	0.6475	0.4039 (6.118)	0.3035
33	0.8007 (3.667)	0.2843	0.2845 (1.517)	0.0995	0.7777 (3.458)	0.2758
34	0.5125 (2.769)	0.2626	0.1989 (1.333)	0.1050	0.4978 (2.693)	0.2547
35	0.4581 (2.990)	0.3106	0.1604 (1.354)	0.0932	0.4384 (2.749)	0.3049
36	0.3516 (1.783)	0.2349	0.0978 (0.509)	0.0587	0.3492 (1719)	0.2336
37	0.8691 (4.624)	0.3178	0.3419 (1.942)	0.1112	0.7447 (4.053)	0.2733
38	0.0909 (0.148	0.0025			0.1825 (0.452)	0.0438
39	0.6565 (2.074)	0.2417	0.5779 (2.111)	0.2115	0.8666 (3.753)	0.3613

Turning to the demand variables equation (5.50) as it stands it implicitly assumes that any effect by demand on the markup over normal cost would occur instantaneously. The assumption of no lag in the response to demand is quite a vulnerable assumption to make and so in line with previously examined pricing models a lag of up to four quarters is introduced. Taking these considerations into account and adding an error term equation (5.50) can be written as

$$(5.84)\quad d\ell nP_t = \pi_0 + \pi_{1i} d\ell nPN_{it} + \sum_{i=o}^{4} \pi_{2i} \ \ell n\left(\frac{Q}{Qn}\right)_{t-i} + $$
$$+ \pi_3 d\ell n\left(\frac{O}{QN}\right)_t + u_t$$

where $u_t \sim NID(0, 6^2 u)$

and the term $\sum_{i=o}^{4} \pi_{2i} \ \ell n\left(\frac{Q}{QN}\right)_{t-i} + \pi_3 d\ell n\left(\frac{Q}{QN}\right)_t$

can be either $\sum_{i=o}^{4} \pi_{21i} CU_{t-i} + \pi_{31} ECU_t$

if the trend method is used (see equation (3.107))

or $\sum_{i=o}^{4} \pi_{22i} CW_{t-i} + \pi_{32} ECW_t$

if the Wharton method is used (see equation (3.108))

Furthermore, depending on the definition of PN (see equation (5.81) and (5.82)), two alternative equations will be run and so equation (5.84) will be transformed as

$$(5.84a)\quad d\ell nP_t = \pi_0 + \pi_{11} d\hat{\ell} nPN_{1t} + \sum_{i=o}^{4} \pi_{2i} \ \ell n\left(\frac{Q}{QN}\right)_{t-i} + $$
$$+ \pi_3 d\ln\left(\frac{Q}{QN}\right)_t + u_t$$

if normal prices are exclusive of capital costs, or

$$(5.84b) \quad d\ell nP_t = \pi_{12} d\ell nPN_{2t} + \sum_{i=o}^{4} \pi_{2i} \; l\ell n(\frac{Q}{QN})_{t-i} + \pi_3 d\ell n(\frac{Q}{QN})_t + u_t$$

if normal prices are inclusive of capital costs

The results of the estimation of equations (5.84a) and (5.84b) are presented in tables (5.15a) and (5.15b) respectively. Each table consists of three parts: part 1 presents the coefficients of the equations, part 2 a number of summary statistics and tests and part 3 the individual coefficients on the demand variables.

In general the performance of the normal cost model when applied to the data of the two digit SIC sectors of Greek manufacturing seems to be exceptionally good, since as it will be seen later, 13 out of 21 sectors possess a data generation process that is in accordance with the normal cost principle. On the whole the results are better when normal prices inclusive of capital costs are used (equation 5.84b), and this is the reason why equation 5.84b is our preferred choice for the normal cost model.

Starting from table 5.15a, part 2, the multiple correlation coefficient in general takes scores significantly lower than previous pricing models: 6 sectors have scores higher than 50%, 5 between 40% and 50%, 6 between 30% and 40% and 4 sectors have $\bar{R}^2$ below 30%. The hypothesis of zero autocorrelation is firmly rejected on the basis of the $Z_{1(4)}$ statistic in four sectors (SIC: TOT,28, 32 and 38). The post-parameter stability test indicates mispecification in 7 sectors (SIC: TOT,21,25,29,32,35 and 38). On the basis of econometric criteria alone therefore the normal cost equation

Table 5.15a: Results on the normal cost equation (5.84a)

Part 1 : Long-run coefficients

Sector	π_o	$\pi_{11} d\ln PN_{1t}$	$\sum_{i=o}^{4} \pi_{21i} CU_{t-i}$	$\pi_{31} ECU_t$	$\sum_{i=o}^{4} \pi_{22i} CW_{t-i}$	$\pi_{32} ECW_t$
TOT	-0.00590 (0.463)	0.68805 (5.786)			-0.001824 (1.4611)	0.00045 (2.299)
20	0.00381 (0.455)	0.81956 (7.339)			-0.000068 (0.089)	
21	0.00941 (2.249)	0.569697 (4.181)	0.000272 (1.082)	0.004053 (1.824)		
22	0.01184 (1.955)	0.370509 (2.044)	-0.001104 (2.292)			
23	0.004845 (1.043)	0.81977 (4.9006)	0.000433 (0.720)			
24	0.00211 (0.444)	0.763898 (5.304)	-0.000312 (0.758)			
25	0.0834 (4.931)	0.546025 (2.715)			0.004804 (4.310)	0.000471 (1.839)
26	0.0155 (1.850)	0.680995 (3.538)			0.001006 (1.614)	
27	0.00234 (0.401)	0.851623 (5.207)	0.000672 (1.585)			
28	0.00442 (0.488)	0.776851 (3.376)	0.000406 (0.537)			
29	0.00768 (0.988)	0.820059 (4.620)			0.000193 (0.396)	
30	-0.00298 (0.428)	0.896548 (3.854)	0.000830 (1.233)			
31	0.00138 (0.314)	0.83100 (5.718)	0.000253 (0.691)	-0.000270 (1.532)		
32	0.00648 (0.872)	0.828649 (8.587)	-0.000006 (0.029)			
33	0.00074 (0.123)	0.906638 (4.179)	0.000890 (1.095)	0.000555 (1.431)		
34	0.00100 (0.077)	0.741962 (3.793)			-0.000305 (0.564)	
35	0.0120 (2.598)	0.397639 (2.893)	0.001616 (3.476)	-0.000176 (3.851)		
36	0.0299 (2.893)	0.380952 (1.998)			0.001305 (2.194)	0.000313 (2.010)
37	0.00294 (0.523)	0.702996 (3.640)	0.000247 (1.104)			
38	0.00417 (0.225)	0.00787 (0.0902)	-0.00787 (1.132)			
39	0.00121 (0.176)	0.7345 (2.938)	0.002337 (3.048)	0.002412 (1.824)		

Table 5.15a Results on the normal cost equation (5.84a)

Part 2 : Summary Statistics

Sector	SSR	SE	$\bar{R}$	DW	$t(\pi_{11}-1)$	Z1(4)	Z4(4,i)	$Z_5(i,j)$
TOT	0.027546	0.027285	0.5235	1.283	2.623	19.012	3.08 (2.61) (4.41)	1.89 (2.42) (6.31)
20	0.021262	0.023349	0.5810	1.623	1.616	7.014	0.614(2.61) (4.43)	1.111 (2.64) (4.35)
21	0.017146	0.021242	0.4344	1.893	3.158	6.153	6.153(2.61) (4.42)	2.96(2.53) (5.33)
22	0.030279	0.028228	0.5171	1.973	3.9733	1.209	2.519 (2.61) (4.42)	1.017 (2.53) (5.33)
23	0.016411	0.020513	0.4751	2.051	1.077	3.777	0.916(2.61) (4.43)	1.043(2.65) (4.35)
24	0.017316	0.021071	0.4516	2.176	1.639	2.450	1.739(2.61) (4.43)	1.555(2.65) (4.35)
25	0.051251	0.037218	0.3590	1.526	2.257	6.081	3.751(2.61) (4.41)	4.24(2.42) (6.31)
26	0.030630	0.027672	0.3233	1.697	1.657	7.103	1.761(2.61) (4.43)	2.47(2.84) (4.35)
27	0.043147	0.033261	0.4739	2.090	0.907	1.684	0.392(2.61) (4.43)	0.766(2.65) (4.35)
28	0.073867	0.043521	0.3789	2.780	0.969	14.302	1.455(2.61) (4.43)	0.529(2.65) (4.35)
29	0.022956	0.024261	0.5106	1.320	1.014	14.721	4.09(2.61) (4.43)	7.777(2.65) (4.35)
30	0.042450	0.032577	0.2960	2.278	0.445	0.905	0.551(2.61) (4.43)	1.018(2.84) (4.35)
31	0.019307	0.022541	0.4886	2.276	1.163	4.891	1.827(2.61) (4.42)	1.208(2.53) (5.33)
32	0.068519	0.041916	0.6961	2.7055	1.775	20.991	4.091(2.61) (4.43)	3.125(2.65) (4.35)
33	0.031058	0.028589	0.3293	1.699	0.430	1.044	1.16(2.61) (4.42)	0.616(2.53) (5.33)
34	0.023187	0.025034	0.3857	2.164	1.319	4.311	0.603(2.61) (4.41)	1.071(2.42) (6.31)
35	0.024335	0.023979	0.5066	1.675	4.383	7.895	4.12(2.61) (4.43)	1.297(2.53) (5.33)
36	0.024335	0.024976	0.2890	1.666	3.247	6.503	0.591(2.61) (4.42)	2.12(2.65) (4.35)
37	0.022263	0.023893	0.3475	2.276	1.538	3.756	0.677(2.61) (4.43)	1.593(2.65) (4.35)
38	0.0898602	0.457963	0.00097	2.921	11.371	27.199	7.153(2.61) (4.44)	5.969(2.84) (3.37)
39	0.036723	0.030686	0.2565	2.149	1.062	0.915	1.091(2.61) (4.42)	1.783(2.65) (4.35)

Table 5.15a: Results on the normal cost equation (5.84a)

Part 3: Individual coefficients of the demand variable

Sector	π_{210}	π_{211}	π_{212}	π_{213}	π_{214}	π_{220}	π_{221}	π_{222}	π_{223}	π_{224}
TOT							0.001993 (1.658)	-0.001597 (1.501)		-0.002220 (2.603)
20							0.001338 (2.343)			-0.001406 (2.415)
21	-0.00113 (2.302)	-0.00140 (2.866)								
22	-0.00193 (5.098)	0.00157 (4.084)			-0.00074 (2.251)					
23	0.00151 (3.464)				-0.00108 (1.916)					
24	-0.00235 (3.536)	0.00204 (3.221)								
25						0.00214 (3.107)		0.00073 (1.019)		0.00193 (2.650)
26							0.00100 (1.614)			
27	0.00147 (2.004)	-0.00080 (1.258)								
28	-0.00470 (3.584)	0.00511 (2.862)								
29						-0.00254 (4.373)	0.00274 (4.578)			
30		0.00083 (1.233)								
31			0.00189 (3.461)		-0.00163 (3.035)					
32	-0.00023 -(1.751)			0.00022 (1.831)						
33	0.002063 (3.270)				-0.00117 (1.881)					
34						0.00118 (2.779)	-0.00131 (2.793)	0.00066 (1.798)	-0.00084 (1.903)	
35	0.000722 (1.675)	0.000893 (2.124)								
36						0.001306 (2.193)				
37	-0.000936 (1.710)	0.001184 (2.124)								
38			-0.00787 (1.312)							
39	0.00234 (3.048)									

TABLE 5.15b: Results on the normal cost equation (5.84b)

Part 1: Long-run coefficients

Sector	π_0	$\pi_{11}dlnPN_{2t}$	$\sum_{i=0}^{4}\pi_{21}CU_{t-i}$	$\pi_{31}ECU_t$	$\sum_{i=0}^{4}\pi_{22i}CW_{t-i}$	$\pi_{32}ECW_t$
TOT	-0.00812	0.762452			-0.001909	0.000416
	(0.660)	(6.266)			(1.589)	(2.151)
20	0.00636	0.824248			0.000191	
	(0.746)	(7.244)			(0.251)	
21	0.0155	0.811819			0.000364	
	(1.573)	(5.195)			(1.172)	
22	0.0121	0.371407	-0.001164			
	(2.026)	(2.0656)	(2.650)			
23	0.00719	0.914269	0.000970			
	(1.511)	(3.889)	(1.403)			
24	-0.00721	0.796426			-0.000224	-0.000728
	(0.788)	(5.590)			(1.031)	(1.816)
25	0.0753	0.596266			0.004314	0.000348
	(4.239)	(2.949)			(3.680)	(1.567)
26	0.0114	0.912500			0.000614	
	(1.214)	(5.137)			(1.346)	
27	0.00026	0.965506	0.000399	0.008407		
	(0.004)	(5.951)	(1.170)	(1.291)		
28	-0.0322	1.16766			-0.002124	-0.000114
	(1.171)	(4.709)			(1.133)	(2.451)
29	0.00630	0.901703			0.000227	
	(0.836)	(5.095)			(0.484)	
30	-0.00634	1.15086	0.000525			
	(0.937)	(4.801)	(1.187)			
31	0.00199	0.930425	0.000367			
	(0.613)	(6.686)	(0.878)			
32	0.00955	0.894825			0.000029	0.000775
	(0.712)	(10.746)			(0.197)	(2.546)
33	-0.00222	1.17571	0.000449			
	(0.478)	(6.584)	(0.683)			
34	-0.00300	0.89499			-0.000540	
	(0.240)	(4.384)			(1.009)	
35	0.02091	0.701546			0.00129	
	(1.0077)	(4.049			(1.702)	
36	0.010048	0.786886	0.000047			
	(0.9631)	(2.999)	(0.098)			
37	0.00282	0.771427	0.0001865			
	(0.536)	(3.966)	(0.856)			
38	-0.00299	1.1237			-0.000147	
	(0.119)	1.918)			(0.266)	
39	0.03143	0.76802			0.002162	0.000278
	(2.300)	(3.276)			(2.461)	(2.203)

Table 5.15b: Results on the normal cost equation (5.84b)

Part 2 : Summary Statistics

Sector	SSR	SE	$\bar{R}^2$	DW	t(π₁r-1)	Z1(4)	Z4(4,i)	Z5(ij)
TOT	0.025457	0.026230	0.5596	1.280	1.9522	14.14	3.11(2.61) (4.41)	1.94(2.42) (6.31)
20	0.021585	0.023526	0.5746	1.618	1.5446	7.119	0..597(2.61) (4.43)	1.085(2.64) (4.35)
21	0.018219	0.021614	0.04144	2.030	1.2042	3.125	5.993(2.61) (4.43)	2.121(2.64) (4.35)
22	0.030216	0.028199	0.5181	1.975	3.4959	1.431	2.613(2.61) (4.42)	1.131(2.53) (5.33)
23	0.013614	0.018928	0.5531	2.034	0.3647	0.711	1.313(2.61) (4.42?	0.671(2.53) (5.33)
24	0.013013	0.019012	0.5535	2.008	1.429	2.461	1.651(2.61) (4.40)	1.439(2.33) (7.29)
25	0.048736	0.036794	0.3735	1.5991	1.996	5.959	3.862(2.61) (4.40)	4.53(2.33) (7.29)
26	0.027126	0.026041	0.04007	1.7071	0.0959	6.466	1.899(2.61) (4.43)	2.591(2.84) (3.37)
27	0.038666	0.031487	0.5285	2.176	0.2126	1.319	0.228(2.61) (4.43)	0.517(2.65) (4.35)
28	0.052369	0.037628	0.5359	2.753	0.6761	21.19	3.771(2.61) (4.41)	7.501(2.42) (6.3)
29	0.021324	0.023383	0.5454	1.326	0.555	13,997	4.151(2.61) (4.43)	7.919(2.65) (4.35)
30	0.037490	0.030615	0.3341	2.346	0.629	0.881	0.485(2.61) (4.44)	0.996(2.84) (3.37)
31	0.018670	0.021879	0.5182	2.314	0.500	3.621	2.404(2.61) (4.42)	1.091(2.64) (4.35)
32	0.058143	0.039116	0.7354	2.619	1.263	19.897	3.721(2.61) (4.42)	4.075(2.53) (5.33)
33	0.021707	0.023592	0.5433	1.6563	0.9894	0.985	1.092(2.61) (4.43)	0.517(2.65) (4.35)
34	0.021192	0.023932	0.4386	2.0140	0.5144	3.913	0.719(2.61) (4.41)	0.954(2.42) (6.31)
35	0.028340	0.027309	0.3600	1.916	1.72291	7.825	3.591(2.61) (4.43)	1.439(2.53) (5.33)
36	0.025125	0.025382	0.2659	1.7011	0.8122	6.799	0.919(2.61) (4.42)	2.025(2.65) (4.35)
37	0.021256	0.023346	0.3770	2.375	1.175	4.001	0.703(2.61) (4.43)	1.577(2.65) (4.35)
38	0.0117481	0.055602	0.0693	2.596	0.211	16.999	2.993(2.61) (4.42)	3.096(2.53) (5.33)
39	0.033959	0.030295	0.2753	1.938	0.9895	0.753	0.818(2.61) (4.41)	1.566(2.42) (6.31)

Table 5.15b: Results on the normal cost equation (5.84b)

Part 3: Individual coefficients on the demand variable

Sector	π_{210}	π_{211}	π_{212}	π_{213}	π_{214}	π_{220}	π_{221}	π_{222}	π_{223}	π_{224}
TOT							0.001907 (1.649)	-0.001526 (1.497)		-0.002290 (2.799)
20						0.001389 (2.414)				-0.001198 (2.050)
21						-0.00074 (2.338)	0.00110 (3.322)			
22	-0.00203 (5.499)	0.00164 (4.187)			-0.00077 (2.342)					
23	0.00091 (2.122)		0.00135 (2.503)		-0.00129 (2.467)					
24						-0.00100 (1.395)	0.00143 (1.772)	-0.00131 (1.725)	0.00066 (1.164)	
25						0.00239 (3.201)	-0.00089 (1.669)	0.00103 (1.598)		0.00171 (2.454)
26								0.000614 (1.346)		
27		0.000399 (1.170)								
28						-0.00317 (2.143)	0.00276 (1.765)			-0.00172 (1.308)
29						-0.00259 (4.639)	0.00287 (4.88)			
30	0.00053 (1.189)									
31			0.00189 (2.733)	-0.00152 (2.075)						
32						-0.00028 (1.810)	0.00031 (1.588)			
33	0.001722 (3.42)				-0.001272 (1.489)					
34						0.00088 (2.203)	-0.00111 (2.499)	0.00064 (1.517)	-0.00094 (2.218)	
35						0.00163 (2.166)		0.001124 (1.128)	-0.001468 (1.710)	
36	0.001400 (1.531)			-0.001353 (1.489)						
37	-0.000927 (1.743)	0.001114 (2.037)								
38						-0.00115 (1.154)		0.00245 (1.773)		-0.00145 (1.451)
39							0.00239 (2.041)	-0.00127 (1.448)	0.00104 (1.425)	

can not be considered as a representative method of the data generation process in 8 sectors (SIC: TOT,21,25,28,29,32,35 and 38). Finally the Chow $Z_{5(ij)}$ statistic indicates a different pricing pattern between subsamples 1963i - 1970ii and 1970iii - 1977iv for sectors SIC: 21,25,29,32 and 38.

It was mentioned in section 5.5.2. that one of the conditions required to be fulfilled for the acceptance of the normal cost model is that the coefficient on the normal price series (PN_1) should be insignificantly different from unity. A t-statistic is calculated on the difference $\pi_{11}-1$ and the results are presented on the fifth column of table 5.15α, part 2. Out of the 21 sectors, the t-statistic is below its critical value (1.96) in 14 sectors. If one excludes the 8 sectors, where the normal cost model is rejected on the basis of econometric criteria, then of the remaining 13 sectors the t-statistic indicates acceptance of the normal cost model in 11 (SIC: 20,23,24,26,27,30,31,33,34,37 and 39). Sectors with t-statistic higher than the critical in which the normal cost model is rejected on the basis of this are sectors 22 (t=3.4733) and 36(t=3.247)

Turning on to part 1 of table 5.15α, the coefficient on PN_1 has a considerable range between 0.008 (for sector 38) to 0.907 (for sector 33). As far as the sectors where the $\pi_{11}-1$ coefficient is insignificantly different from unity are concerned, the values are between 0.7 and 0.9. The demand variables perform on the whole rather poorly since only 4 sectors have positive and significant coefficients (SIC: 25,35,36 and 39) Furthermore on the 11 sectors where the π_{11} coefficient is insignificantly different from unity, demand variables do not have significant coefficients with the exception of sectors 26 and 27 which are significant as the 10% level and of course sector 39 which has significantly positive demand coefficients at the 5% level. On the whole the trend generated demand variables are preferred and the distribution of the individual demand coefficients is more or less constrained to the current and first quarters (see table 5.15α, part 3)

What conclusions can be drawn from this set of results as far as the acceptance or rejection of the normal cost model is concerned and how do they compare with the corresponding results of CGN? As far as the first question is concerned, the conditions for acceptance of the normal cost model are given by equation 5.51 and if translated in terms of equation (5.84α) require that $\pi_0=0$ $\pi_{11}=1$, $\Sigma\pi_{2i}=\pi_3=0$ Performing these tests individually for all non-mispecified sectoral equations, we can see from tables 5.15α, part 1 and 5.15α part 2, that the normal cost model, where normal prices are exclusive of capital costs can be regarded as an adequate representation of the data generation process in 10 altogether sectors, namely SIC: 20,23,24,26,27,30,31,33,34 and 37.

Consider now the results obtained by CGN[45]. Out of the 7 sectors examined only 3 have a π_{i1} coefficient insignificantly different from unity. (Mechanical Engineering, Textiles and Paper Industries) The rest of the sectors have coefficients that take values around 0.5 and are in any case significantly different from one. It is true that the coefficients on the demand variables are almost always insignificant but to our opinion this does not justify CGN's conclusion about the acceptance of the normal cost hypothesis, since, according to CGN "lagged normal cost traces out the quarterly pattern of observed prices sufficiently well for analysis of the relationship between the two series to reveal whether or not fluctuations in demand alter prices other than in factor markets" CGN p.63

Nonetheless reported values of normal cost do not trace out the quarterly pattern of actual prices sufficiently well, since in the majority of industries examined the coefficient on normal prices in below unity. The justification given to this rather unexpected result by GCN is that
"because predicted and actual prices are known to contain sizeable errors in measurement and specification and because omitted variables may affect the markup one would not expect a unit coefficient on predicted price" CGN p.62

However the fact remains that one can not judge the performance of the normal cost model on the basis of the significance or not of the demand coefficients only. It is true that measurement errors may affect the performance of the normal price, but this does not necessarily mean that such errors would bias the value of the coefficient downwards. Omitted variable bias however, particularly regarding the omission of unit capital costs may be a likely culprit for the below unity coefficients. For this reason our expectations as far as equation (5.84b) is concerned is that the π_{12} coefficient will be closer to unity then π_{11}.

Indeed this is the pattern depicted by the π_{12} coefficient as can be seen in Table 5.15b, part 1. π_{12} is closer to unity than π_{11} in every sector and consequently π_{12} is significantly different from unity in only 3 sectors (SIC: TOT,22 and 25). In general equation (5.84b) performs much better than (5.84a), although the values of the multiple correlation coefficient remain low throughout. The hypothesis of zero autocorrelation on the basis of the $Z_1(4)$ statistic is rejected in six sectors, in all of which the post-parameter stability test shows signs of mispecification (SIC: TOT,25,28,29,32 and 38). Furthermore the Chow $Z_5(ij)$ statistic indicates a significance difference in the pricing process between 1963i-1970ii and 1970iii-1977iv in 6 sectors (SIC: 21,25,28,29,32 and 38)

The demand variables on the whole perform reasonably well, particularly the Wharton generated ones. However if one excludes the 6 sectors that are mispecified, then of the remaining 15, demand is statistically different from zero in only two sectors, ie SIC:22 ($\Sigma\pi_{\cdot 21i}$=-0.001164(2.650)) and SIC 39 ($\Sigma\pi_{22i}$ =0.002162 (2.461) and π_{32} =0.000278(2.203)). Furthermore one could add sector 35 where $\Sigma\pi_{\cdot 22i}$ is found significant but at the 10% significance level. In general the picture drawn by the performance of demand variables in equation (5.84b) remains pretty much the same with that of equation (5.84α), namely that demand elements do not affect the movement of actual prices, given the movement of normal prices.

Since equation (5.84b) remains our preferred specification of the normal cost model a summary of the results is given in table (5.16). Inspection of the table indicates that the normal cost model performs significatly well since it is found consistent with the data generation process of 13 two digit SIC sectors. Of the remaining sectors in 6 the normal cost model is rejected due to mispecification and in 2, the results do not confirm the conditions required for acceptance as these are given in equation (5.51)

The discussion of the normal cost model ends the presentation of the 6 pricing models considered in this thesis. What remains still

Table 5.16: Summary of sectoral results. Normal cost equation (5.84b) Two digit SIC sectors, Greek manufacturing

SECTORS	RESULTS
TOT	Auto, Z_4, $\pi_{12} \neq 1$
20	Accepted
21	Accepted
22	$\pi_{12} \neq 1$, $\Sigma\pi_{21i} \neq 0$
23	Accepted
24	Accepted
25	Auto, Z_4, $\pi_0 \neq 0$, $\pi_{12} \neq 1$, $\Sigma\pi_{22i} \neq 0$, $\pi_{32} \neq 0$
26	Accepted
27	Accepted
28	Auto, Z_4, $\pi_{32} \neq 0$
29	Auto, Z_4,
30	Accepted
31	Accepted
32	Auto, Z_4, $\pi_{32} \neq 0$
33	Accepted
34	Accepted
35	Accepted
36	Accepted
37	Accepted
38	Auto, Z_4,
39	$\pi_0 \neq 0$, $\Sigma\pi_{22i} \neq 0$, $\pi_{32} = 0$

to be examined is an evaluation of these models on the basis of the empirical evidence obtained so far. This is the subject matter of the next and final chapter.

NOTES

1. Apart from references cited in section 3.8.2 see also P.W.S. Andrews (1949) and P. Sylos-Labini (1957)

2. See for example J. Bain (1949), (1950), P. Sylos-Labini (1957) F. Modigliani (1958) B.P. Pashigian (1968) and J.N. Bhagwati (1970)

3. See M. Sawyer (1983)

4. See for example G.S. Stigler (1947), Walter J. Primeaux Jr and Mickey S Smith (1976), W.J. Primeanx Jr and M.R. Bomball (1974) and J.L. Simon (1969)

5. See P.W.S. Andrews (1949) p.158

6. For diagrammatic purposes it has been argued that the average cost curve is inclusive of normal profits.

7. For an analysis of the arguements of the right hand-side of equation 5.19 see further, chapter 4 and section 5.5.3.

8. D.F. Hendry (1986) provides a classification and distinction of simultaneous equation estimation methods. An account of these methods at a more elementary level is given in G.S. Maddala (1976) pp 231-251 and pp 471-492 and also in M. Desai (1976) chapter 2

9. For 2SLS estimator and its asympotic properties see example H. Theil (1971) pp 497-500

10. See for example J. Johnston (1972) pp 408-420 and C.F. Christ (1966)

11. See also R.R. Neild (1963) pp 12-13 and M.C. Sawyer (1983) pp 53-54.

12. A brief description of the Hausman test (see J.A. Hausman (1978)) may be considered as follows;

Let the equation to be estimated be

$$Y=f(X_1 \ldots X_n)$$

and assume that X_1 is suspected to be endogenous.

Regress X_1 on $X_1^{inst} \ldots X_n$ as in

$$X_1=f(X^{inst} \ldots X_n)$$

and obtain $\hat{X}_1$. Then regress

$$Y=f(\hat{X}_1, X_1 \ldots X_n)$$

and test for the significance of the coefficient on $\hat{X}_1$. If the value of the test statistic is less than the critical, reject the hypothesis of significant endogeneity bias.

13. For the derivation of the variance of each long-run coefficient see equation (3.71)

14. See equation (5.19) and sections 4.3 and 4.5

15. See P.H. Earl (1973)

16. See section 3.6.5 and note 28 of chapter 3.

17. See for example I.F. Pearce, P.K. Triuedi, C.T. Stromback and G.J. Anderson (1976) for a number of alternatives of ULCN, pp 111-114

18. See references in P.H. Earl (1974)

19. Donaldson Brown (1924), a vice president of General Motors described in a considerable detail the principles of a pricing method that came to be known in the literature as target rate of return pricing. The principles to which he was referring involve setting a desired target rate of return, classifing cots as "fixed" or "variable" and establishing a volume of production at which the target rate is to be met.

20. See R.F. Lanzilotti (1958) and J.M. Blair (1972)

21. On this point see comments to the contrary by O. Eckstein and G. Fromm (1968) p. 1169 and also W. Nordhaus (1972) p. 40

22. See for example evidence provided by W. Haynes (1964) and R.B. Heflebower (1955).

23. See National Statistical Service of Greece (1981)

24. See also D.R. Kamerschen (1975) and J.M. Blair (1972) for comparison of actual with target rate data of the A.D.H. Kaplan et al (1953) results.

25. See comments by D.E.W. Laider and M. Parkin (1975) and M. Parkin (1977)(1978)

26. The process is similar to that of the full cost model. Assume for convenience that PN is exclusive of the markup. Then equation (5.48) can be written as

(1) $P=M.PN$

Taking the total differential of (1), dividing by P and rearranging, results in

(2) $\frac{dP}{P} = \frac{PN}{P}\, dM + \frac{M}{P}\, dPN$

which after some manipulation is equivalent to

(3) $\frac{dP}{P} = \frac{dM}{M} + \frac{dPN}{PN}$

which is approximately equal to

(4) $d\ell nP = d\ell nM + d\ell n\, PN$

by substituting equation (5.49) into (4) we get equation (5.50)

27. Actually proposed by D.E.W. Laidler and M. Parkin (1975) See also G.W. Smith (1978)

28. This point really applies to the arguements provided by CGN in order to justify the significantly different from unity coefficients obtained on the PN variable . See for example CGN p.63

29. See equation 3.106

30. For a slightly different specification of normal output see W. Nordhaus (1974)

31. It is assumed that the notional remuneration of employers and family members is equal to that of the male salaried earners.

32. There exists an average-cost stock valuation procedure used by number of firms which is compatible with this pricing strategy, see R. Mathews (1962)

33. Note that in the prior to CGN study paper by W. Godley - W. Nordhaus (1972) the pricing stragegy adopted corresponded to historic cost pricing. This was recognised as an extreme case in the CGN study.

34. See table 5.14

35. Table A5.1 also gives the values of θ; moreover it gives the values of θ obtained under the limiting cases that b=o and b=1 and an estimate of α for year 1970

36. See H.M. Peseran (1972b), table 5, p. 111

37. See Appendix 5, section A5.2

38. The following sectors are broadly comparable. See CGN p 40 (θ expressed in quarters)

	CGN results	Greek two-digit SIC sectors	
Chemicals	1.4	(31)	1.49456
Mechanical Engineering	2.9	(36)	2.87782
Electrical Engineering	3.0	(37)	2.51282
Textiles	2.33	(23)	2.12277
Clothing	1.13	(24)	1.36907
Paper Industries	1.7	(27)	1.90678

39. Also see equations (A5.20)(A5.23) and (A5.28) Slightly different notation is used.

40. See equation A5.29

41. Defined in equations (A5.30)(A5.31)(A5.32) and (A5.33)

42. See P. Sylos-Labini (1979) p.153, 155, 161. See also J. Ros (1980) p.219 and the criticism by D.E.W. Laider and M. Parkin (1975), M. Parkin (1977)(1978) and G.W. Smith (1978)

43. See P.J.W.N. Bird (1983) and J. Ros (1980)

44. See equation (5.10)

45. See CGN p.60

CHAPTER 6 : Conclusions

The discussion in chapters 3 and 5 established a procedure by which each and every pricing model that is confronted with the data of the two-digit SIC sectors is ultimately regarded as an adequate representation of the data generation process or not. This procedure was based on various criteria both statistical and theoretical, the fulfilment of which allowed the pricing models to be accepted or not. Nonetheless, as it was mentioned in chapter 2, situations may arise whereby a sector may have a data generation process that can be adequately represented by more than one price-determination models. In this chapter we will discuss the process by which one pricing model is finally selected, whenever this is possible, for each two digit industrial sector.

The argument is not only statistical; Indeed it bears a close relationship to the goal of this thesis which is to examine whether and how industrial price changes respond to changes in demand and costs and furthermore, given the relationship between costs and prices, to examine whether actual or standard costs are relevant in the price determination process. If for example it is established that for a sector i, the average cost model which is based on actual costs and the target rate of return model which is based on standard costs are both regarded as adequate representations of the data generation process, then, if we don't have a procedure by which it is possible to select between the two models, the objective of this thesis would only be partly served.

The working hypothesis maintained so far is that industrial price determination can take the form of the following five alternative models.

(1) Neoclassical price determination model, the only model to be derived from an explicit maximization process, where price is a function of the prices of factors of production (Pw,Pm,Pc), income (Y) and an index of "other prices" (P_B)

(2) Average cost price determination model, which may or may not include capital costs, where the price is a function of unit costs (ULC, UMC or ULC, UMC and UCC) calculated at the actual output level and demand pressure variables (CU, ECU or CW, ECW as the case may be).

(3) Full-cost price determination model where price is modeled as a function of unit costs calculated at the standard level of output (ULCN, UMCN, UCCN) and demand pressure variables (CU, ECU or CW, ECW as the case may be).

(4) Target rate of return price determination model where price is determined by unit costs calculated at the standard output level (ULCN, UMCN), the ratio of capital stock over standard output (K/QN) and demand pressure variables (CU, ECU, or CW, ECW, as the case may be) and finally

(5) Normal cost pricing models which is essentially a full-cost model, whereby price is a function of an index of normal or "predicted" prices (PN) and demand pressure variables (CU, ECU or CW, ECW as the case may be)

Application of the above pricing models to the data of the two-digit

Greek industrial sectors, yielded the following pattern of results: the neoclassical model is accepted in 7 sectors, the average cost model in 15, the full cost model in 4, the target rate of return model in 5 and the normal cost model is accepted in 13 sectors. The results for each sector are given in table 6.1, where the neoclassical model is denoted by P_N, the average-cost by P_A, the average cost inclusive of capital costs by P_{AC}, the full-cost by P_F, the target rate by P_T and the normal cost model by P_R. As it can be seen from table 6.1,

(a) In only one sector (SIC:38), none of the models examined can be regarded as an adequate representation of the data generation process

(b) In six sectors (SIC:22,25,28,29 and 39) only one model is accepted, and

(c) In the remaining 14 sectors more than one model is found to be an adequate representation of the data generation process for each particular sector. These sectors are SIC: TOT,20,21,23,24,26,27, 30,31,33,34,35,36 and 37

Clearly therefore a problem of model selection exists in the majority of sectors examined. Since the five price theories examined so far are non-nested between each other and since it is rather impossible to construct a comprehensive model that includes all five as special cases (and then select on the basis of a likelihood ratio or an F-test) a non-nested procedure seems to be the best way of dealing with this problem. The test procedure that was chosed is the Pesaran

(1974) non-nested test mainly for reasons of computational convenience.[1] In chapter 2 we gave a brief summary of this test. A complete description of the test however is required at this stage.

Suppose that the model

$$(6.1) \quad Ho: y = xb_0 + u_0$$

where y is a vector of observations on the dependent variable and x is a matrix of observations on the explanatory variables, is the correct model and we wish to test it against the alternative non-nested model

$$(6.2) \quad H_1: y = zb_1 + u_1$$

where z is a matrix of observations on the explanatory variables. The Pesaran testing procedure involves the following steps:

<u>Step 1</u> Assume model Ho is correct and estimate $y=xb_0+u_0$ by OLS and get $\hat{y}_0 = x\hat{b}_0$ and $\hat{6}_0^2$

<u>Step 2</u> Find the consequences of fitting the second model, if the first model is actually correct, ie fit the predicted values of (6.1) into (6.2) as in (6.3)

$$(6.3) \quad \hat{y}_0 = zb_1 + v_1$$

<u>Step 3</u> Calculate $\hat{6}_{10}^2$ using the vector of residuals from (6.3) as in

$$(6.4) \quad \hat{6}_{10}^2 = 6_0^2 + \frac{1}{n} \hat{v}_1' v_1$$

where n is the number of observations.

Table 6.1: Summary of price determination results
Five pricing models
Two digit SIC sectors Greek Manufacturing

Sector	Neoclassical	Average Cost		Full Cost	Target Rate	Normal Cost
	P_N	P_A	P_{AC}	P_F	P_T	P_R
TOT		/	/			
20	/	/				/
21	/		/			/
22			/			
23	/	/				/
24					/	/
25			/			
26	/		/	/	/	/
27					/	/
28				/		
29			/			
30			/			/
31	/		/			/
32		/				
33			/	/		/
34	/					/
35			/		/	/
36	/				/	/
37		/		/		/
38						
39		/				

Step 4 Assume H_1 is correct and estimate $y = zb_1 + u_1$ by OLS and get $\hat{y}_1 = z\hat{b}_1$ and $\hat{6}_1^2$

Step 5 Calculate T_o defined as

(6.5) $$T_o = \frac{n}{2}[\ln \hat{6}_1^2 - \ln \hat{6}_{10}^2]$$

i.e. the value of T_o conditional on the validity of H_o

Step 6 Estimate model H_o using the residuals from equation (6.3) as the dependent variable, i.e.

(6.6) $$\hat{v}_1 = xb_o + v_2$$

Step 7 Calculate the variance of T_o, defined as

(6.7) $$\text{var } T_o = (\hat{6}_o^2 / \hat{6}_{10}^4)\hat{v}_2{}' \hat{v}_2$$

Step 8 Calculate the statistic N_o defined as

(6.8) $$N_o = T_o/\sqrt{\text{var } T_o}$$

Step 9 Since the Pesaran test does not employ a single null hypothesis one may reverse the roles of H_o and H_1 and carry out the tests again. This is what will be done here for every part of the price equations compared as it may turn out that neither specification is rejected in favour of the others. Therefore, repeat the sequence of calculations described so far taking now H_1 as the maintained hypothesis. Estimate $y = zb_1 + u_1$ by OLS and get $\hat{y}_1 = z\hat{b}_1$, $\hat{6}_1^2$ (Repetition of Step 4).

Step 10 Find the consequences of fitting the first model if the second model is actually correct, i.e. fit the predicted values of (6.2) into (6.1) as in (6.9).

(6.9) $$\hat{y}_1 = xb_o + v_o$$

Step 11 Calculate $\hat{6}_{01}^2$ using the vector of residuals from (6.9), as

(6.10) $$\hat{6}_{01}^2 = \hat{6}_1^2 + \frac{1}{n}\hat{v}_o' \hat{v}_o$$

Step 12 Assume H_o is correct and estimate $y = xb_o + u_o$ by OLS and get $\hat{y}_o = x\hat{b}_o$ and $\hat{6}_o^2$ (Repetition of step 1)

Step 13 Calculate T_1 defined as

(6.11) $T_1 = \frac{n}{2} [\ell n\hat{6}_o^2 - \ell n\hat{6}_{01}^2]$

i.e. the value of T_1, conditional on the validity of H_1

Step 14 Estimate model H_1 using the residuals from equation (6.9) as the dependent variable i.e.

(6.12) $\hat{v}_o = zb_1 + v_1$

Step 15 Calculate the variance of T_1, defined as

(6.13) var $T_1 = (\hat{6}_1^2 / \hat{6}_{01}^4) \hat{v}_1' \hat{v}_1$

Step 16 Calculate the statistic N_1 defined as

(6.14) $N_1 = T_1/\sqrt{\text{var}T_o}$

Step 17 Having calculated both statistics then the possible options can be classified as follows at the 5% significant level:

(6.15) Accept H_o and reject H_1, when
$|No| < 1.96$ and $|N1| \geq 1.96$

(6.16) Reject H_o and accept H_1, when
$|No| \geq 1.96$ and $|N1| < 1.96$

(6.17) Reject both H_o and H_1, when
$|No| \geq 1.96$ and $|N1| \geq 1.96$

(6.18) Accept both H_o and H_1, when
$|No| < 1.96$ and $|N1| < 1.96$

Application of the above non-nested procedure is carried out for 14 sectors where more than one pricing model is accepted as an adequate representation of the data generation process. The results are reported in tables (6.2), (6.3) and (6.4) where each table contains sectors with the same number of acceptable pricing models. Table 6.2 contains 7 sectors, where two pricing models are considered as valid representations of the data generation process, table 6.3 contains 6 sectors each of which is represented by three alternative pricing hypotheses and table 6.4 contains one sector represented by five alternative pricing models. Furthermore in each table, apart from the (absolute) values of the N-statistic for each pair of hypotheses tested, we also give the values of the standard error of the models under consideration listed along the diagonals of each table. Finally, the tables are presented in such a way that the rows relate to a particular maintained hypothesis, while the columns relate to the alternative hypothesis.

Out of the four possible options that can be produced in this non-nested test, the majority of the cases is described by outcomes (6.15) or (6.16), i.e. one model is finally selected in the sense that hypothesis H_0 is either accepted (or rejected) in favour of hypothesis H_1. Rejection of all models (outcome 6.17) did not occur in any sector, although when testing individual pairs for sector 26 (see table 6.4 part 2) both P_T and P_R were rejected. Finally acceptance of both models (hypothesis H_0 and H_1), described by outcome 6.18 occurred only in sectors 21 and 24 which are the only two sectors where the pricing generation process is described by more than one pricing model.

Table 6.2 : Non nested tests; Application to two digit SIC sectors where two pricing models are accepted: SIC: TOT, 23,24,27,30,33,34

(1) Sector TOT : |N| -statistics and $\hat{\sigma}^2$ (SE) for P_A, P_{AC}

Alternative Hypothesis		P_A	P_{AC}
Maintained Hypothesis	P_A	0.02044	2.4371
	P_{AC}	1.6934	0.1680

(2) Sector 23: |N| -statistics and $\hat{\sigma}^2$ (SE) for P_N, P_A

Alternative Hypothesis		P_N	P_A
Maintained Hypothesis	P_N	0.00811	1.6555
	P_A	2.8394	0.01186

(3) Sector 24: |N| -statistics and $\hat{\sigma}^2$ (SE) for P_T, P_R

Alternative Hypothesis		P_T	P_R
Maintained Hypothesis	P_T	0.01497	0.7777
	P_R	1.4397	0.01901

(4) Sector 27: |N|-statistics and $\hat{\sigma}^2$ (SE) for P_T, P_R

Alternative Hypothesis		P_T	P_R
Maintained Hypothesis	P_{AC}	0.02290	1.3572
	P_R	2.4891	0.03149

(5) Sector 30: |N|-statistics and $\hat{\sigma}^2$ (SE) for P_{AC}, P_R

Alternative Hypothesis		P_{AC}	P_R
Maintained Hypothesis	P_{AC}	0.01382	0.3592
	P_R	4.7633	0.03062

(6) Sector 33: |N|-statsistics and $\hat{\sigma}^2$ (SE) for P_{AC}, P_F

Alternative Hypothesis		P_{AC}	P_F
Maintained Hypothesis	P_{AC}	0.01351	2.4365
	P_F	1.6688	0.01039

(7) Sector 34: |N|- statistics and $\hat{\sigma}^2$ (SE) for P_N, P_R

Alternative Hypothesis		P_N	P_R
Maintained Hypothesis	P_N	0.01071	1.8139
	P_R	5.3682	0.02359

Table 6.3: Non nested tests: Application to two digit SIC sectors, where three pricing models are accepted: SIC:20,21,31,35,36,37

(1) Sector 20: |N|-statistics and $\hat{6}^2$ (SE) for P_N, P_A, P_R

Alternative Hypothesis		P_N	P_A	P_R
Maintained Hypothesis	P_N	0.00686	1.3917	0.8264
	P_A	2.0008	0.00971	1.0076
	P_R	6.5199	2.8574	0.02352

(2) Sector 21: |N|-statistics and $\hat{6}^2$ (SE) for P_N, P_{AC}, P_R

Alternative Hypothesis		P_N	P_{AC}	P_R
Maintained Hypothesis	P_N	0.00575	1.6917	0.3921
	P_{AC}	1.4709	0.00935	0.4602
	P_R	4.3039	3.0778	0.02188

(3) Sector 31: |N|-statistics and $\hat{6}^2$ (SE) for P_N, P_{AC}, P_R

Alternative Hypothesis		P_N	P_{AC}	P_R
Maintained Hypothesis	P_N	0.00941	1.3761	0.4699
	P_{AC}	2.2125	0.01265	0.6170
	P_R	4.3039	3.0778	0.2188

(4) Sector 35: |N|-statistics and $\hat{6}^2$ (SE) for P_{AC}, P_T, P_R

Alternative Hypothesis		P_{AC}	P_T	P_R
Maintained Hypothesis	P_{AC}	0.01138	2.1992	1.0047
	P_T	1.7514	0.01081	0.8555
	P_R	2.6582	3.2820	0.09731

(5) Sector 36: |N|-statistics and $\hat{6}^2$ (SE) for P_N, P_T, P_R

Alternative Hypothesis		P_N	P_T	P_R
Maintained Hypothesis	P_N	0.00881	2.1008	0.6565
	P_T	1.4981	0.00893	0.7107
	P_R	4.3099	4.0182	0.09358

(6) Sector 37: |N|-statistics and $\hat{6}^2$ (SE) for P_A, P_F, P_R

Alternative Hypothesis		P_A	P_F	P_R
Maintained Hypothesis	P_A	0.01126	2.8831	0.2798
	P_F	1.7659	0.01129	0.3111
	P_R	9.5943	7.6527	0.02335

Table 6.4 : Non nested tests; Application to two digit SIC sectors where five pricing models are accepted: SIC:26

(1) Sector 26: N -statistics and 6' (SE) for P_N, P_{AC}, P_F, P_T, P_R

Maintained Hypothesis \ Alternative Hypothesis		P_N	P_{AC}	P_F	P_T	P_R
	P_N	0.01238	2.1142	1.5914	1.0063	0.6542
	P_{AC}	1.6422	0.00836	0.9530	0.4907	0.4319
	P_F	2.0619	2.5862	0.01859	1.7947	1.4344
	P_T	2.8956	3.3763	1.9232	0.02162	2.1137
	P_R	13.903	12.717	2.3864	3.0095	0.02604

(2) Explanation of the performance of each model vis-a-vis the other

Neoclassical	$P_N \rightleftarrows P_{AC}$	accept	P_{AC}
	$P_N \rightleftarrows P_F$	"	P_N
	$P_N \rightleftarrows P_T$	"	P_N
	$P_N \rightleftarrows P_R$	"	P_N
Average cost	$P_{AC} \rightleftarrows P_F$	"	P_{AC}
	$P_{AC} \rightleftarrows P_T$	"	P_{AC}
	$P_{AC} \rightleftarrows P_R$	"	P_{AC}
Full Cost	$P_F \rightleftarrows P_T$	"	Both
	$P_F \rightleftarrows P_R$	"	P_F
Target Rate	$P_T \rightleftarrows P_R$	Reject	Both

Table 6.5 : Price determination models: Final Specifications

Two-digit SIC sectors, Greek manufacturing

Sector	Model	Sector	Model	Sector	Model
TOT	P_{AC}	26	P_{AC}	33	P_F
20	P_N	27	P_T	34	P_N
21	P_N, P_{AC}	28	P_F	35	P_T
22	P_{AC}	29	P_{AC}	36	P_T
23	P_N	30	P_{AC}	37	P_F
24	P_T, P_R	31	P_N	38	-
25	P_{AC}	32	P_A	39	P_A

The results of the non-nested test are summarised in table 6.5 which also gives the final correspondence between pricing models and sectors. A number of points can be discussed with reference to this table.

(1) On the whole, the performance of short-run price models (neo-classical and average cost) overwhelms the performance of long-run models (full-cost, target rate of return and normal cost). As can be seen from table 6.5 out of 20 sectors where results are produced (excluding that is sector 38) the short-run pricing models are preferred in 13.

(2) The sectors where the short-run models are preferred are with few exceptions consumer and intermediate goods sectors which on the whole are expected to have a shorter production and pricing horizon than capital goods sectors. Following G. Koutsoumaris (1967) we may

classify the two digit SIC sectors into consumer, intermediate and capital goods sectors as follows:

Consumer Goods: SIC: 20,21,22,24,26,28,29,39

Intermediate goods: SIC: 23,25,27,30,31,32

Capital goods: SIC: 34,35,36,37,38

It can be seen from table 6.5 that short-run models are the dominant pricing hypotheses in consumer and intermediate goods sectors with the exceptions of 24,27 and 28. On the other hand long-run models are adequate descriptions of the pricing processes in the capital goods sectors with the exception of sector 34.

(3) Turning to the performance of each pricing model it can be seen that the neoclassical model is accepted in 5 sectors, the average cost in 9, the full-cost model in 3, the target rate in 4 and the normal cost model in one sector (Note that there are two sectors represented by two models) The neoclassical model on the whole performs very well when compared with the other models since it is represented in 5 sectors out of a possible of 7. The same is also true in the full-cost (3 sectors out of 5). The opposite however holds as far as the normal cost model is concerned.

(4) The main reason for the poor performance of the normal cost model when compared to other pricing hypotheses is probably due to the inevitable existence of some degree of multicollinearity in all pricing models except normal cost. Since the values of the non-nested test are based (among others) on the standard errors of the equations compared, which in turn are affected

by the number of explanatory variables contained by each model, it seems rather expected that the normal cost (which includes only one price series as an explanatory variable, while the other models a significant number of price and (or) unit cost series) is not preferred when compared with all other pricing hypotheses. An exception should of course be made for sector 24 for which both the normal cost and target rate of return models are accepted. However one should note that the main purpose of the normal cost hypothesis is not really to present an alternative to the other price markup models, since as it is mentioned before, its theoretical content is more or less similar to that of the full-cost model. What the normal cost model purports to show is that demand changes do not influence the change in prices.

(5) The model that is mostly represented of all five discussed is the average cost model accounting for a little less that 50% of the sectors examined. Of the two possible options of the average cost model (P_A or P_{AC}) the one inclusive of capital costs is largely preferred sicne in only two sectors (SIC: 32 and 39) the average cost model exclusive of capital costs is considered as the best representation of the pricing generation process.

(6) Finally the poor results as far as sector 38 (transport equipment industries) is concerned require some explanation. The fact that none of the pricing models examined in this thesis can be considered as an adequate representation of the pricing process of sector 38, can always point to the possibility that another pricing model, as for example the excess demand model

can account for the price generation process of this sector. More likely however the reasons for our failure to obtain reasonable results should be looked into the fact that this sector displays considerable hetorogeneity. Indeed sector 38 is rather a dual sector since it includes a very small number of large firms (shipyards) and a large number of very small firms (automobile garages). In such a situation even to contemplate the notion of a "product" for this sector is faced with considerable problems, let alone the determination of a pricing process. Perhaps a solution would be to examine the pricing process on a three-digit level aggregation. However such a task would be faced with an almost insurmountable data problem.

The results of the price determination models are summarised in table 6.6 which presents the finally accepted versions for each sector. Table 6.6 consists of three parts; part 1 gives the results of the neoclassical model, part 2 the results of the average cost model and part 3 the results of the long-run models. The questions set out in the introduction of the thesis can be answered with reference to table 6.6.

The procedure discussed so far for the testing and selection of price determination models has been useful in two respects; first it provided for a one to one correspondence between pricing models and two-digit sectors and second, by doing this, it also provided the framework within which the examination of the relative significance of the cost and demand influences on prices can be conducted. Had this procedure not been followed, then we would have to evaluate the cost and demand influences on each sector's prices for a large number of models, some of which would have certainly been mispecified.

Table 6.6 Final Specification Results. Two digit SIC sectors

Greek Manufacturing

Part 1 Neoclassical pricing model

Sectors / Variables	20	21	23	31	34
π_0	-0.00817	-0.000171	-0.00783	-0.00233	-0.00371
	(1.136)	(1.231)	(0.454)	(0.970)	(1.317)
$\sum^{4}\pi_{1i}d\ell nPw_{t-i}$	0.123112	0.23245	0.37639	0.17249	0.27584
	(4.779)	(10.580)	(10.131)	(2.883)	(14.039)
$\sum^{4}\pi_{2i}d\ell nPm_{t-i}$	0.583920	0.657614	0.49634	0.645028	0.652043
	(12.204)	(13.841)	(6.249)	(16.987)	(7.427)
$\sum^{4}\pi_{3i}d\ell nPc_{t-i}$	0.047444	0.041242	0.081630	0.070779	0.078333
	(1.797)	(1.803)	(1.867)	(2.665)	(1.981)
$\sum^{4}\pi_{4i}d\ell nY_{t-i}$	0.172883	0.10776	0.076892	-0.051940	-0.135614
	(5.064)	(2.661)	(3.289)	(1.637)	(1.881)
$\sum^{4}\pi_{5i}d\ell nP_{B_{t-i}}$	0.392765				0.370862
	(4.950)				(3.0988)

Table 6.6 Final Specification Results. Two digit SIC sectors

Greek manufacturing

Part 2 Average Cost Model

Variables \ Sectors	TOT (P_{AC})	21 (P_{AC})	22 (P_{AC})	25 (P_{AC})	26 (P_{AC})	29 (P_{AC})	30 (P_{AC})	32 (P_{A})	39 (P_{A})
π_0	0.00138 (0.462)	-0.00070 (0.253)	0.00400 (1.219)	0.0413 (1.364)	0.00107 (0.389)	-0.00056 (0.258)	-0.0141 (0.410)	0.00316 (1.046)	-0.0023 (0.746)
$\overset{*}{\Sigma}\pi_{1i} d\ell nPw_{t-i}$		0.28399 (8.915)	0.19707 (4.082)		0.20459 (2.436)	0.27504 (6.441)	0.690216 (8.432)	·	0.39532 (7.520)
$\overset{*}{\Sigma}\pi_{1i} d\ell n(\frac{Q}{L})_{t-i}$		-0.1647 (3.817)	-0.02012 (2.466)		-0.15085 (2.210)	-0.10309 (4.765)	-0.13137 (5.595)		-0.10248 (1.956)
$\overset{*}{\Sigma}\pi_{1i} d\ell nULC_{t-i}$	0.37119 (4.128)			0.081987 (2.224)				0.11451 (5.573)	
$\overset{*}{\Sigma}\pi_{2i} d\ell nUMC_{t-i}$	0.35688 (3.990)	0.59125 (9.580)	0.38132 (5.857)	0.42351 (3.003)	0.55296 (10.408)	0.49629 (7.160)	0.37216 (6.179)	0.77339 (18.00)	0.31733 (4.861)
$\overset{*}{\Sigma}\pi_{3i} d\ell nUCC_{t-i}$	0.19754 (2.410)	0.09241 (3.585)	0.05008 (2.610)	0.11075 (2.493)	0.14936 (2.145)	0.06738 (2.637)	0.206109 (4.392)		
$\overset{*}{\Sigma}\pi_{41i} CU_{t-i}$	0.00025 (0.710)		-0.00048 (1.483)		-0.000184 (0.925)	-0.00030 (1.328)	-0.00004 (0.189)	-0.000109 (1.474)	-0.001679 (3.478)
$\pi_{51} ECU_t$							0.000652 (1.989)		
$\overset{*}{\Sigma}\pi_{42i} CW_{t-i}$		0.000193 (1.442)		0.002125 (2.911)					
$\pi_{52} ECW_t$									

Table 6.6 Final specification Results. Two digit SIC sectors

Greek Manufacturing

Part 3 Full cost, Target rate of return and normal cost pricing models.

Variables \ Sectors	24 (P_T)	24 (P_R)	27 (P_T)	28 (P_F)	33 (P_F)	35 (P_T)	36 (P_T)	37 (P_F)
π_0	-0.00566 (0.701)	-0.00721 (0.788)	0.0011 (0.270)	0.01382 (1.172)	-0.00034 (0.159)	0.0032 (1.069)	0.00004 (0.014)	0.00087 (0.328)
$\sum_{i=o}^{4}\pi_{1i} d\ell n ULCN_{t-i}$	0.14958 (1.911)		0.25765 (2.226)	0.33547 (2.965)	0.67837 (3.162)	0.18439 (2.007)	0.22794 (2.345)	0.14679 (2.672)
$\sum_{i=o}^{4}\pi_{2i} d\ell n UMCN_{t-i}$	0.56645 (5.898)		0.69014 (6.769)	0.57320 (3.737)	0.36457 (2.695)	0.47593 (8.059)	0.49815 (4.858)	0.68285 (8.543)
$\sum_{i=o}^{8}\pi_{3i} d\ell n \underline{UCCN}_{t-i}$				0.28382 (2.243)	0.16308 (2.265)			0.08207 (2.849)
$\sum_{i=o}^{12}\pi_{4i} d\ln \left(\frac{K}{QN}\right)_{t-i}$	0.25906 (1.989)		0.15706 (5.002)			0.15852 (3.427)	0.18867 (2.878)	
$\pi_5 d\ell n PN_t$		0.79643 (5.590)						
$\sum_{i=o}^{4}\pi_{61i} CU_{t-i}$					0.000181 (0.490)	0.00110 (1.215)	0.00126 (1.296)	
$\pi_{71} ECU_t$							0.000797 (0.829)	
$\sum^{4}\pi_{62i} CW_{t-i}$	-0.00016 (1.091)	-0.00022 (1.031)						
$\pi_{72} ECW_t$	-0.00085 (1.468)	-0.00073 (1.316)						

A very clear picture emerges from the results of table 6.6. First, the cost elements overwhelmingly outperform the demand elements as far as the explanation of two-digit sectoral price changes is concerned. More specifically demand elements are found to be important either in the form of income (dlnY) or demand pressure varialbe (CU,ECU, or CW,ECW) in 6 sectors altogether (SIC: 20,21,23 for the neoclassical model and SIC: 25,39 and to some extent 30 for the average cost model). Second, as far as the cost elements are concerned again there is a clear indication that short-run cost measures either in the form of factor prices or actual unit costs are preferred to long-run cost measures taking the form of standard or normal costs. Only 7 sectors seem to base their price generation process on standard costs, as these are given by Table 6.6 part 3.

The conclusions of this analysis have significant implications as far as policy making is concerned. If demand changes have relatively little impact on price changes, then the major impact of a fall in the level of demand will be on output and employment (to a lesser extent) and not on prices. Furthermore the volume of profits will fall, although not by as much as it would if the price-cost margin was influenced by demand pressures. It also follows that demand management policies designed to reduce the level of inflation will be met with relatively little success. However one can point out that demand management policies may have an effect on prices since demand reductions would push the prices of inputs (wages and materials) downwards. Such an effect would be achieved through the combined effects of (a) the reduction in demand in the market of those inputs and (b) the attempts by industrial firms faced with declining demand for their product to push the effect of that to the suppliers of their inputs by negotiating lower input prices.[2]

But perhaps the most important conclusion that can be drawn from this thesis is the fact that policies designed to reduce inflation should take into account the particular circumstances of each industrial sector. Application of macroeconomic policies that take a uniform approach as far as industrial prices in Greece are concerned will be faced with limited success since the pricing pattern of individual sectors is greatly diversified.

Notes

1. By the time the calculations on this non-nested test were completed a similar test by R. Davidson and S.G. McKinnon (1981) came to our knowledge. This test is computationally easier than the H.M. Pesaran (1974) test or its non linear version (See H.M. Pesaran and A.S. Deaton (1978)). In comparing the two tests H.M. Pesaran (1982) has produced a Monte-Carlo study which demonstrated that his test rejects the true model in small samples far more frequently than it should. A brief description of the Davidson and McKinnon test is as follows.

Suppose that the model

$H_o : y = Xb_1 + Wb_2 + e_1$

where y is the vector of observations on the dependent variable X and W are the matrices of observations on the regressors, is the correct model and we wish to test it against the alternative non-nested model.

$H_1 : y = Z\gamma_1 + W\gamma_2 + e_2$

where Z and W are the matrices of observations on the non-overlapping and overlapping regressors respectively.

The Davidson and McKinnon test consists of estimating the compound model

$$y = (1 - \alpha)(Xb_1 + Wb_2) + \alpha\hat{y}$$

where $\hat{y}$ is the fitted value of y under H_1 and in examining the significance of parameter α. If α is insignificant we conclude that the model under H_1 must be rejected against the evidence of the data and H_o combined.

2. See M.C. Sawyer (1983)

APPENDIX 3

This appendix contains 5 sections, each of which describes analytically the generation of consistent sectoral series on the following variables: The wage rate index (Pw), the materials price index (P_M), the price of capital services index (Pc), the "other prices" index (P_B) and the Capacity Utilization variable based on the Wharton method (CW). The first four variables belong to the neoclassical model, but they are also used in the construction of unit costs employed in the markup models. The Wharton Capacity Utilization variable is used in all markup models as a measure of demand pressures.

A.3.1. The wage rate index

In order to construct a price of labour index we require quarterly data on the various categories of employment mentioned in section (2.4), on hours worked and on labour remuneration.

The methodology is described below. Data drawn from publichsed sources are either from AIS or LS. The first stage is concerned with the construction of "corrected" quarterly series on the various employment categories that are consistent on a yearly basis with the information on employment as provided by AIS. The second stage deals with the correction of labour remuneration variables corresponding to each category of employment used, so that a consistent (to AIS) quarterly series on labour bill is generated. This procedure is repeated for each of the two digit SIC sectors in the study.

Let

subscript y denote yearly data 1963-1977, y=1...15

q denote quarterly data 1963_i-1977_{iv}, q=1...60

and carrets (^) denote generated quarterly series

Also let

LTy = total yearly employment of wage and salary earners (AIS)

$\overline{LTy}$ = total yearly employment of wage and salaried earners calculated as an unweighted average of quarterly employment of wage and salaried earners (LS), i.e.

$$\overline{LTy} = (LTy_{i} + LTy_{ii} + LTy_{iii} + LTy_{iv})/4$$

where i, ii, iii, iv correspond to the four quarters of year y.

LTq = total quarterly employment of wage and salary earners (LS)

LSy = yearly employment of salaried earners (AIS)

LWy = yearly employment of wage earners (AIS)

LSq = quarterly employment of salaried earners, males and females (LS)

LWq = quarterly employment of wage earners, males and females (LS)

$\overline{LSy}$ = yearly employment of salaried earners, males and females calculated as an unweighted average of quarterly employment of salaried earners (LS), i.e.

$$\overline{LSy} = (LSy_{i} + LSy_{ii} + LSy_{iii} + LSy_{iv})/4$$

$\overline{LWy}$ = yearly employment of wage earners, males and females calculated as an unweighted average of quarterly employment of wage earners (LS), i.e. $\overline{LWy} = (LWy_{i} + LWy_{ii} + LWy_{iii} + LWy_{iv})/4$

LSMq= quarterly employment of male salaried employees (LS)

LSFq= quarterly employment of female salaried employees (LS)

LWMq= quarterly employment of male wage earners (LS)

LSFq= quarterly employment of female wage earners (LS)

Corrected quarterly employment for the four labour categories is defined as

$$\text{(A3.1)} \quad \widehat{LSMq} = \frac{LSy}{\overline{LSy}} * LSMq$$

$$\text{(A3.2)} \quad \widehat{LSFq} = \frac{LSy}{\overline{LSy}} * LSFq$$

$$\text{(A3.3)} \quad \widehat{LWMq} = \frac{LWy}{\overline{LWy}} * LWMq$$

$$\text{(A3.4)} \quad \widehat{LWFq} = \frac{LWy}{\overline{LWy}} * LWFq$$

Furthermore and in relation to the criteria about consistency and reliability set forth in chapter 2 we can observe the following identities

(A3.5) $L\hat{T}q \equiv L\hat{S}q + L\hat{W}q \equiv (LS\hat{M}q + LS\hat{F}q) + (LW\hat{M}q + LW\hat{F}q)$

(A3.6) $LSy \equiv L\hat{S}y_i + L\hat{S}y_{ii} + L\hat{S}y_{iii} + L\hat{S}y_{iv} \equiv$

$$\equiv (LS\hat{M}y_i + LS\hat{M}y_{ii} + LS\hat{M}y_{iii} + LS\hat{M}y_{iv}) + (LS\hat{F}y_i + LS\hat{F}y_{ii} + LS\hat{F}y_{iii} + LS\hat{F}y_{iv})$$

Identity (A3.6) states that if we add the generated quarterly employment for male and female salaried earners for the four quarters of any year y of the period under study we will get the same number as that provided by the yearly figures published in AIS. The same condition (A3.7) holds for the wage earners. In other words identity (2.8) holds with the generated quarterly data (if we exclude proprietors and working family members (LRy)).

(A3.7) $LWy \equiv L\hat{W}y_i + L\hat{W}y_{ii} + L\hat{W}y_{iii} + L\hat{W}y_{iv} \equiv$

$$\equiv (L\hat{W}M_{yi} + L\hat{W}M_{yii} + L\hat{W}M_{yiii} + L\hat{W}M_{yiv}) + (L\hat{W}Fy_i + L\hat{W}Fy_{ii} + L\hat{W}F_{iii} + L\hat{W}F_{iv})$$

For the generation of quarterly remuneration indices for the four categories of labour, i.e. for wage and salary indices for males and females we need to define the following:

SBy = yearly salary bill (males and females) (AIS)
$\overline{STy}$ = yearly average monthly salary (males and females) ((LS), calculated as $\overline{STy} = (STy_i + STy_{ii} + STy_{iii} + STy_{iv})/4$

STq = average monthly salary for males and females corresponding to a quarter (LS)

SMq = average monthly salary for males corresponding to a quarter (LS)

SFq = average monthly salary for females corresponding to a quarter (LS)

WBy = yearly wage bill (males and females((AIS)
$\overline{WTy}$ = yearly average hourly wage rate (males and females((LS) calculated as $\overline{WTy} = (WTy_i + WTy_{ii} + WTy_{iii} + WTy_{iv})/4$

WTq = average hourly wage rate for males and females corresponding to a quarter (LS)

WMq = average hourly wage rate for males corresponding to a quarter (LS)

WFq = average hourly wage rate for females corresponding to a quarter (LS)

$\overline{HTy}$ = yearly average weekly hours worked for male and female wage earners (LS) calculated as:

$\overline{HTy} = (HTy_{i} + HTy_{ii} + HTy_{iii} + HTy_{iv})/4$

HTq = quarterly average of weekly hours worked for male and female wage earners (LS)

HMq = quarterly average of weekly hours worked for male wage earners (LS)

HFq = quarterly average of weekly hours worked for female wage earners (LS)

49 = it is assumed that wage earners (manual workers) work 49 weeks per year, or 294 days per year, which is equivalent to <u>4.08333</u> working weeks per month, or 12.25 working weeks per quarter.

Generated quarterly labour remuneration, i.e. salaries and wages for males and females is defined as

(A3.8) $\hat{SMq} = \frac{SBy}{12*\overline{STy}*LSy} * SMq$

(A3.9) $\hat{SFq} = \frac{SBy}{12*\overline{STy}*LSy} * SFq$

(A3.10) $\hat{WMq} = \frac{WBy}{LWy*\overline{WTy}*\overline{HTy}*49} * WMq$

(A3.11) $\hat{WFq} = \frac{WBy}{LWy*\overline{WTy}*\overline{HTy}*49} * WFq$

Generated quarterly total labour bill is defined as the sum of each labour category, i.e.

(A3.12) $\hat{\hat{LBq}} = (1.175*3*LSMq*\hat{SMq}) + (1.175*3*LSFq*\hat{SFq}) + (1.175*12.25*\hat{WMq}*HMq*LWMq) + (1.175*12.25*\hat{WFq}*HFq*LWFq)$

where 3 in the first two brackets accounts for the fact that we have average monthly figures for employment of salaried earners and salaries and we want to generate quarterly figures for labour bill

0.175 accounts for employers contributions. Data on labour bill include employee's contributions but exclude employers contributions to social insurance agencies. Social insurance legislation does not apply a unified premium but on the contrary the contributions vary according to the risk associated with the job, to the location of the firm and to the type of insurance provided (See for example T. Georgakopoulos (1977) p. 80). The premium was assumed to be the same across sectors due to lack of more precise information at a rate of 17.5% (Note that A. Kintis (1970), p.88 calculates employer's contributions at a rate of 17%).

Wage rate can now be defined as the weighted average of wages and salaries for male and female workers per quarter where the weights are the shares of each employment category to total employment.

$$\text{(A3.13)}\quad Pwq = (3.525*\hat{SMq})*\frac{\hat{LSMq}}{LTq} + (3.525*\hat{SFq})*\frac{\hat{LSFq}}{LTq} + (14.39375*\hat{WMq}*HMq)*\frac{\hat{LWMq}}{LTq} + (14.39375*\hat{WFq}*HFq)*\frac{\hat{LWFq}}{LTq}$$

which is equivalent to

$$\text{(A3.14)}\quad Pwq = \frac{\hat{LBq}}{LTq}.$$

A3.2 The materials price index P_M

The construction of materials prices is based on information provided by the Input-Output Tables, which are available on a yearly basis from 1958-1977 (See Th. Skountzos and G.S. Mattheos (1980)). They consist of 35 sectors of production and provide information on each intermediate input purchased by these sectors at constant 1970 prices for each year covered. Input price indices may be constructed as follows:

Let

subscript y denote yearly data

q denote quarterly data

i denote 2 digit SIC industrial sector (20.39)

i.e. i = 1...20

j denote an input-output sector i.e. j = 1...36

Materials price index for sector i, PM_{iy}, is defined as a weighted average of prices charged by j sectors for purchases from sector i; the prices charged by the j sectors are the final output prices of those sectors (Pjy); the weights are the shares of an intermediate purchase of sector i from sector j to the total of intermediate purchases of sector i (from sectors j) Algebraically we have for a <u>yearly</u> materials price index.

$$(A3.15) \quad PM_{iy} = \sum_{j=1}^{34} \frac{Q_{ijy}}{\sum_{j=1}^{34} Q_{ijy}} * P_{jy} \quad \text{for } i=1\ldots20,\ j=1\ldots34$$

where PM_{iy} = materials price index of sector i

Q_{ij} = intermediate purchase of sector i from sector j

P_{jy} = output price of each j sector

It is obvious that inputs from each i sector to itself are excluded and this explains the summation up to 34 and not 35. Also as it will be shown below the two digit SIC sectors directly correspond to the sectoral disaggregation of industry used by the input-output tables.

In equation (A3.15) the Q_{ijy}'s are provided by Input-Output tables. Pjy's are the final output prices of the j sectors. These sectors are given in table (A3.1) with their code numbers and their correspondence with the 2 digit SIC classification. The Pjy's are approximated as follows:

Table A3.1: Input-Output sectors and correspondence with 2 digit SIC (20-39)

Input-Output	SIC classification
(1) Agriculture, Livestock, Forestry, Fishing	
(2) Mining, Quarrying, Salterns	
(3) Processed Food	20
(4) Beverages	21
(5) Tobacco	22
(6) Textiles	23
(7) Footwear	24
(8) Clothing	24
(9) Wood	25
(10) Furniture	26
(11) Paper	27
(12) Printing and Publishing	28
(13) Leather	29
(14) Rubber Products	30
(15) Plastic Products	30
(16) Basic and other Chemical	31
(17) Oil refining and by-product industries	32
(18) Cement	33
(19) Glass and Glassware	33
(20) Construction materials and other non-metal products	33
(21) Basic metal products	34
(22) Metal products	35
(23) Machinery and appliances	36
(24) Electrical machinery	37
(25) Transport means	38
(26) Miscellaneous manufacturing	39
(27) Constructions	
(28) Electricity-Gas-Water	
(29) Transportation	
(30) Communications	
(31) Trade	
(32) Banking, Other financial institutions and insurance	
(33) Other Services	
(34) Housing	
(35) Public Services	

(a) For sectors (1) and (2) of the Input-Output tables we used the "wholesale price index of finished products of local primary production for home consumption" with regard to agriculture and mining respectively. Data are taken from the "Monthly Statistical Bulletin" that provides information on wholesale price indices in monthly and yearly figures.

(b) For sectors (3) to (26) that correspond to the 2 digit SIC classification we used the "wholesale price indices of finished products of local industrial production for home consumption" (Sectors 20-39), All these indices are provided by the Monthly Statistical Bulletin with year 1970 as the base year.

(c) For sectors (27)-(35) there are no published price indices. The only possible approximation for these sectors is to use implicit deflators that are provided in the National Accounts (Ministry of Coordination (1976) pp.58-59 and 196-197).

Quarterly material price indices are constructed in a similar pattern with that of yearly prices.

$$\text{(A3.16)} \quad PM_{iq} = \sum_{j=1}^{34} \frac{Q_{ijq}}{\sum_{j=1}^{34} Q_{ijq}} * P_{jq} \quad \text{for } i=1\ldots20,\ j=1\ldots34$$

and where $Q_{ijq} = Q_{ij}(i) = Q_{ij}(ii) = Q_{ij}(iii) = Q_{ij}(iv) = Qijy$

i.e. we assumed that the share of an intermediate purchase of sector i from sector j to the sum of intermediate purchases of sector i that is expressed in yearly figures is the same for each and every quarter (i) of year y. This is a plausible assumption to make, particularly when compared to assumptions used for the construction of input price indices in other studies as for example in O. Eckstein and D. Wyss (1972) where the corresponding shares are constrained to be constant throughout the period of construction.

The Pjq's are obtained from the same sources as the Pjy's. For each quarter we take the average of three monthly figures.

For sectors (27)-(35) of the Input-output tables, the implicit deflators are expressed only in yearly figures. The assumption that is used to generate quarterly data from the yearly implicit deflators is that they follow the quarterly pattern of the Consumer Price Index. The Consumer Price Index is obtained from the Monthly Statistical Bulletin and is expressed in quarterly data by taking the average of three monthly figures.

So far we have discussed the procedure by which input price indices are generated for each two digit SIC sector. Total manufacturing sector is excluded from this procedure. For total manufacturing the "Index of wholesale prices for raw materials and semi-manufactured goods, General Index" is used that is published monthly by the Statistical Bulletin of the Bank of Greece. Quarterly data are obtained by averaging monthly figures.

A3.3 The Price of Capital Services, Pc

In this section we will describe the derivation of a user-cost of capital formula based on the neoclassical theory of investment behaviour. The model follows closely the work by D.W. Jorgenson (See for example D.W. Jorgenson (1963), D.W. Jorgenson (1965), D.W. Jorgenson and S.A. Stephenson (1967a) (1967b) (1969), R.E. Hall and D.W. Jorgenson (1967), D.W. Jorgenson and C.D. Siebert (1968), D.W. Jorgenson (1974)). A tax equation is introduced to account for the effects of tax and other allowances granted to Greek manufacturing firms. The section consists of three parts; the first derives the model augmented to account for the peculiarities of the Greek tax system. The second deals with the calculation of the user-cost. In the third we discuss a method used for the splitting of the yearly user-cost figures with quarterly ones.

A3.3.1. The Model

The standard neoclassical formulation of the theory of investment behaviour requires that the demand for capital services (and the demand for other inputs of the firm) is determined in a way that maximises the net worth of the enterprise. Assume (a) that the levels of output and each variable input are constrained by a production function (b) that the rate of change of capital stock is equal to investment less replacement and (c) that replacement is proportional to capital stock. Maximization of net worth implies that a detailed representation of the tax structure that the company faces is required. Such a representation should take into account that in the absence of tax, investment will carry to the point where the gross rate of return equals the cost of borrowing and the stream of depreciation needed to recover capital. The introduction of tax reduces the expected rate of return on the one hand, but on the other reduces the cost through the various tax allowances such as accelerated depreciation, investment allowances, interest rate subsidies, etc.

Let the difference between revenue and outlay on both the current and capital account be Z. Note that all variables refer to years y (y=1...15) and sectors i (i=1...21). Then

(A3.17) $Z = P.Q - s.L - P_k.I$

where P,s,Pk are the prices of output, variable input and investment in capital stock respectively, and
Q,L,I are the quantities of output, variable input and investment in capital stock respectively

For the introduction of the tax equation let

T = the amount of direct tax payable by the firm
u = the rate of taxation on net income
v = the proportion of depreciation that may be charged against revenue less outlay on the current account in measuring income for tax purposes
w = the proportion of cost of capital chargeable against pre-tax profits for tax purposes
δ = the rate of depreciation
τ = the cost of capital
k = the stock of capital

The tax equation may be defined as

(A3.18) $T = u\left[P.Q - s.L - P_k(v.\delta + w.\tau)K\right]$

Net worth, V, is defined as the integral of discounted revenue less discounted outlay on both the current and capital account, less discounted direct taxes, where φ is the rate of discount

(A3.19) $V = \int_0^{\infty} e^{-\varphi t}[Z-T]dt$

Net worth is maximized subject to two constraints. The first is the production function.

(A3.20) $F(Q,K,L) = o$

where it should be noted that capital services and not the stock of capital is the input of the productive process. The second is an assumption about replacement investment.

(A3.21) $\dot{K} = I - \delta k$

i.e. the rate of change of capital stock is equal to investment less replacement, replacement being proportional to capital stock.

Maximization of net worth (A3.19) subject to (A3.20) and (A3.21) requires the formulation of the usual Langranzian expression (A3.22).

(A3.22) $R = \int_0^{\infty}\left[e^{-\varphi t}(Z-T) + \ell o\ F(Q,L,K) + \ell_1(\dot{K}-I+\delta k)\right] dt$

The first order conditions have been derived elsewhere (R.E. Hall and D.W. Jorgenson (1967)) and need not be repeated here. It is possible to derive the marginal productivity condition for capital services as

(A3.23) $\frac{\partial Q}{\partial k} = \frac{Pk\left[\left(\frac{1-uv}{1-u}\right)\delta + \left(\frac{1-uw}{1-u}\right)\tau\right]}{p}$

from which the user-cost of capital may be defined as

$$(A3.24) \quad Pc = Pk \{(\frac{1-uv}{1-u})\delta + (\frac{1-uw}{1-u})\tau\}$$

Transformation of the tax equation to account for specific conditions pertaining in the Greek legal system with reference to manufacturing requires the definition of the following variables

λ = the percentage of capital stock that may be charged against revenue less outlay on current account to cover the value of investment, future losses, etc. There is a number of legal decrees passed on throughout the period under examination, on which we are able to collect information. The total amount of tax deductible from revenue less outlay on the current account is $\lambda . P_k . k$

ρ = the percentage of investment cost that is granted in the form of tax and duties exemptions, since most of capital investment in machinery is imported. In this respect the amount deductible is $\rho . P_k . I$

With these two modifications equation (A3.18) can be written as

$$(A3.18') \quad T = u\,[P.Q-s.L-Pk(v.\delta+w.\tau+\lambda)k-\rho.Pk.I]$$

Note that the term $\rho.Pk.I$ is deducted from the revenue less outlay account irrespective of the amount of profits that are subject to tax, since the allowance of taxes and duties is applied before the investment items enter the productive process. With the modification (A3.18') the user cost equation becomes

$$(A3.25) \quad Pc = Pk\,[(\frac{1-\rho-u.v}{1-u})\delta + (\frac{1-\rho-u.w}{1-u})\tau - (\frac{u}{1-u})\lambda]$$

Calculations of user cost are based on equation (A3.25) This is the subject matter of the next subsection

A3.3.2 Calculation of the user-cost

Prior to the calculation of the user cost we require data on capital stock and profits which are not available for the Greek manufacturing. The methodology of generating data for profits and capital stock is described below.

A3.3.2(a) Capital stock. In order to calculate capital stock for two digit SIC sectors we need information on the following:

(a) Gross investment per year

(b) An assumption about the useful life of depreciable assets (depreciation rate) and

(c) An evaluation of the existing capital stock in the beginning of the period

(a) Gross investment per year. Annual Industrial Surveys (AIS) provide data on gross investment per year classified according to whether the item is bought new or used and according to the nature of the investment item. There are six categories of investment items according to the (AIS):

(1) Machinery and mechanical equipment

(2) Buildings

(3) Transport means

(4) Furniture and fixtures

(5) Lots and sites

(6) Other fixed items

For each of the above six categories AIS provide data on new items, used items, and sales and destructions. Although it is not permissible to use aggregates of heterogeneous categories it is practical to condense the above six categories into two as follows:

Machinery = (1)+(3) and

Buildings = (2)+(4)+(5)+(6)

and of course for each of the above two categories we add items bought (new and used) and deduce sales and destructions. We can therefore generate gross investment per year, per sector on machinery and buildings.

(b) Depreciation rate. The investment plans of firms are inextricably bound up with decisions concerning whether or not to continue operating the oldest machinery and equipment. The need for replacement represents a reduction of the capacity of capital stock in the current period to produce a flow of capital services in the following period. The assumption is that replacement investment generated by previous acquisition of capital goods is distributed over time. A particular form of this relationship is based on the geometric distribution of replacement over time. This leads to the hypothesis that replacement investment is proportional to capital stock. Formally

(A3.26) $IR = \delta k$

where IR = replacement investment

δ = depreciation rate = $1/\lambda$, where λ=useful lifetime of depreciable assets.

Furthermore capital stock is generated as follows:

(A3.27) $K = K_{-1} - IR_{-1} + GINV$

where K = Capital stock and GINV = Gross Investment
Combination of (A3.26) and (A3.27) yields

(A3.28) $K = GINV + (1-\delta)K_{-1}$

which generates capital stock from data on gross investment and an assumption about depreciation rate (δ). Since information about δ is not available we followed A. Kintis (1973) in assuming δ=2% for buildings, implying a useful lifetime of 50 years and δ=5% for machinery, implying a useful lifetime of 20 years. These depreciation rates are applied uniformly to all sectors despite R. Krengel and D. Mertens's (1966) comment to the contrary. With the above assumptions capital stock's generating equations are (subscripts B,M are for buildings and machinery respectively).

(A3.29) $K_B = GINV_B + (0.98)K_{-1B}$

(A3.30) $K_M = GINV_M + (0.95)K_{-1M}$

(A3.31) $K_{B+M} = K_B + K_M$

(c) Capital stock on the beginning of the period. Information for capital stock for year 1958 is provided by A. Kintis (1973), pp 170-171. It is easy to construct data for 1963 having the 1958 data by using equations (A3.29) and (A3.30). Note that A. Kintis's data for sectors 27 and 28, 30 and 39, 31 and 32 are aggregated. We assumed that for each of two parts of aggregate data the share of capital stock is equal to the share of investment between each pair during 1958.

(d) "Accounting" depreciation. The depreciation rate that corresponds to the economic (=useful) lifetime of capital was assumed to be 0.02 for buildings and 0.05 for machinery. In practice the State allows higher depreciation rates in order to stimulate investment through increased profits. These rates differ among companies according to various criteria such as the kind of depreciable asset, the legal form of the company, the location of the company, according to whether the machinery in Greek or foreignly bought, etc. Furthermore various legal decrees passed on during the period under study continuously alter these depreciation rates in the light of industrial development policies considered by each Government. Such a perplexity of depreciation rates granted, made it extremely difficult to assess the true accounting depreciation rates without resorting to the use of data drawn from the balance sheets reported by companies with the legal form of limited liability or société anonyme. Such an information is only available from the annual editions of the Confederation of Greek Industries (CGI). In particular, we have data on gross capital stock in buildings and machinery from which we are able to calculate gross investment, since

(A3.32) $GINV_{(CGI)} = \text{Gross } K_{(CGI)} - \text{Gross } K_{-1(CGI)}$

Moreover CGI also provides data on net capital stock for buildings and machinery from which we can calculate the "accounting" depreciation rate for buildings (B) and machinery (M), as :

(A3.33) $1-\delta_{CGI(B)} = \dfrac{netK_{CGI(B)} - GINV_{CGI(B)}}{net\ K_{CGI(B)-1}}$

and (A3.34) $1-\delta_{CGI(M)} = \dfrac{netK_{CGI(M)} - GINV_{CGI(M)}}{net\ K_{CGI(M)-1}}$

A3.3.2(b) Calculation of net profits. It was mentioned in chapter 2 that net profits are a part of an identity, (2.2), expressing the various elements forming the Value Added (VA). Distinguishing between "economic" and "accounting" depreciation we can have the following identities for "economic" and "accounting" profits:

(A3.35) PROF(A)=VA-LB-(0.175*LB)-EMREM-DEP(EC)-INS-INT-RENT-
-ADV-(LAW+AGENT+TRANS+PTT)

(A3.36) PROF(B)=VA-LB-(0.175*LB)-EMREM-DEP(AC)-INS-INT-RENT-ADV-
-(LAW+AGENT+TRANS+PTT)

Each of the above items was approximated as follows:

VA = Value Added, data drawn from AIS

LB = receipts of employed, salary and wage bill, data drawn from AIS

(0.175*LB) = employers contributions (See section A3.1)

EMREM = employers remuneration. It refers to non-paid family members provided that they work at least 3 hours daily and to employers provided that they are not considered as employees. The latter is the case for most of the personal companies having the legal form of joint-stock or partnership. AIS provide data on the number of employees and non-paid family members. It was assumed that the average salary is what it would be paid, if they were considered as employees. Average salary is the ratio of salary bill by the number of salaried earners as that is provided by the AIS.

DEP(EC), DEP(AC) = economic and accounting depreciation. The method for calculation was explained before

INS = Insurance expenditure. AIS as a rule provides no information on INS. Nonetheless the 1970 issue (AIS,1970) p. 106-107 provides data on insurance premium from a sample of 2170 industries. On the assumption that information provided by this sample holds true for the population at the same year we calculated insurance expenditure for each sector during 1970. Furthermore it was assumed that insurance expenditure is proportional to sales. Since we had no other information but the 1970 sample, we applied the ratio of insurance expenditure to sales for 1970 for the whole period 1963-1977. Insurance expenditure is therefore calculated as

(A3.37) $$INS = \frac{INS_{1970}}{GPV_{1970}} * GPV,$$ GPV = Gross Production Value
1970 = refers to the 1970 sample

INT = Interest bill plus banker's commission. Data on financial expenditure as well as borrowed funds are provided by CGI for a sample consisting of the total of companies that have the legal form of limited liability or société anonyme for each year of the period 1963-1977. We are thus able to calculate the cost of borrowing by dividing data on financial expenditure by borrowed funds. On the assumption that the cost of borrowing funds for the CGI sample is the same as that of AIS we only had to calculate borrowed funds for the AIS sample. Since this information is unavailable we proceeded as follows:
CGI provides data on fixed capital stock working capital and borrowed funds. The ratios of (a) working capital to fixed capital and (b) borrowed capital to total capital (fixed and working capital) from the CGI sample were

applied to fixed capital from AIS in order to estimate working and borrowed capital for AIS firms, on the assumption that the two ratios are the same for both CGI and AIS samples. Multiplying the cost of borrowing by the borrowed funds for AIS we are able to calculate the financial expenditure corresponding to the AIS firms.

Let

WK = working capital

BF = borrowed funds

FE = financial expenditure

Then,

$$\text{(A3.38)} \qquad WK = \frac{WK_{CGI}}{K_{CGI(B+M)}} * K_{B+M}$$

$$\text{(A3.39)} \qquad BF = \frac{BF_{CGI}}{K_{CGI(B+M)}+WK_{CGI}} * (WK+K_{B+M})$$

$$\text{(A3.40)} \qquad FE = \frac{FE_{CGI}}{BF_{CGI}} * BF$$

ADV = advertising expenditure. Data on advertising expenditure are provided only in two AIS samples conducted in 1963 and in 1970. We are able to calculate the amount of advertising expenditure per firm in the two samples and by multiplying that with the number of firms from AIS for 1963 and 1970 we obtain the amount of advertising expenditure for the years 1963 and 1970. Since advertising is a function of sales we can calculate the ratio of advertising to sales by dividing the amount of advertising in the two sample years to GPV for those years. The 1970 ratio is used to generate advertising expenditure for the years 1970-1977 (as shown by (A3.41)), while for the years 1963-1970 we interpolate between the 1963 and 1970 ratios. Formally we have

$$\text{(A3.41)} \qquad ADV = \frac{\dfrac{ADV_{1970\ SAMPLE}}{NOF_{1970\ SAMPLE}} * NOF_{1970}}{GPV_{1970}} * GPV$$

and similarly for the 1963 sample, where NOF is the number of firms

RENT = rent expenditure. AIS do not provide information on rent expenditure except for the 1970 sample. We can calculate the rent expenditure per firm in the sample. On the assumption that rent increases followed the Consumer Price Index during the period, rent expenditure is calculated as

$$(A3.42)\quad RENT = \frac{RENT_{1970\ SAMPLE}}{NOF_{1970\ SAMPLE}} * NOF * P_{CON}$$

where P_{CON} = Consumer Price Index

LAW = expenditure for lawyers offices, accounting offices, organization offices tax and control offices, etc.

AGENT = agents and brokers commission, research expenditure and patents

TRANS = transportation expenditure

PTT = post, telephone, telegraph and subscriptions expenditure

The procedure for calculating the above items is the same as that followed for RENT and ADV. Formally we have

$$(A3.43)\quad LAW = \frac{LAW_{1963\ SAMPLE}}{NOF_{1963\ SAMPLE}} * NOF * P_{CON}$$

$$(A3.44)\quad AGENT = \frac{\frac{AGENT_{1970\ SAMPLE}}{NOF_{1970\ SAMPLE}} * NOF_{1970}}{GPV_{1970}} * GPV$$

$$(A3.45)\quad TRANS = \frac{TRANS_{1970\ SAMPLE}}{GPV_{1970}} * GPV$$

$$(A3.46)\quad PTT = \frac{PTT_{1970\ SAMPLE}}{NOF_{1970}} * NOF * P_{CON}$$

Having approximated all items on the right hand side of equations (A3.35) and (A3.36) it is then possible to calculate profits (losses) as a residual for each year and each two digit sector. Turning to the elements of the user cost equation (A3.25) each one of them can be calculated as follows:

A3.3.2(c) Calculation of the tax-rate (u). There is a number of different tax rates applied in the Greek manufacturing companies depending on the legal form of the company and other parameters. A company may have the form of a partnership, joint-stock, limited liability or société anonyme. The first three types of companies are not taxed as legal entities but the profits reported are taxed on the names of the shareholders of these companies with a tax rate that depends on the amount of income that the shareholders declare generated from their company and other sources as well (personal income tax). The tax rat applied on sociétés anonymes is differentiated depending on whether profits are retained or paid in as dividents. Retained earnings are taxed as income of the société anonyme whereas dividents are taxed as personal income of the shareholders according to legislative decrees 3323/1955 and 3843/1958. The latter is further differentiated depending on whether the shares are issued to the bearer or not.

The tax rates on (retained) earnings of the sociétés anonymes are further differentiated depending on whether the company draws capital from the public through the Athens Stock Exchange or not and on whether the société anonyme is Greek owned, foreignly owned, or has the legal form of a cooperative. The latter distinction does not exactly apply to the tax rate but to thedifferent allowances that are granted to Greek companies vis-a-vis foreign ones. For example for Stock-exchange companies the tax-rate on retained profits is 35%, while for those not in the Stock-exchange the rate is 40%. Moreover shares issued to the bearer for stock-exchange companies are taxed with 43% whereas shares that are not issued to the bearer are taxed with 38%. The corresponding figures for the non stock-exchange sociétés anonymes are 43% and 47% (See also J. Joannos (1980)(1984)).

It is clear therefore that a unified tax rate is not applicable as far as equation (A3.25) is concerned. (See also G. Break and R. Turvey (1964)). The only way out is to use the effective tax rate. This is constructed as follows: we have two groups of companies: sociétés anonymes (S.A) and personal companies such as partnerships, joint stocks and limited liability companies (P.C.). First we calculate the share of profits that correspond to (S.A.) and the share of profits that correspond to (P.C.) companies per year and sector. Since the profits of (S.A.) are taxed differently depending on whether profits are retained or distributed, what is of interest is only the retained portion of profits of (S.A.) since the distributed part is taxed as personal income of the shareholders.

The following identity is useful

(A3.47) PROF(B)≡PROF(P.C.)+PROF(RT.S.A.)+PROF(DIS.S.A.)

where PROF(B) = accounting profits, defined before
PROF(P.C.) = profits of personal companies
PROF(RT.S.A.) = retained profits of S.A. companies
PROF (DIS.S.A.) = distributed profits of S.A. companies

Annual publications by the NSSG of the bulletin "Statistics of declared income and taxation of legal entities" are useful in providing information on the above categories of profits: (A) the table "Legal entities reporting net profit or loss by kind of legal form by sector of industrial activity" that contains information on the following: (1) Net income based on balance sheets (2) Net income reported after tax reformulation (3) Taxable (retained) income (4) Tax due (5) Non-taxable (retained) income and (6) Loss. (B) Further information is provided on the following (1) Untaxed income according to various legal decrees such as l.d.4002/59, law 147/67, l.d. 1313/72 and l.d. 331/74, (2) Distributed income and (3) Retained income. Retained income of sociétés anonymes can be defined in the terminology of "Statistics of declared income and taxation of legal entities" bulletin as

(A3.48) PROF(RT.S.A.) = (Net income reported after tax reformulation)+(Non-taxable retained income)-(Loss)-PROF(DIS.S.A.).

Calculation of PROF(PC) can be approximated as a residual from (A3.47), since all other elements of (A3.47) have been generated. We are able therefore to calculate the shares of two different (in the taxable sense) categories of profits; PROF(PC) and PROF(RT.S.A.). To arrive at a figure for u used in equation (A3.25) we have to estimate the tax rates of the two categories of profits just mentioned.

Tax rate of retained S.A. profits (u_A). The first table of the "Statistics of declared income and taxation of legal entities" bulletin provides data on tax due. Dividing data on taxes by retained income of S.A. companies we get u_A.

Tax rate of distributed S.A. profits and personal companies (u_B) NSSG publishes annually "The Public Finance Statistics" where there is information on income taxation. Tax authorities distinguish family income into six categories, one of which refers to merchants and industrialists. We have data on family income reported, exemptions and deductions, taxable income and total tax. The tax rate u_B is the ratio of total tax over family income for category "merchants and industrialists". Since there is no detailed information the personal tax rate applies uniformly to all sectors.

Tax rate u can now be defined as a weighted average of u_A and u_B, where the weights have been defined previously

$$(A3.49) \quad u = u_A * \frac{PROF(RT.S.A.)}{PROF(B)} + u_B * \frac{PROF(DIS.S.A.)+PROF(PC)}{PROF(B)}$$

A3.3.2(d) Calclulation of δ(economic depreciation) δ is the actual depreciation rate that represents the wear and tear of the capital stock. The various assumptions about δ were discussed before. Since we have two types of investment assets δ is calculated as the weighted average of depreciation rates for buildings, δ_B, and machinery, δ_M, where the weights are the proportion of capital stock in buildings (k_B) to total capital stock and the proportion of capital stock in machinery (K_M) in total capital stock. Formally

$$(A3.50) \quad \delta_{B+M}=\delta_B * \frac{K_B}{K_B+K_M} + \delta_M * \frac{K_M}{K_B+K_M} = \frac{0.02\ K_B+0.05\ K_M}{K_B+K_M}$$

A3.3.3.(e) Calculation of v. v is the proportion of depreciation rate that is charged against revenue less outlay on current account for tax purposes. As it was mentioned before, one of the incentive schemes used by the State to generate investment is the depreciation rate that firms are allowed to charge against their profits. A number of legal decrees have enacted increased depreciation rates throughout the period under study, aiming to stimulate investment growth based on various criteria such as the geographic location of the company, the technology of the investment asset, the amount of annual investment expenditure, the destination of the products (exported or to home markets) the branch of manufacture etc. (See also N. Tsoris (1984)). Since v is the proportion of depreciation rate that is deduced from profits for tax purposes it can be defined as the ratio of "accounting" to "economic" replacement. Economic and accounting depreciation have been defined previously, v can therefore be defined as

$$\text{(A3.51)} \quad v = \frac{(\delta_{(CGI)B}*K_B) + (\delta_{(CGI)M}*K_M)}{(K_B+K_M) * \delta_{B+M}}$$

A3.3.2 (f) Calculation of investment implicit deflator P_K. There are two types of investment assets; buildings and machinery. The implicit deflator for total investment is the weighted sum of price for investment in buildings and price for investment in machinery. The weights are the proportion of gross investment in buildings to total gross investment and the proportion of gross investment in machinery to total gross investment, all expressed in constant 1970 prices.

The price for investment in buildings was approximated as follows: National Accounts of Greece provide data on gross domestic asset formation, in current and constant 1970 prices for the following categories; Dwellings, Other buildings, Other Construction and Works, Transport equipment and other equipment (See National Accounts of Greece (1976) pp 122-125 and 152-155 and Provisional National Accounts (1980 pp. 68 and 79)). PINV(B) was calculated as the ratio of the sum of "other buildings" and "other construction and works" in current and constant 1970 prices. Due to the lack of more detailed information it was further assumed that this price was the same for all sectors.

The same is not true for investment in machinery, PINV(M), where for example the typical investment unit in textiles does not have the same price as that of chemical industries. Prices for machinery that correspond to the two digit industrial sectors were provided by the Center of Planning and Economic Research and are given in table A3.2. As far as PINV(M) for the total manufacturing sector, information by T. Scountzos (1979) was used. P_K is then estimated as:

Table A3.2: PINV(M) Implicit deflator for investment in machinery and mechanical equipment: large scale manufacturing, two digit SIC sectors

SECTOR / YEAR	TOTAL	20-21	22-27 28-29 30-31	23	24	25-26	32-33	34	35	37	38	39
1963	0.828	0.884	0.905	0.846	0.887	0.849	0.905	0.827	0.830	0.987	0.932	0.987
1964	0.864	0.872	0.894	0.846	0.874	0.874	0.894	0.838	0.827	0.978	0.931	0.978
1965	0.855	0.881	0.897	0.881	0.879	0.879	0.897	0.852	0.863	0.962	0.933	0.996
1966	0.895	0.902	0.914	0.922	0.898	0.893	0.914	0.870	0.890	0.961	0.932	0.984
1967	0.925	0.923	0.932	0.947	0.922	0.933	0.932	0.877	0.902	0.964	0.937	0.970
1968	0.967	0.917	0.924	0.941	0.916	0.933	0.924	0.871	0.910	0.954	0.941	0.974
1969	0.934	0.938	0.939	0.950	0.936	0.938	0.939	0.929	0.948	0.952	0.948	0.976
1970	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1971	1.152	1.079	1.071	1.105	1.080	1.061	1.071	1.122	1.085	1.042	1.066	1.083
1972	1.336	1.173	1.165	1.222	1.174	1.229	1.165	1.221	1.187	1.132	1.275	1.194
1973	1.495	1.372	1.350	1.462	1.373	1.435	1.350	1.448	1.368	1.266	1.402	1.384
1974	1.754	1.572	1.538	1.679	1.572	1.740	1.538	1.805	1.814	1.406	1.581	1.559
1975	2.105	1.829	1.796	2.126	1.828	2.079	1.796	2.138	1.981	1.669	1.808	1.829
1976	2.447	2.228	2.154	2.396	2.227	2.472	2.154	2.496	2.229	1.872	2.292	2.096
1977	2.739	2.493	2.410	2.682	2.492	2.767	2.410	2.793	2.495	2.095	2.565	2.346

$$(A3.52)\quad P_K = PINV(B) * \frac{\frac{GINV_B}{PINV(B)}}{\frac{GINV_B}{PINV(B)} + \frac{GINV_M}{PINV(M)}} + PINV(M) * \frac{\frac{GINV_M}{PINV(M)}}{\frac{GINV_B}{PINV(B)} + \frac{GINV_M}{PINV(M)}}$$

A3.3.2(g) Calculation of cost of capital (τ). There is no consensus in the literature as to how this variable should be defined. The reason is that the structure of financing of industry is different among countries and consequently the variables that constitute τ cannot be unique. The peculiarities of the Greek financial system with special emphasis to capital financing in the industry have been discussed by many authors notably by D. Galanis (1963), H. Ellis (1964), D. Psilos (1964), L.S. Lolos (1966), S.G. Andreadis (1966) and recently by D. Halikias (1978) and N. Tsoris (1984).

In principle industrial investment in Greece may be considered to have the following sources of finance (A) External Sources. Borrowing from Banks or non-banking institutions which can be short-term or long-term financing. Short-term borrowing is used to finance working capital, inventories and credit advances to trade. It is not uncommon however for Greek manufacturing enterprises to resort to short-term borrowing to finance the acquisition of fixed assets. Long and medium term borrowing is used in principle to finance investment in fixed assets (buildings and machinery). Yet again it is rather common practice particularly for large industrial companies to use long-term borrowing to finance their working capital. Evidence of the fact that long-term bank funds are invested not in fixed assets but in inventories and accounts receivable is also provided by G.C. Bitros (1981).

(B) Internal Sources. As internal sources of finance we consider retained earnings and depreciation allowances, since the third option, borrowing from the public through the Stock Exchange, is practically unavailable. The ratio of own funds to borrowing was and is very low in Greek manufacturing as a whole. This is believed to be one of the most serious impediments to industrial growth in Greece particularly when one considers the fact that industrialization process in other countries was based for the most part on internal sources of funds, especially on the accumulation of retained profits.

In the light of the above, the definition of τ has to be constructed in a way that incorporates all the sources of investment financing practically used by Greek industrial firms. τ is therefore defined as a weighted average of the short-term interest rate, the long term interest rate and the rate of return on (own) capital, where as weights we used the share of short-term borrowing, long-term borrowing and own capital to the sum of total borrowing plus own capital for each sector and year. Formally

$$\text{(A3.53)} \quad \tau = \tau_1 * \frac{SB}{SB+LB+OF} + \tau_2 * \frac{LB}{SB+LB+OF} + \tau_3 * \frac{OF}{SB+LB+OF}$$

where τ_1 = short-term interest rate
τ_2 = long-term interest rate
τ_3 = rate of return on (own) capital
SB = short-term borrowing
LB = long-term borrowing
OF = own funds

<u>OF</u> = Data on borrowed funds (BF) that correspond to the AIS sample were estimated previously as well as data on working capital (WK). Since total capital (TC) is the sum of working capital and fixed capital stock we can approximate own capital, OF, as

$$\text{(A3.54)} \quad OF = TC-BF = WK+K-BF$$

<u>SB,LB.</u> Data on borrowed funds are distributed between short-term (SB) and long-term (LB) according to the information provided by the Bank of Greece monthly bulletin on the "<u>breakdown of credit to industry by sectors</u>" by using outstanding balances at the end of the period. Since the Bank of Greece sample of

industries is not the same as that of the AIS (actually it is larger since it includes the whole of industry and not only large scale industry), the usual working assumption is made that the proportion of short and long-term borrowing that exists in total industry per sector per year is the same with that of large scale industry. There is a possibility however that the shares thus generated are biased upwards with regard to short-term borrowing and downwards with regard to long-term borrowing, since in effect there is no long-term borrowing in small firms (see also K. Nicolaou (1978)).

τ_1, τ_2. The interest rates on short and long-term borrowing were obtained from the Bank of Greece monthly bulletin, table "interest rates on bank credits" and refer to the maximum of interest rates per period. In addition to the interest rates we added a commission of 1% that is charged for working capital (short-term loans) and 0.5% for long-term loans. Both interest rates varied very slightly throughout the period 1963-1973. Whenever there was a change within a year the interest rate was calculated as a weighted sum

τ_3. It is defined as the ratio of PROF (A) to OF.

A3.3.2.(h) Calculation of w. It is the proportion of the cost of capital that is deduced from profits for tax purposes. D.W. Jorgenson and S.A. Stephenson (1967a) define w as the ratio of net monetary interest to the total cost of capital. Net monetary interest is defined as

$$\text{(A3.55)} \quad \tau^* = \tau_1 * \frac{SB}{BF} + \tau_2 * \frac{LB}{BF}$$

Total cost of capital is defined by D.W. Jorgenson and S.A. Stephenson (1967a) as the product of the cost of capital (τ), capital stock at constant prices and the price of investment goods, P_K

Capital stock in constant 1970 prices is given by

$$\text{(A3.56)} \quad K^* = K^*_B + K^*_M$$

where (A3.57) $$K^*_B = \frac{GINV_B}{PINV(B)} + (0.98)K^*_{-1(B)}$$

(A3.58) $$K^*_M = \frac{GINV_M}{PINV(M)} + (0.95)K^*_{-1(M)}$$

Capital stock in the beginning of the period was deflated by the investment implicit deflators for buildings and machinery as

(A3.59) $$K^*_{1963(B)} = \frac{K_{1963(B)}}{PINV(B)1963}$$

and

(A3.60) $$K^*_{1963(M)} = \frac{K_{1963(M)}}{PINV(M)1963}$$

W can therefore be defined as

(A3.61) $$W = \frac{\tau^*}{\tau.Pk.K^*}$$

A3.3.2.(i) Calculation of ρ. ρ is the percentage of duties and tax allowances on investment. "Public Finance Statistics" provides tables containing data on the value of imports and on import duties and other taxes on the various categories of the Greek customs tariff book. Out of the various categories for commodities the one that corresponds to imports of capital goods is category 16, "machinery and mechanical appliances, electrical equipment, parts thereof". Note that imports of machinery do not refer to industry alone but to the total of Greek Economy. From these tables we can calculate the following:

(a) The value of imports of category 16 (b) The value of imported machinery that is not subject to duties and tax (mostly turnover tax) for various reasons (c) The percentage of duties and taxes that would be charged if the non-taxable amount was being taxed. The product of (b) and (c) gives the value of duties and taxes not collected, i.e.gives the value of duties and tax allowances (DUT).

ρ can be defined as the ratio of DUT by $GINV_{(TOT)M}$ i.e.

$$(A3.62) \quad \rho = \frac{DUT}{GINV_{(TOT)M}}$$

Note that there is a serious possibility that the value of ρ is overvalued since the denominator is not the amount of investment in machinery of the total economy as it should in principle be, but the total investment in machinery in manufacturing. On the other hand, had we divided DUT by the total economy investment we would have undervalued ρ significantly since duties allowances usually (but not exclusively) refer to industrial investment. Note also that ρ is the same for all sectors, since sectoral information is unavailable.

A3.3.2.(j) Calculation of investment allowances λ.

Governments frequently attempt to stimulate aggregate investment with the use of various investment schemes in conjunction with the corporate income tax. In that sense λ can be viewed as representing the proportion of total capital that is deducted from profits in order to cover the value of investments, future losses etc. During the period under examination various legislative decrees of major or minor significance were passed all of which were directed in easing the conditions for industrial development. A full description of these legal decrees can be found in G. Cottis (1980). Quantifiable information is provided for the following laws:

(1) legislative decree 4002/59 as amended by law 4171/61, further amended by legislative decree 916/71 "on taking general measures for the assistance of the economic development of the country".

(2) law 147/67 on "incentives of industrial development"

(3) legislative decree 1078/71 "on taxation and other measures for strengthening regional development"

(4) legislative decree 1313/72 "on measures strengthening tourist development" as amended by legislative decree 1377/1973 and

(5) legislative decree 331/74

In order to calculate λ we should estimate the allowances provided by the above legal decrees and then divide the amount of various allowances by the capital stock for each year and sector. Formally

$$\text{(A3.63)} \quad \lambda = \frac{\text{allowances}(4002/59+146/67+1078/71+1373/72+331/94)}{K_{B+M}}$$

Data for allowances are recorded analytically for all the laws mentioned above in the "Statistics of declared income and taxation for legal entities" bulletin. K_{B+M} was approximated before.

The calculation of λ is the last element of equation (A3.25) that had to be approximated. Yearly data on P_C can now be calculated on the basis of equation (A3.25). Table A3.3 provides these data for the 21 sectors of the Greek manufacturing.

A3.3.3. Calculation of Quarterly data

All elements included in equation (A3.25) are yearly since by definition, capital, profits, tax rates etc., are all defined on a yearly basis. On the other hand, all other

Table A3.3 User cost of capital; Large Scale manufacturing; two digit SIC sectors

SECTOR / YEAR	TOT	20	21	22	23	24	25	26	27	28	29
1963	0.09334	0.09094	0.09662	0.07929	0.09134	0.08352	0.07960	0.07577	0.09808	0.11048	0.09786
1964	0.09355	0.09150	0.09136	0.07802	0.09586	0.08462	0.07602	0.08552	0,08823	0.10695	0.09567
1965	0.09950	0.09838	0.09394	0.07923	0.09835	0.08874	0.07881	0.08747	0.08493	0.10570	0.10028
1966	0.09995	0.10154	0.09822	0.08983	0.10813	0.09147	0.08210	0.08929	0.09552	0.10771	0.10867
1967	0.10573	0.10672	0.09237	0.08766	0.10839	0.09108	0.09061	0.09603	0.09410	0.11444	0.10066
1968	0.10889	0.10466	0.09941	0.08121	0.10873	0.09617	0.08437	0.09605	0.09655	0.11214	0.10492
1969	0.10217	0.09530	0.09512	0.09034	0.10522	0.09334	0.07632	0.09420	0.09447	0.10977	0.10134
1970	0.10982	0.10949	0.10858	0.09407	0.11484	0.09716	0.07905	0.10458	0.11176	0.11810	0.11197
1971	0.11415	0.11718	0.11085	0.09983	0.12037	0.08503	0.08960	0.10636	0.10410	0.12043	0.11373
1972	0.13445	0.12592	0.11827	0.11594	0.13303	0.10802	0.08593	0.11594	0.12121	0.12762	0.11895
1973	0.16277	0.16233	0.14737	0.13628	0.16801	0.13574	0.12098	0.15003	0.14296	0.15513	0.15301
1974	0.24192	0.23748	0.22723	0.20118	0.24227	0.21513	0.19875	0.23609	0.23327	0.24543	0.23214
1975	0.27362	0.26757	0.26750	0.24587	0.29901	0.25177	0.20966	0.27583	0.23738	0.27987	0.27493
1976	0.35038	0.33076	0.32316	0.27739	0.35314	0.31590	0.31002	0.32800	0.30012	0.34164	0.32991
1977	0.40943	0.39103	0.38867	0.32801	0.41519	0.37754	0.37754	0.38512	0.34641	0.40371	0.39126

Table A3.3 User cost of capital, Large Scale manufacturing, two digit SIC sectors, CONTINUED

SECTOR / YEAR	30	31	32	33	34	35	36	37	38	39
1963	0.09477	0.09324	0.11301	0.07437	0.09045	0.09577	0.09771	0.08305	0.08884	0.09599
1964	0.08724	0.08150	0.11245	0.08221	0.07823	0.09837	0.09527	0.08801	0.09784	0.08841
1965	0.09344	0.09565	0.11225	0.08964	0.09530	0.10294	0.09636	0.08808	0.09786	0.08265
1966	0.10325	0.10106	0.11850	0.08709	0.09351	0.10924	0.10322	0.08722	0.10004	0.09567
1967	0.10689	0.10837	0.11750	0.08058	0.10042	0.10827	0.10411	0.08999	0.10432	0.09577
1968	0.10379	0.10833	0.11215	0.08636	0.09220	0.10485	0.10234	0.08507	0.10599	0.10223
1969	0.09752	0.10103	0.11108	0.09314	0.09435	0.10429	0.09428	0.08139	0.10651	0.10311
1970	0.10870	0.11211	0.12081	0.09211	0.11126	0.11425	0.10713	0.08195	0.11102	0.11554
1971	0.11307	0.11130	0.12339	0.09217	0.05494	0.12093	0.11227	0.09630	0.11373	0.11865
1972	0.12475	0.12832	0.13425	0.09994	0.12599	0.13481	0.12191	0.11012	0.12322	0.12863
1973	0.15562	0.14760	0.15917	0.13106	0.16786	0.16525	0.15696	0.13648	0.16277	0.15745
1974	0.21843	0.22326	0.22099	0.19594	0.20597	0.25970	0.24375	0.18889	0.25122	0.24619
1975	0.22381	0.25533	0.24488	0.23642	0.25165	0.29321	0.27238	0.21992	0.27906	0.28154
1976	0.27799	0.30045	0.32843	0.28204	0.29810	0.34817	0.31793	0.28173	0.32541	0.33095
1977	0.33280	0.35323	0.38120	0.33283	0.35169	0.41217	0.38156	0.32215	0.40260	0.39017

variables entering the neoclassical equation are expressed in quarterly data. A number of possible options were open with regard to the elements of equation (A3.25) as far as the generation of quarterly data is concerned. However the assumptions that would have been used for such a generation would have been far from realistic. As a better way out it was decided to obtain quarterly data not on the arguments of equation (A3.25) but on the user-cost variable itself. The usual procedure consists of freehand or mathematical methods of drawing a trend through the given annual data which affords approximations to the required quarterly figures. Various criteria have been used for these approximations. Here we follow a method put forward by Boot et al (1967) according to which the criterion for generating quarterly from yearly figures is the minimization of the sum of squares of the second differences.

Assuming that there are n years, we wish to minimize

$$\text{(A3.64)} \qquad \sum_{i=2}^{4n} (\Delta x_i - \Delta x_{i-1})^2$$

where $\Delta x_i = x_{i+1} - x_i$

subject to

$$\text{(A3.65)} \qquad \sum_{i=4K-3}^{4K} x_i = t_k \qquad (K=1,2\ldots n)$$

where x_i stands for the i^{th} quarterly total

t_k for the given yearly total in year K

The solution to the minimization of (A3.64) subject to (A3.65) is provided by Boot et al (1967). Application of this method for each observation presented in table A3.3 provides quarterly data for the user cost of capital (Pcq). Finally Pc was expressed in index form by taking the average quarterly values of 1970 as the base i.e.

$$100 = \frac{1970_{i}+1970_{ii}+1970_{iii}+1970_{iv}}{4}$$

A3.4 The "other prices Index" P_B

The construction of other prices index is based on equation (3.54) repeated here

$$(3.54) \qquad P_{Bit} = \frac{Y_t - Y_{it}}{\frac{Y_t}{PY_t} - \frac{Y_{it}}{PG_{it}}}$$

using information from the Input-Output tables. Total demand is disaggregated in these tables into intermediate demand consisting of 35 sectors plus final demand. Quarterly figures for total demand are obtained by using the quarterly shares of money supply defined as the sum of currency circulation and sight deposits (Monthly Bulletin, Bank of Greece, various issues) as in (A3.66).

$$(A3.66) \qquad MSS_q = \frac{MS_{qj(y)}}{\sum_{j=1}^{4} MS_{qj(y)}}$$

where j is a quarter of year y.

Own demand for each sector i is expressed in quarterly figures by using INDSq defined in equation (2.19) in the text

$$(2.19) \qquad INDSq = \frac{IND_{qj(y)}}{\sum_{i=1}^{4} INDqj(y)}$$

PY_t is defined as the implicit GNP deflator using information from National Accounts. Quarterly figures of PY_t are generated by using the shares of consumer price index obtained from the Monthly Statistical Bulletin and defined as

$$(A3.67) \qquad \overline{PCONq} = \frac{4*PCON_{qj(y)}}{\sum_{j=1}^{4} PCON_{qj(4)}}$$

Quarterly figures for P_B can now be defined as

$$\text{(A3.68)} \qquad P_{Biq} = \frac{Y_q - Y_{iq}}{\dfrac{Y_q}{PY_y * \overline{PCON}q} - \dfrac{Y_{iq}}{PG_{iq}}}$$

where (A3.69) $Yq = Y*MSSq$

(A3.70) $Yiq = Y_i*INDSq$

and as before subscripts y,q refer to yearly and quarterly figures respectively and subscript i refers to two digit SIC sectors

A3.5. The Wharton Capacity Utilization Index

The Wharton Capacity utilization index is defined in equation (3.118) in the text as

$$\text{(3.118)} \qquad W_t = \frac{Q_t}{Q_t^c}$$

Capacity output Q_t^c is generated by a process of linear interpolation between succcessive peaks based on the series of actual output Q_t. Actual output is measured by the gross production value expressed in constant 1970 prices. This section will describe the procedure by which capacity output is generated according to the Wharton method and give the figures of capacity and actual output for each two digit SIC sectors (Figures A3.1-A3.21). The computational rules by which Q_t^c is generated are the following:

(1) The actual output series is regarded to have a peak at quarter t, provided that the following two conditions are met.

$$\text{(A3.71)} \qquad Q_t > Q_{t-1}$$

$$\text{(A3.72)} \qquad Q_t > \max(Q_{t+1}, Q_{t+2})$$

In other words, a peak occurs in each quarter where

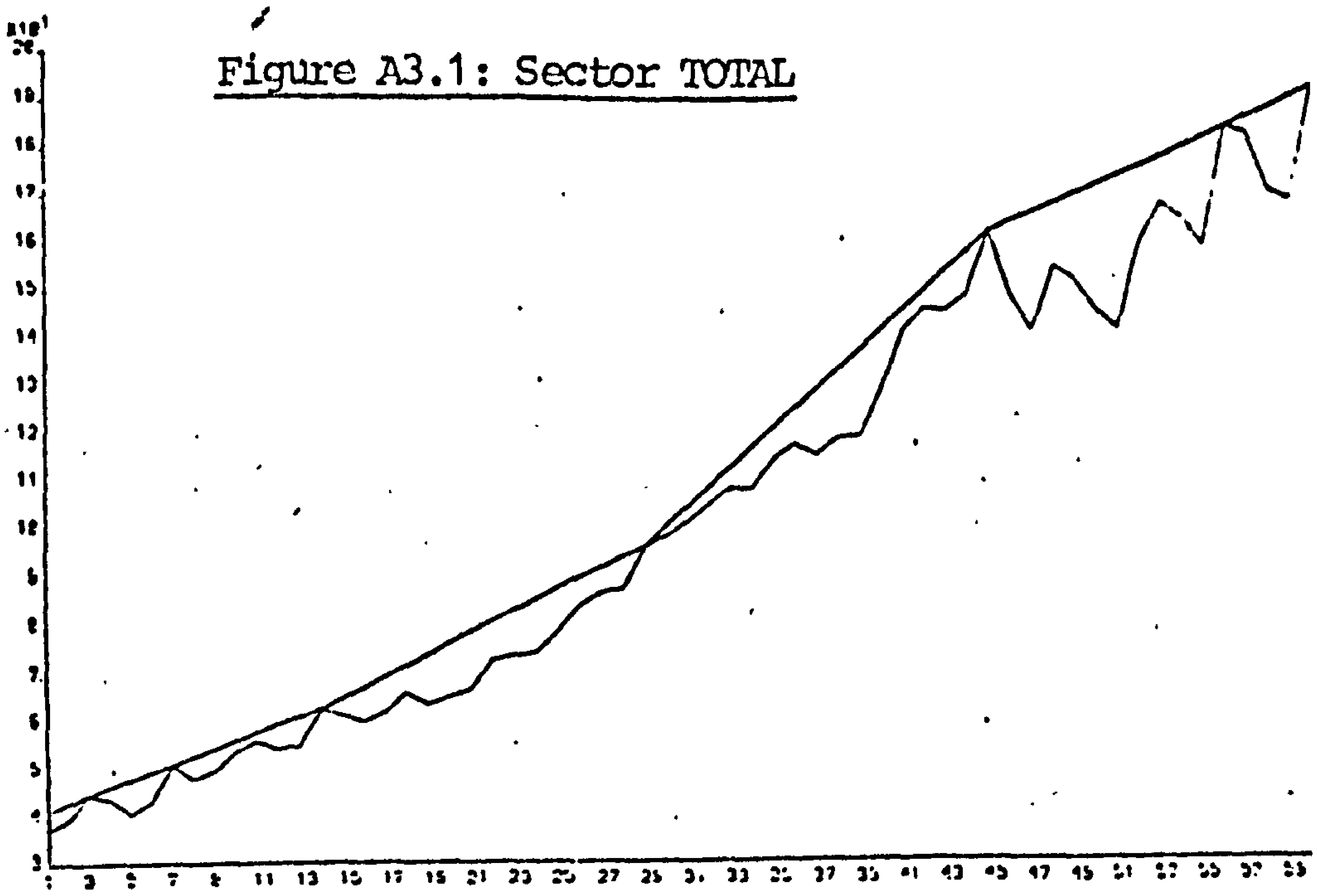


Figure A3.1: Sector TOTAL

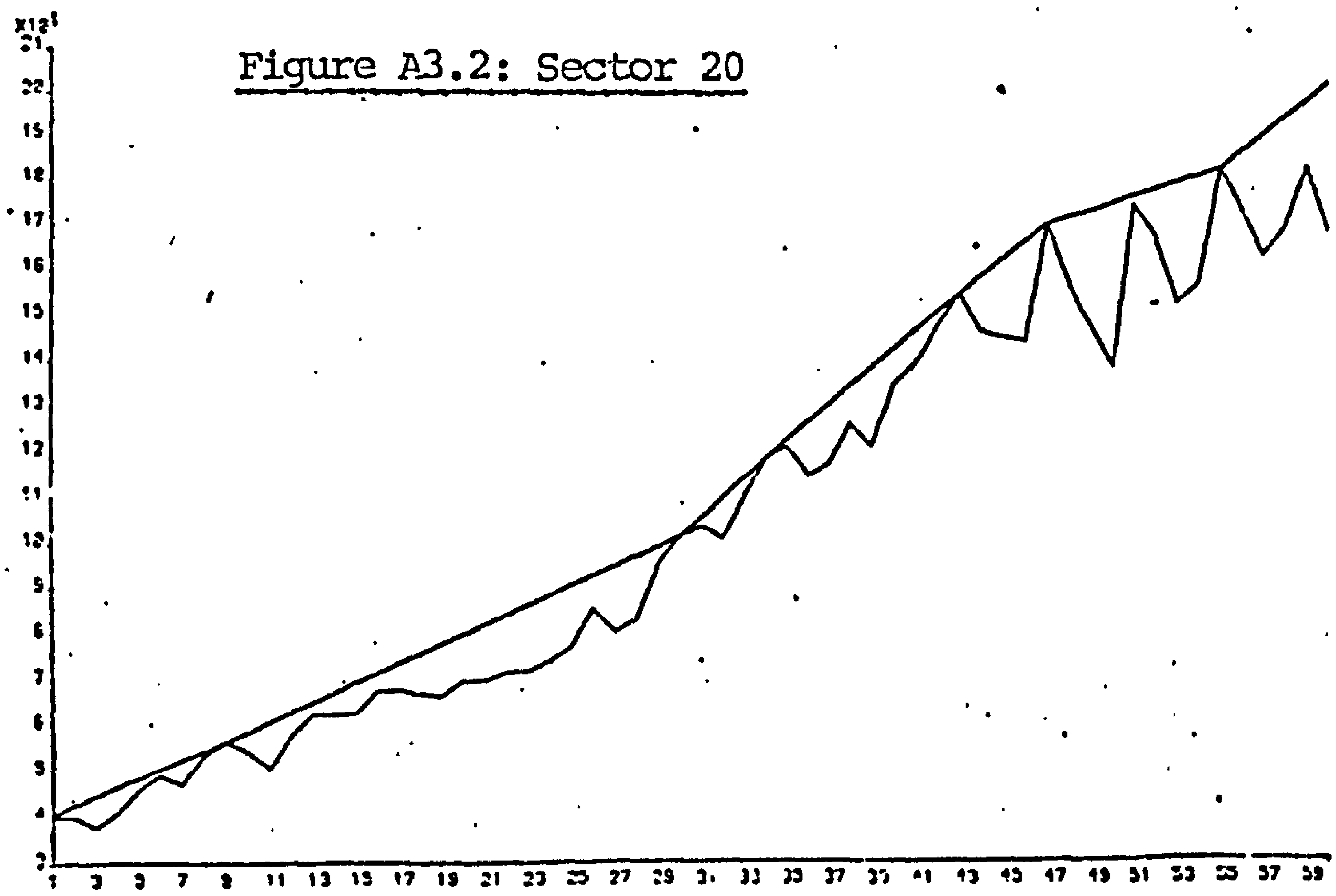


Figure A3.2: Sector 20

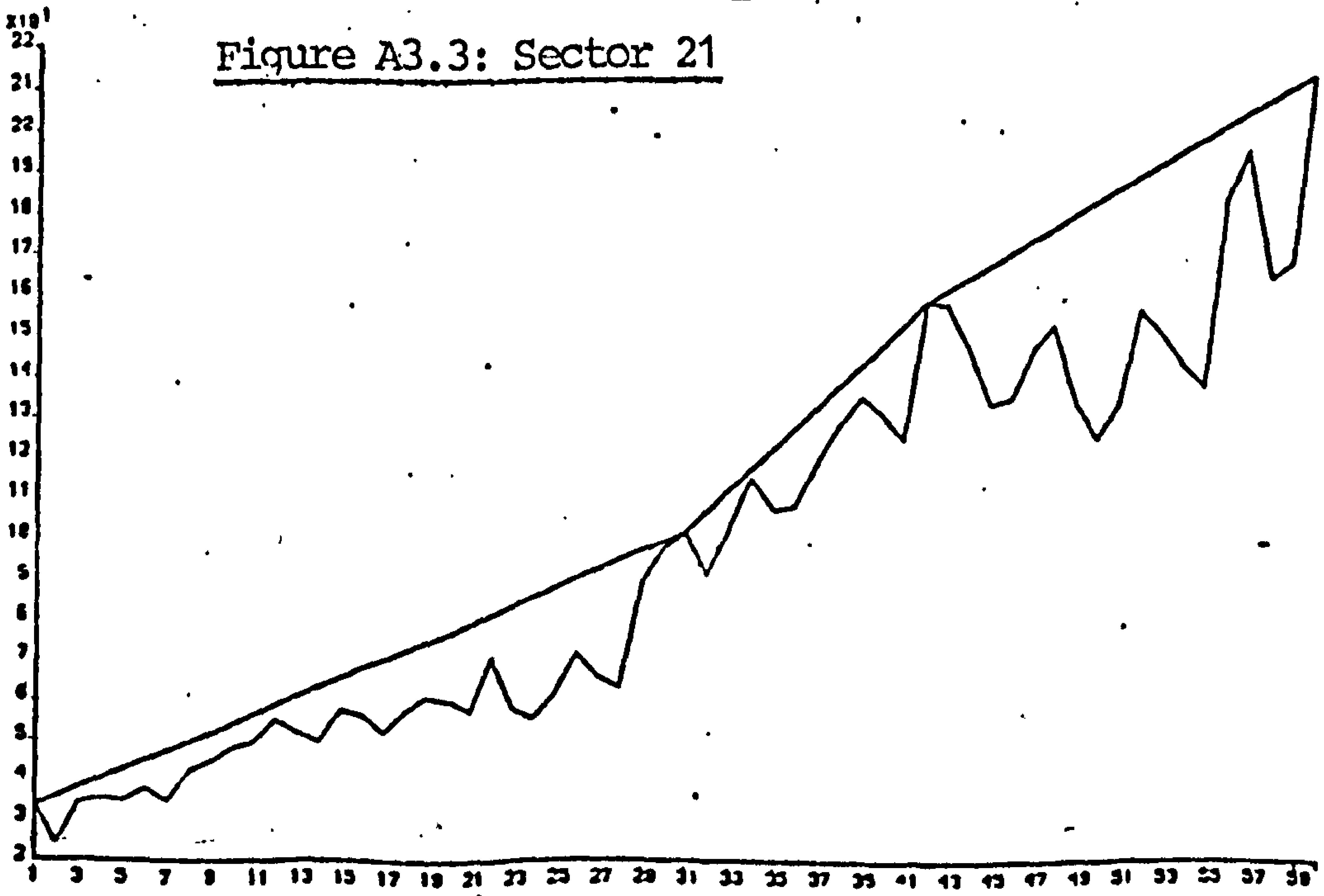


Figure A3.3: Sector 21

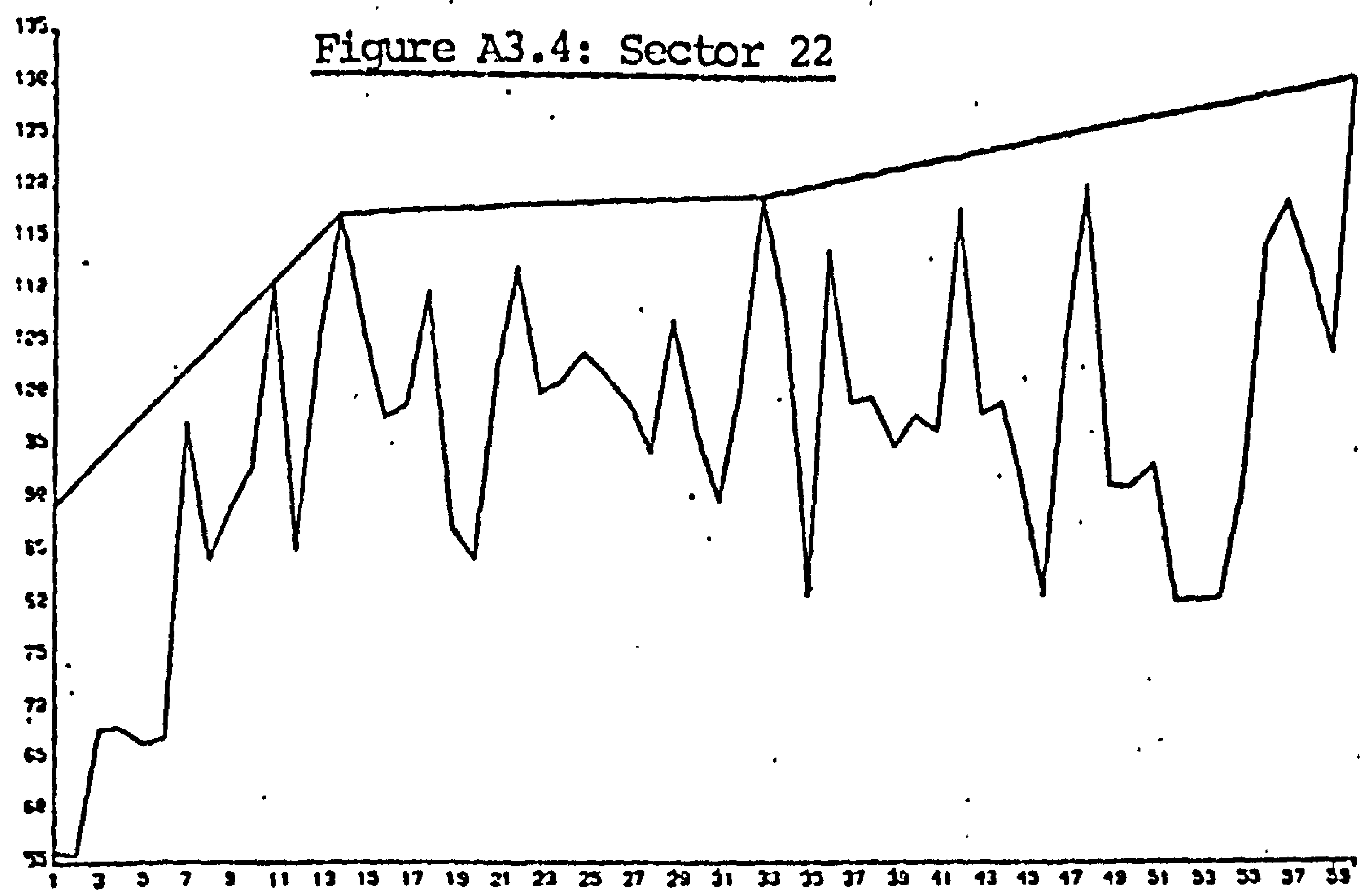


Figure A3.4: Sector 22

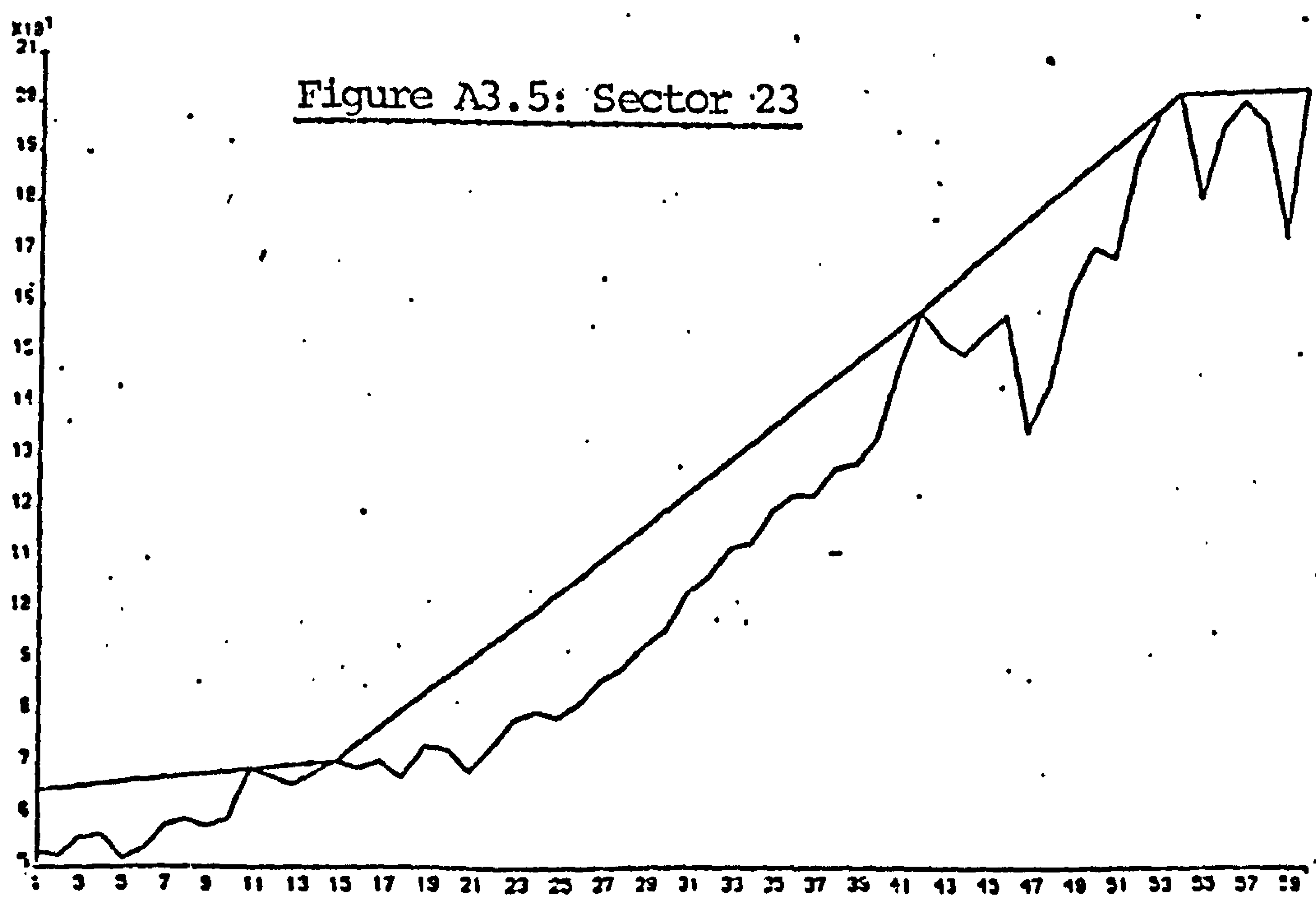


Figure A3.5: Sector 23

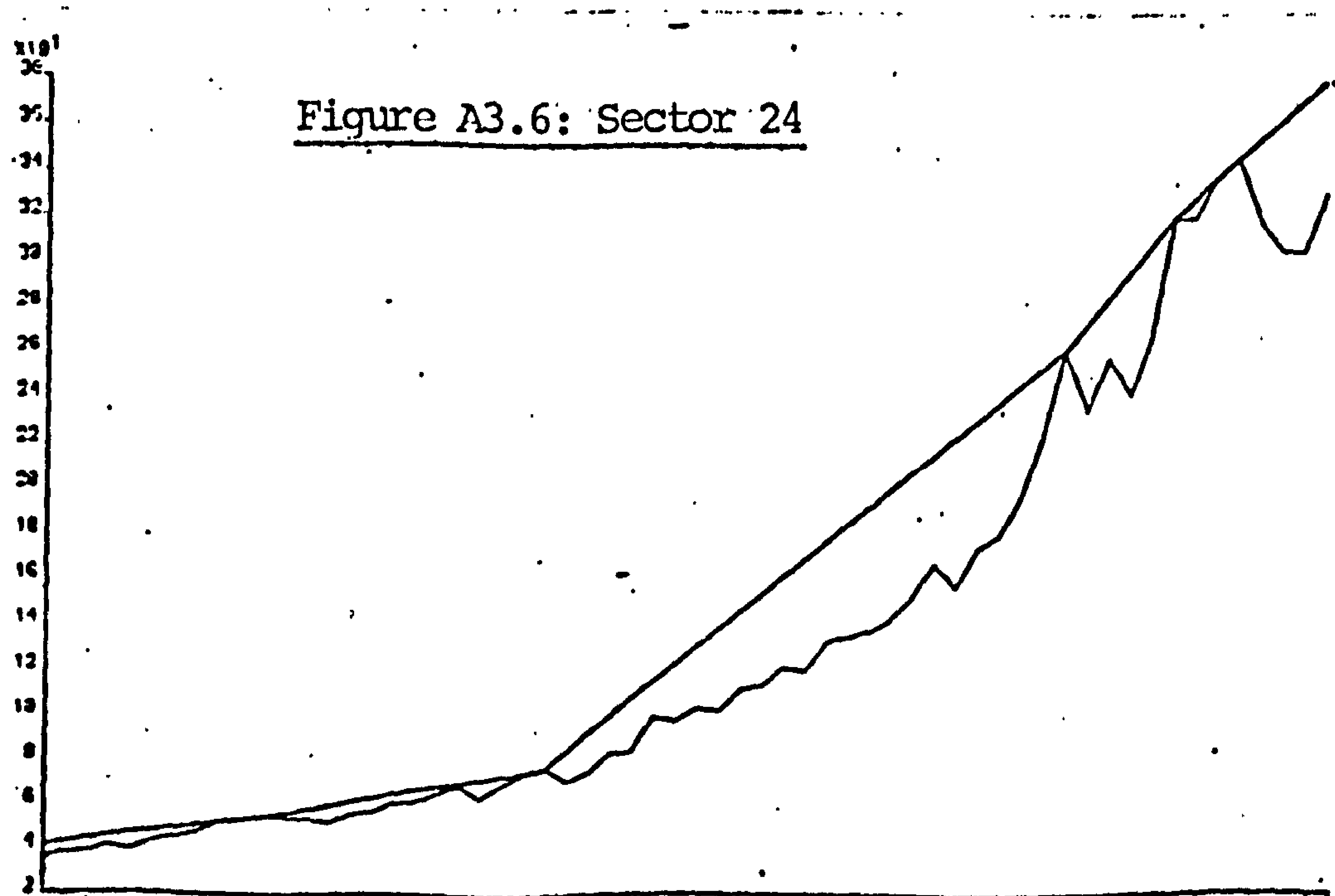


Figure A3.6: Sector 24

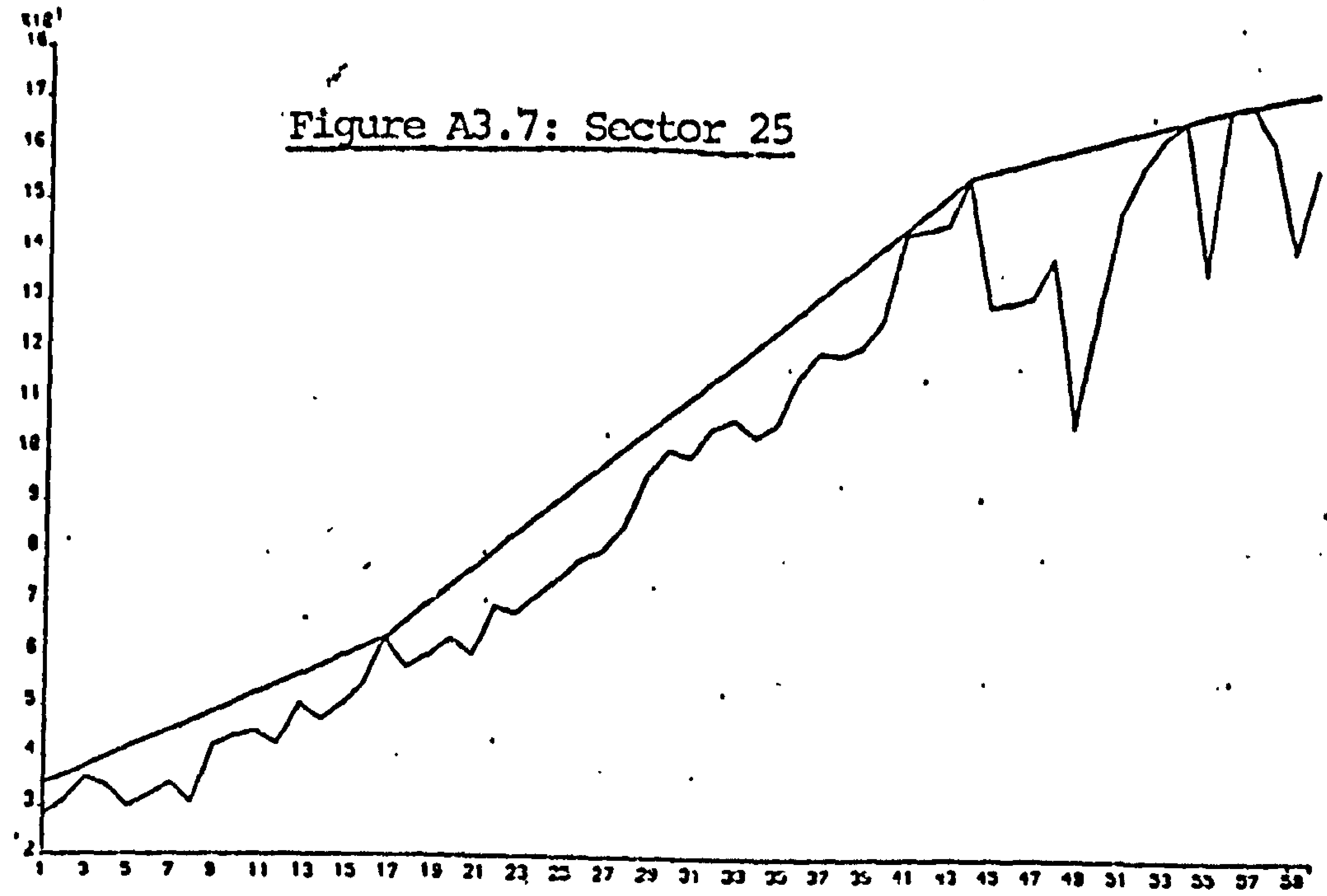


Figure A3.7: Sector 25

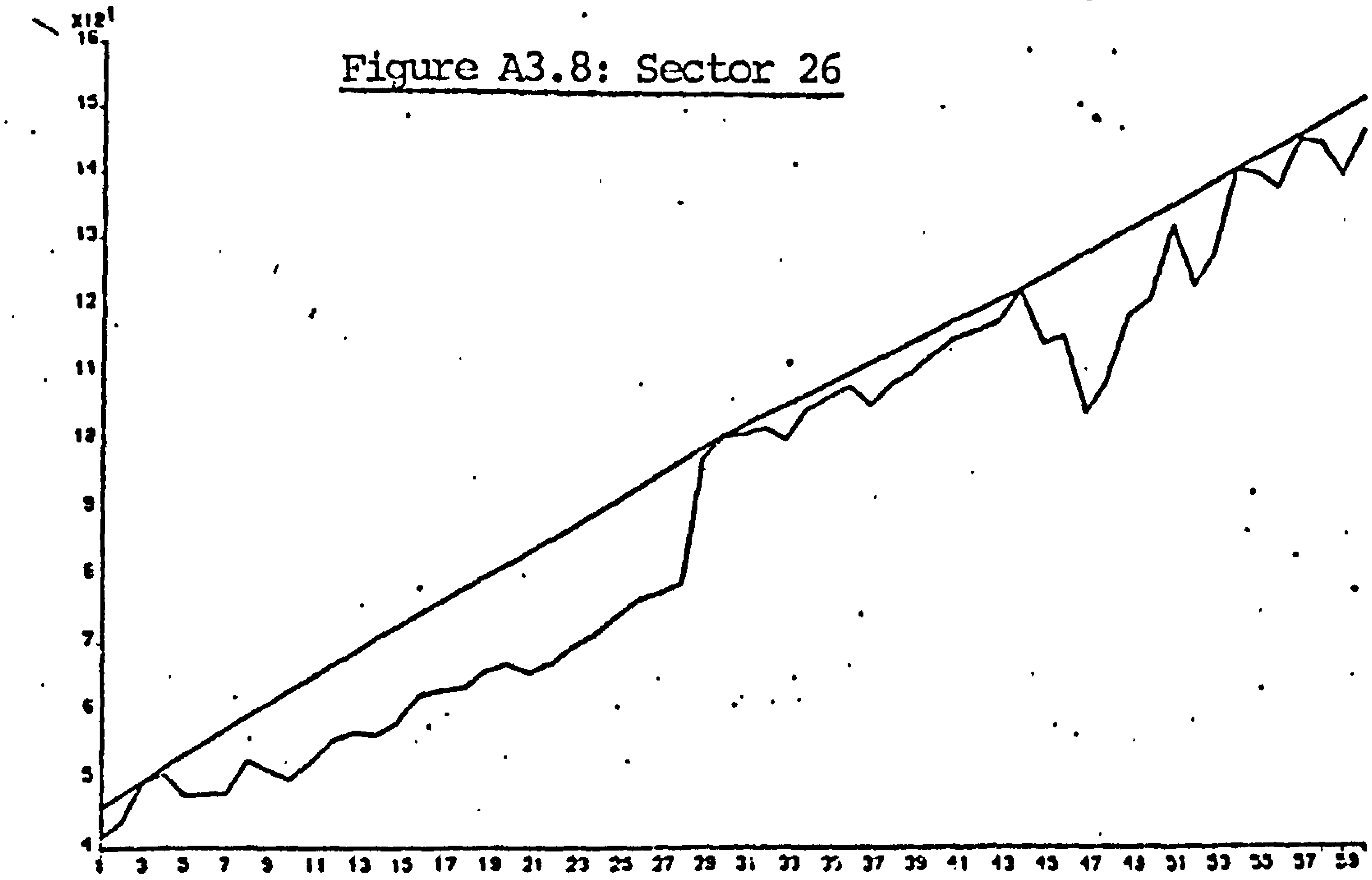


Figure A3.8: Sector 26

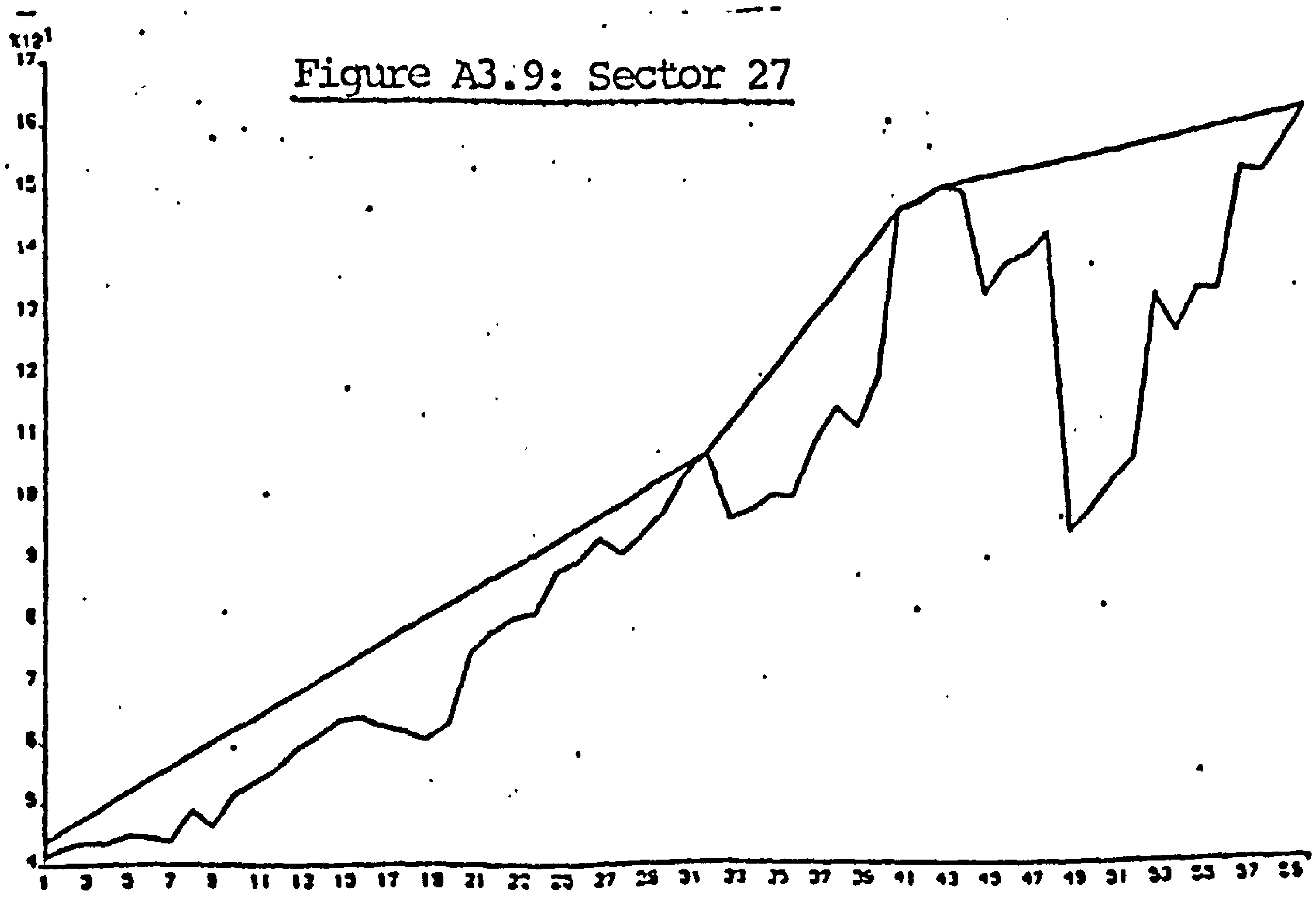


Figure A3.9: Sector 27

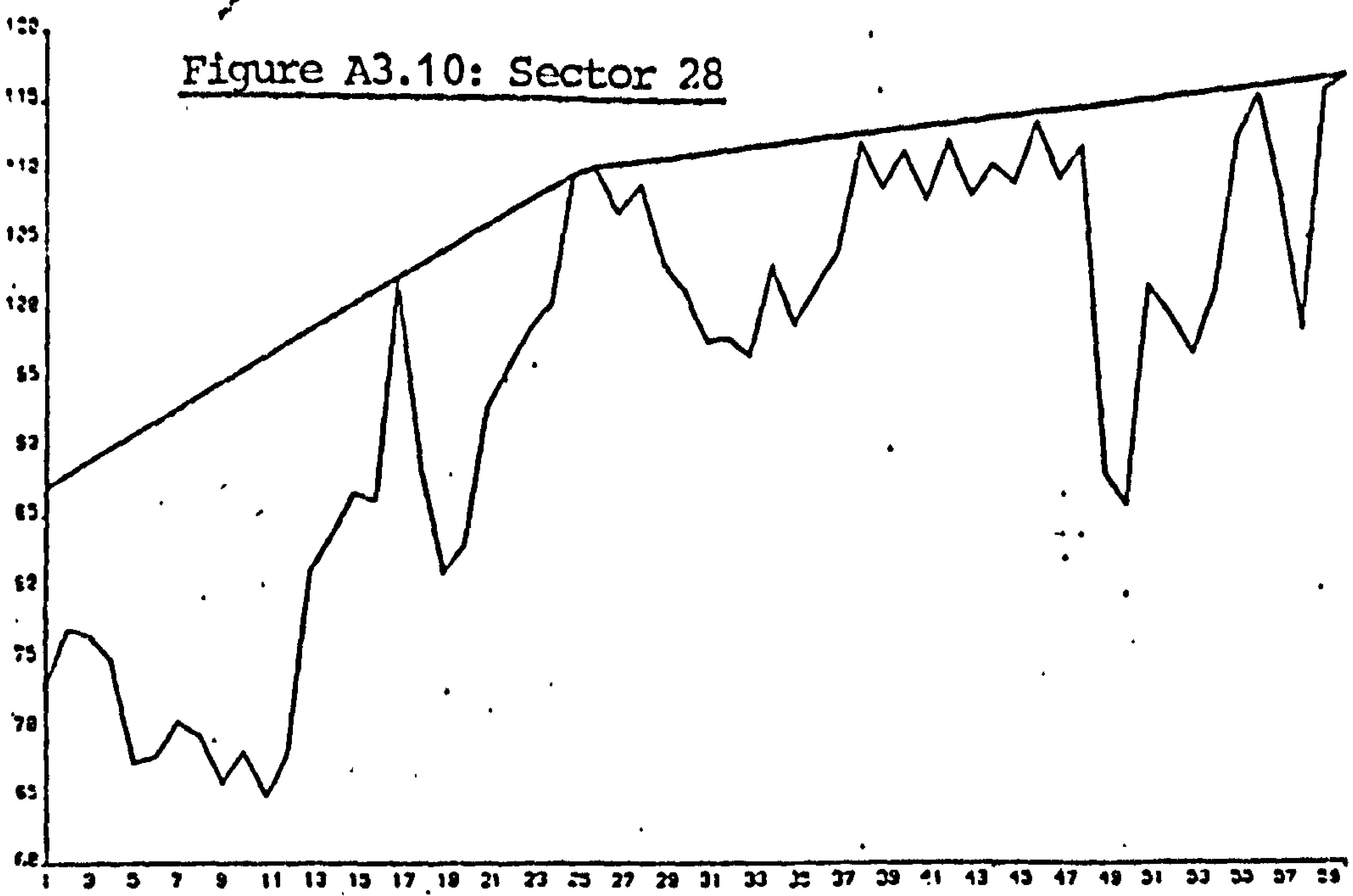


Figure A3.10: Sector 28

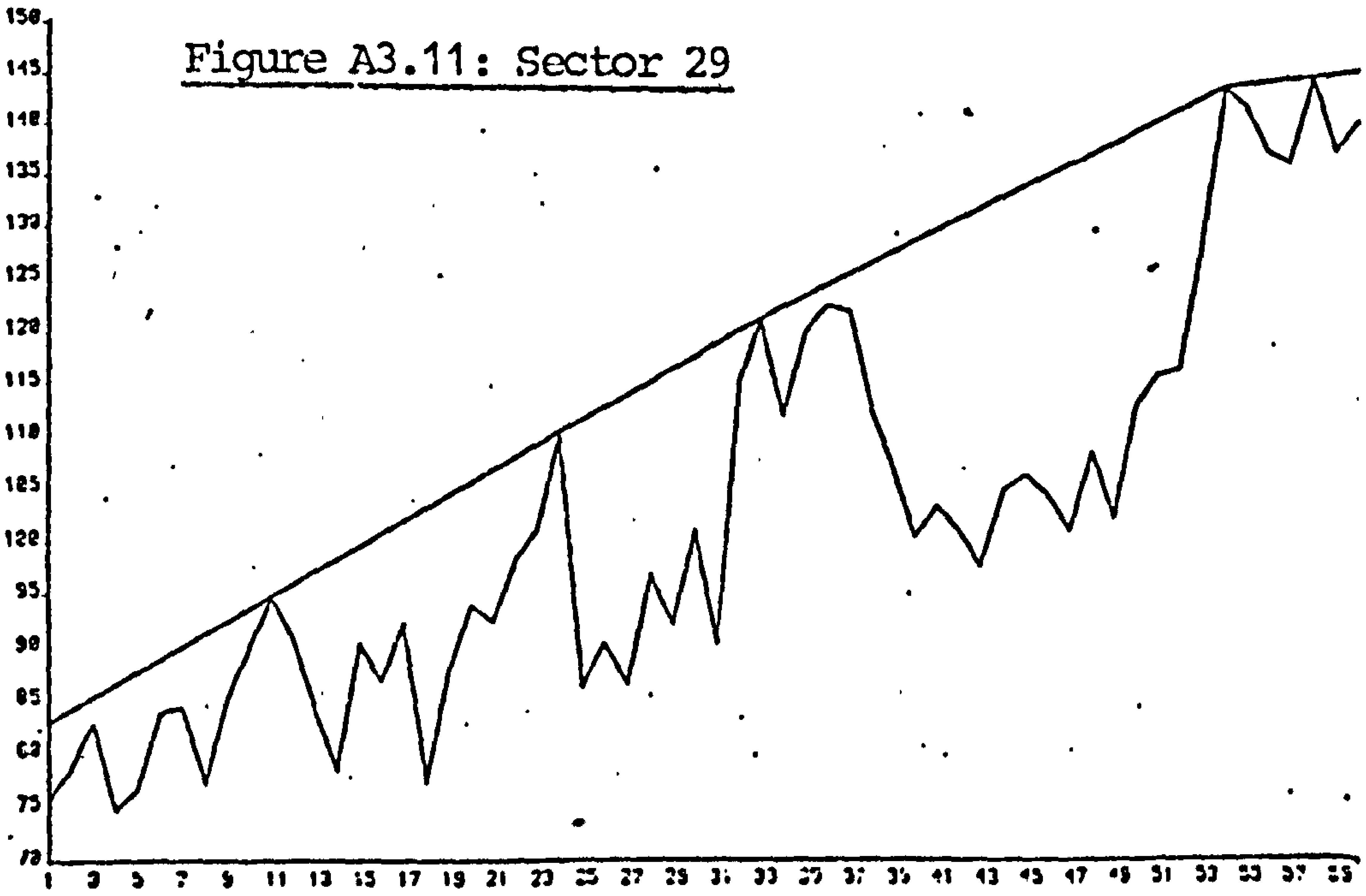


Figure A3.11: Sector 29

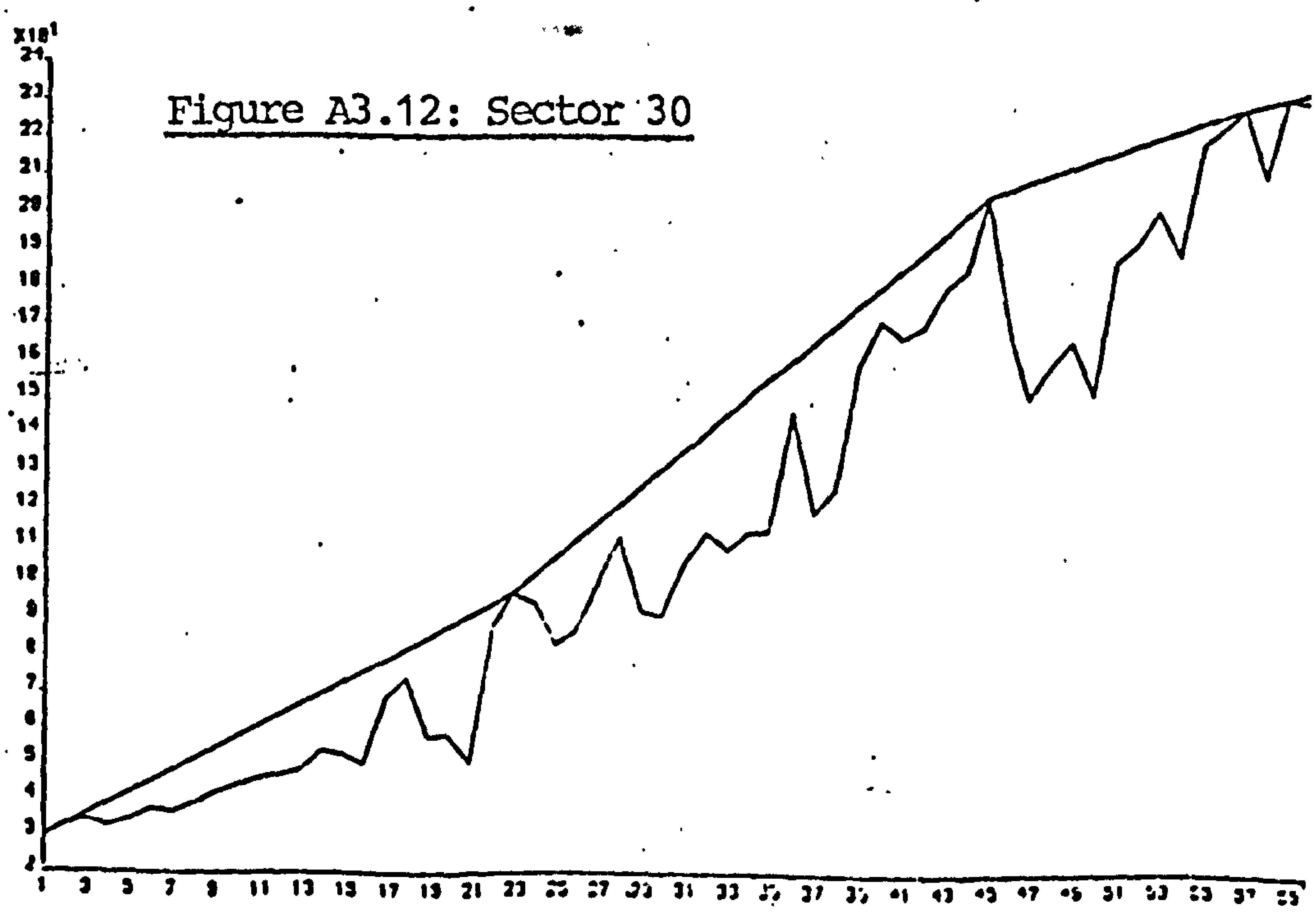


Figure A3.12: Sector 30

Figure A3.13: Sector 31

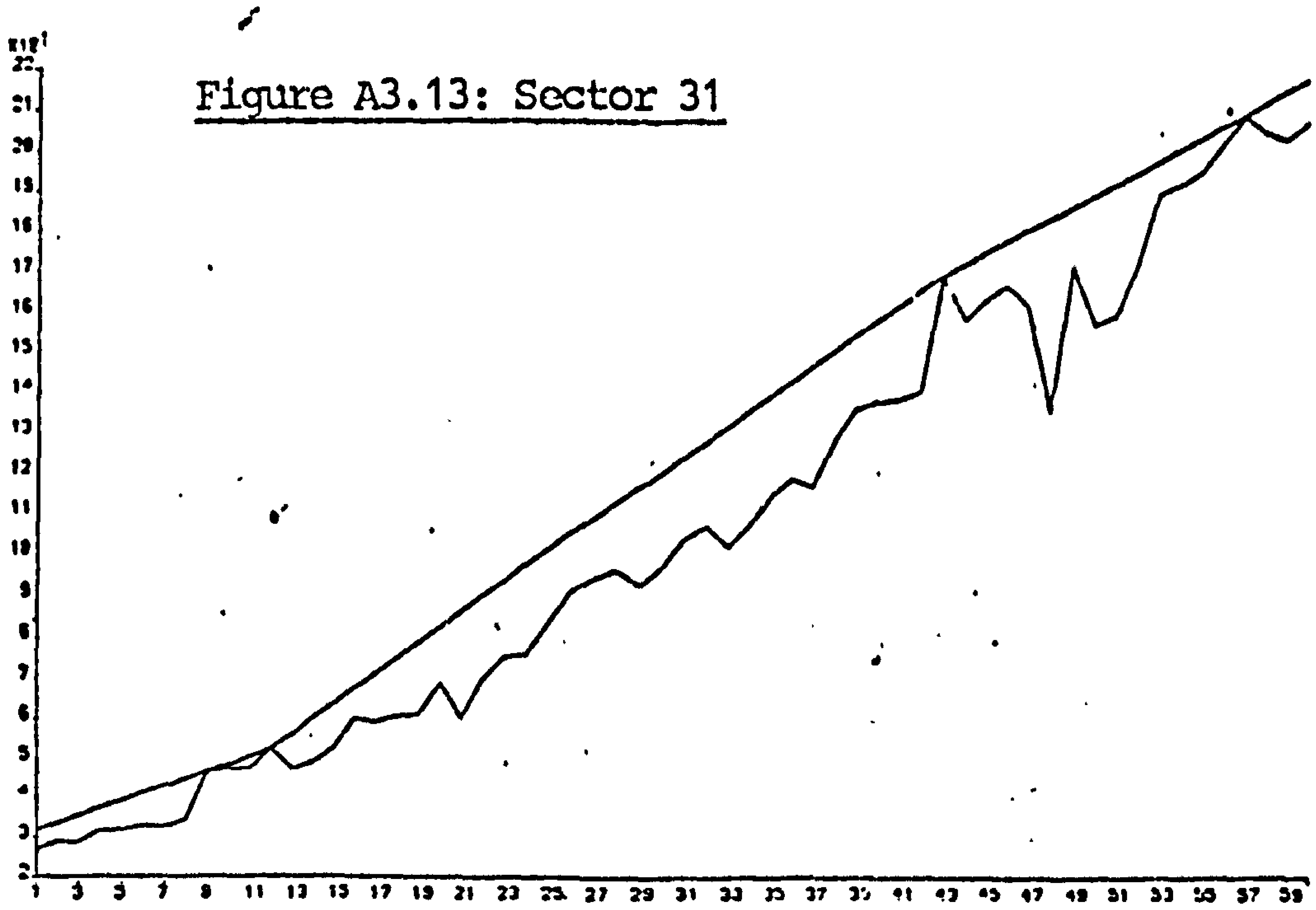


Figure A3.14: Sector 32

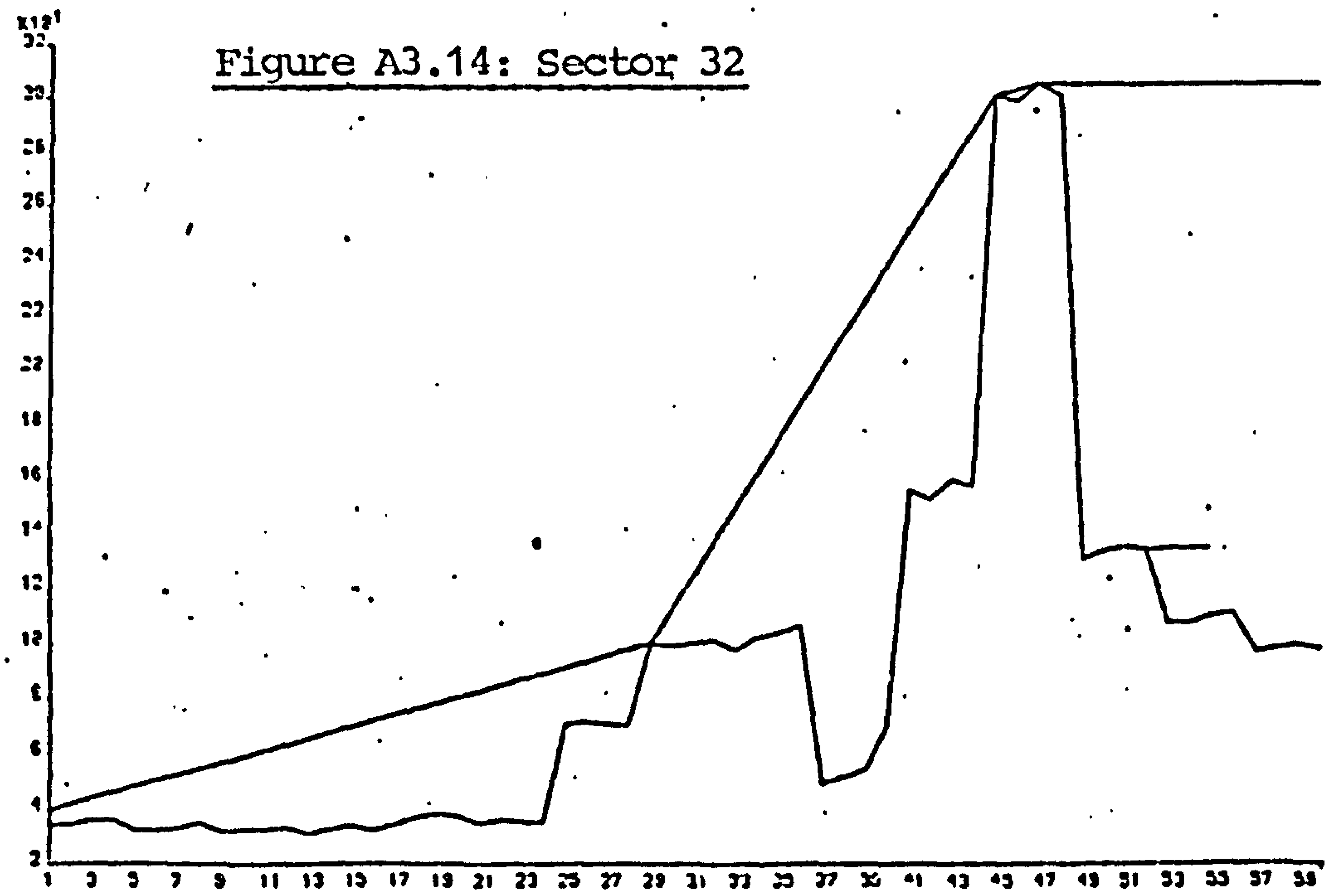


Figure A3.15: Sector 33

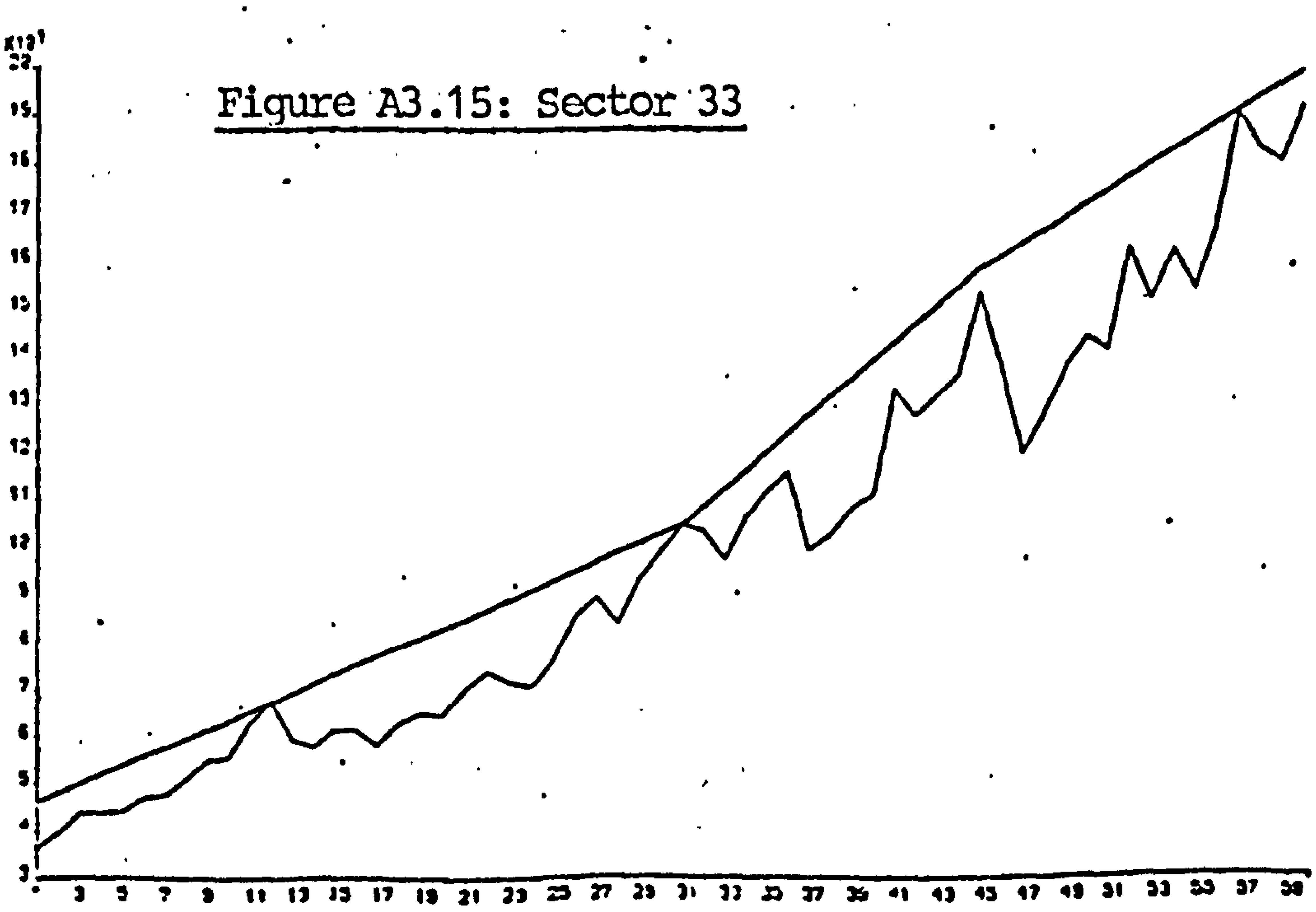


Figure A3.16: Sector 34

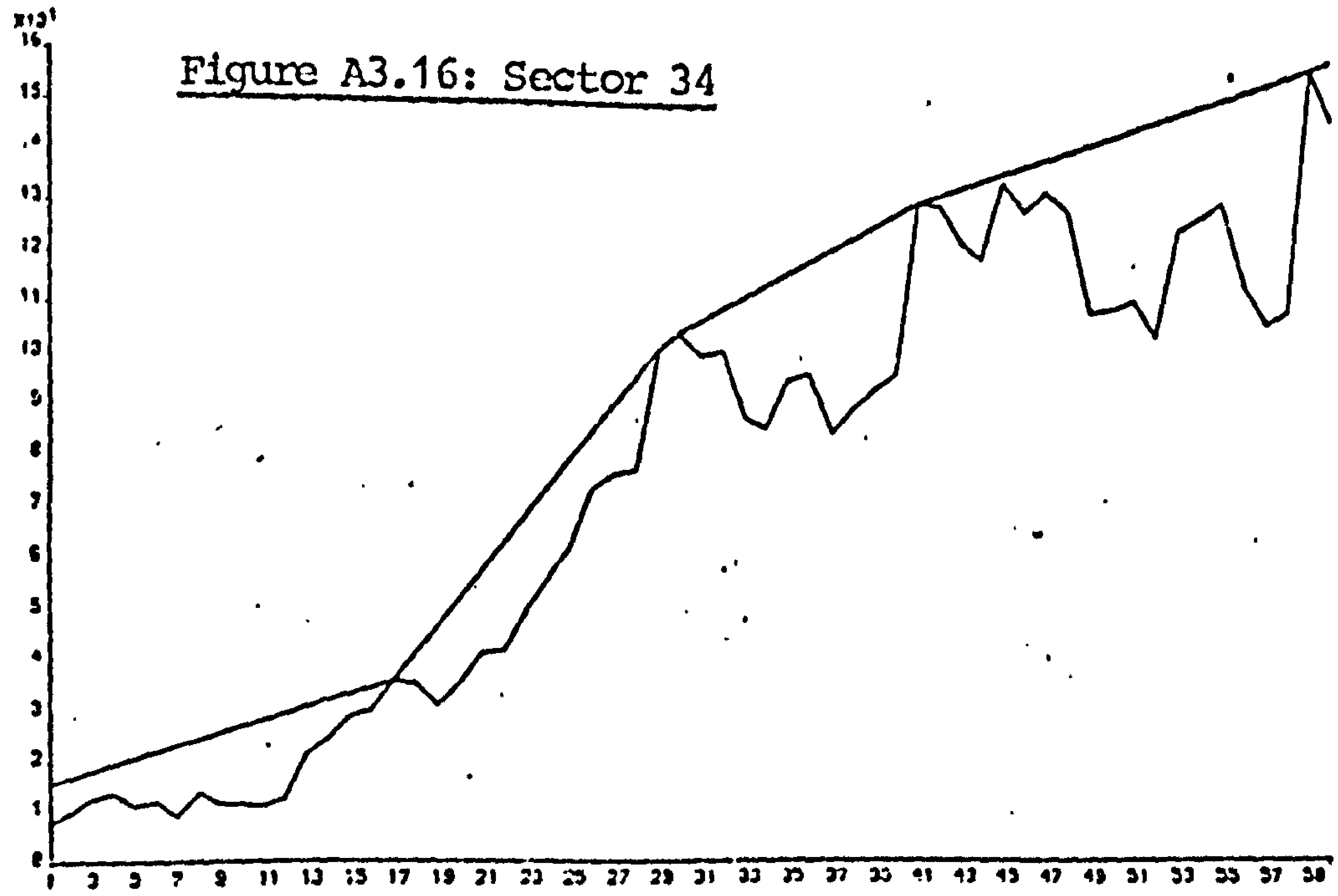


Figure A3.17: Sector 35

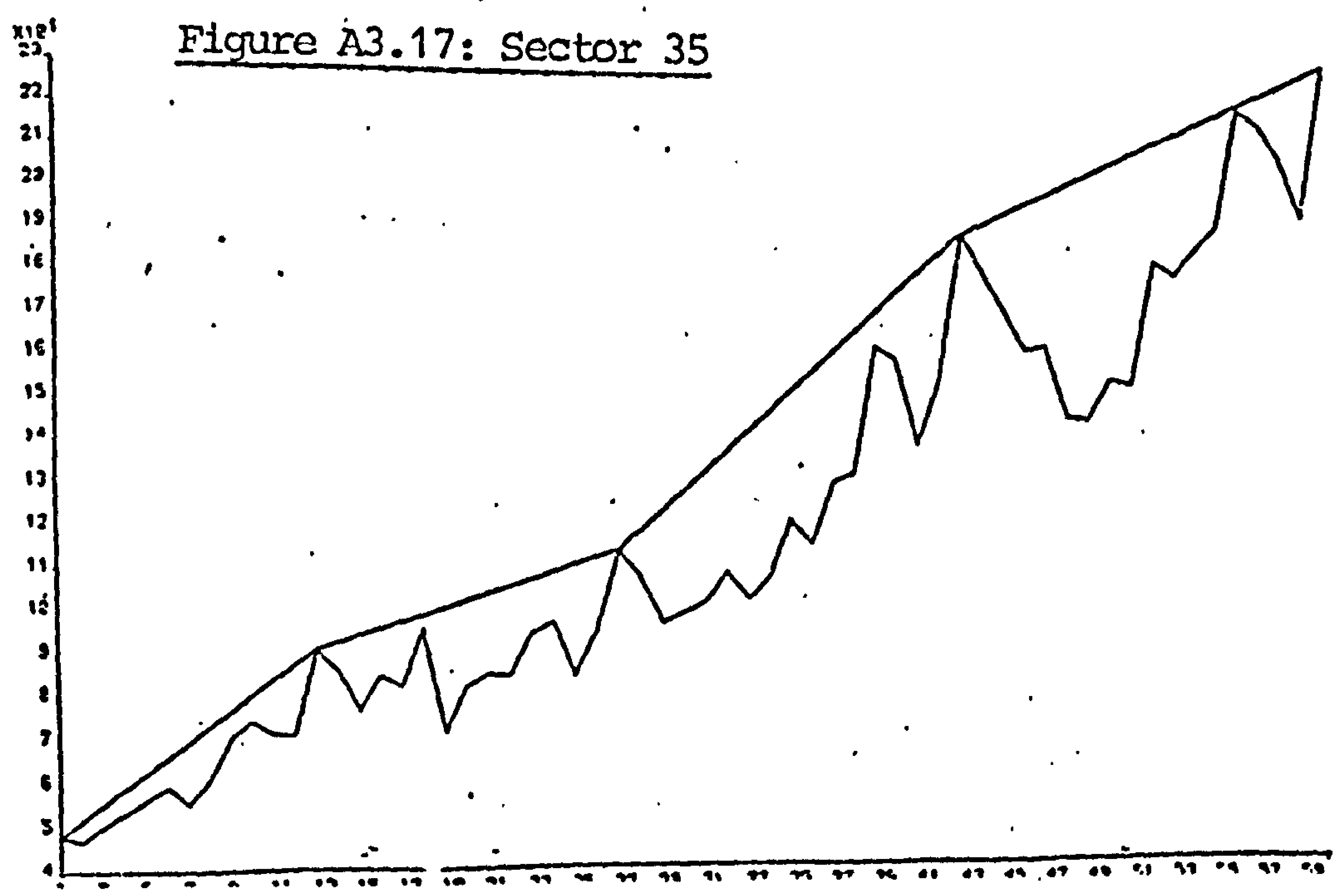


Figure A3.18: Sector 36

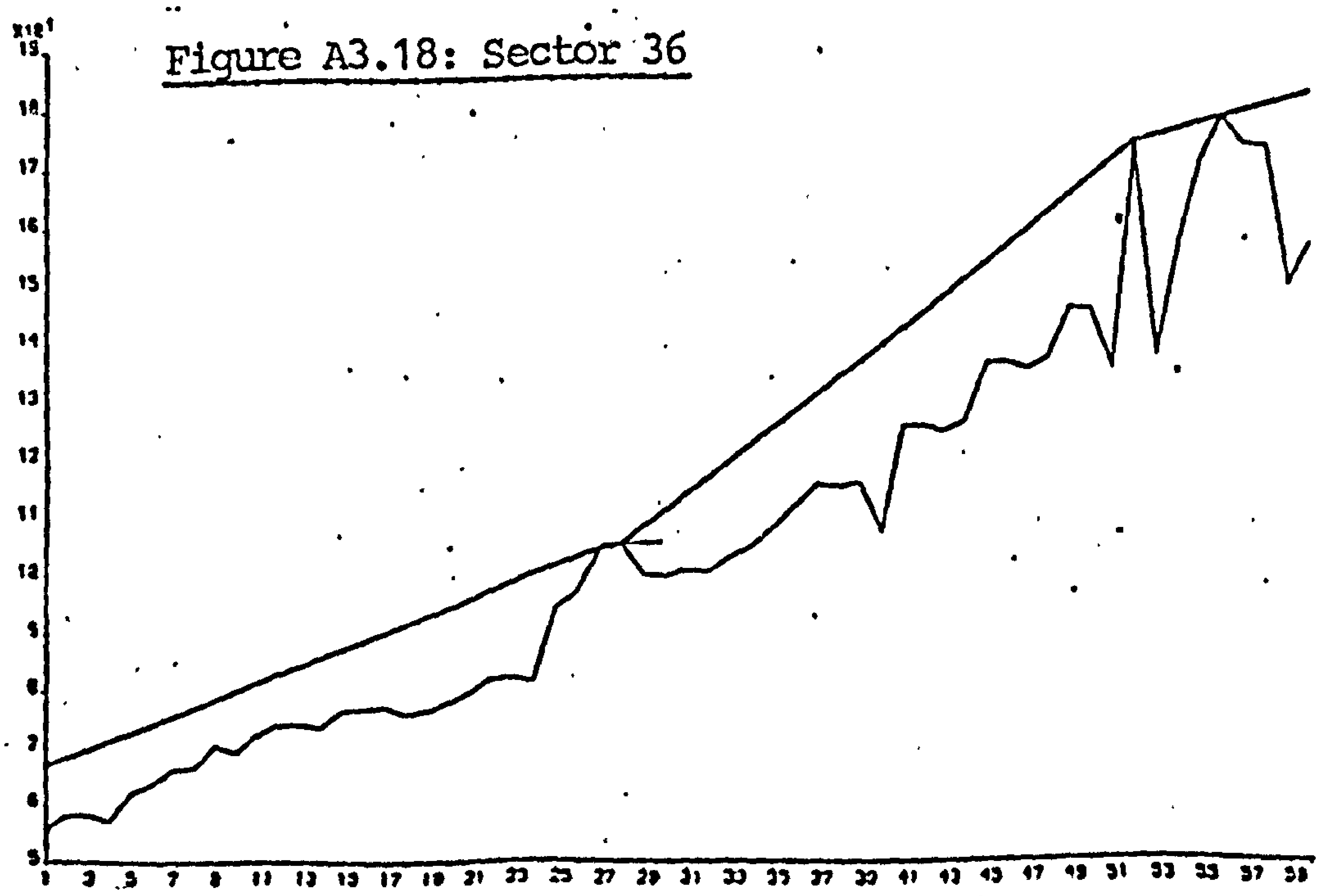


Figure A3.19: Sector 37

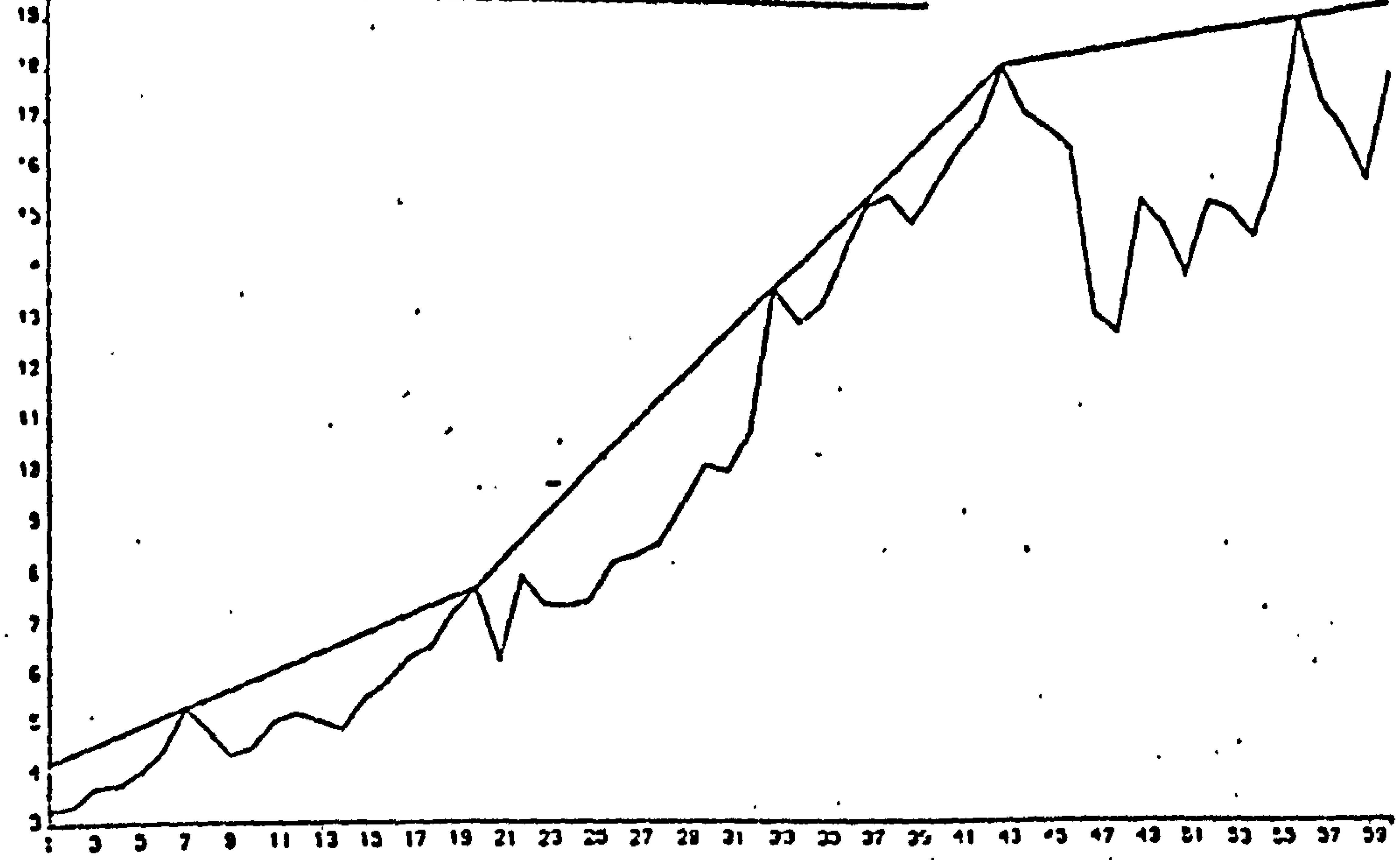


Figure A3.20: Sector 38

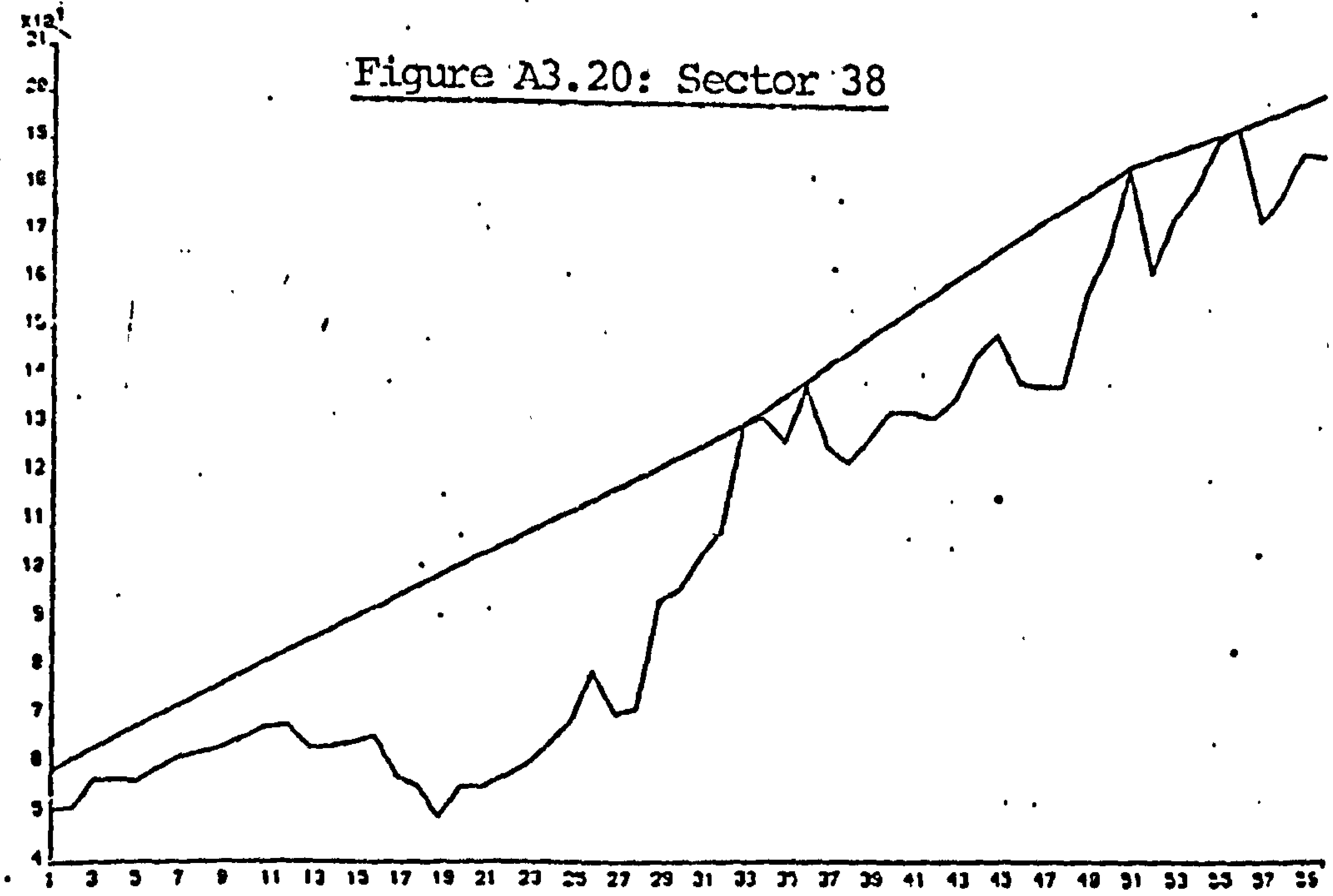
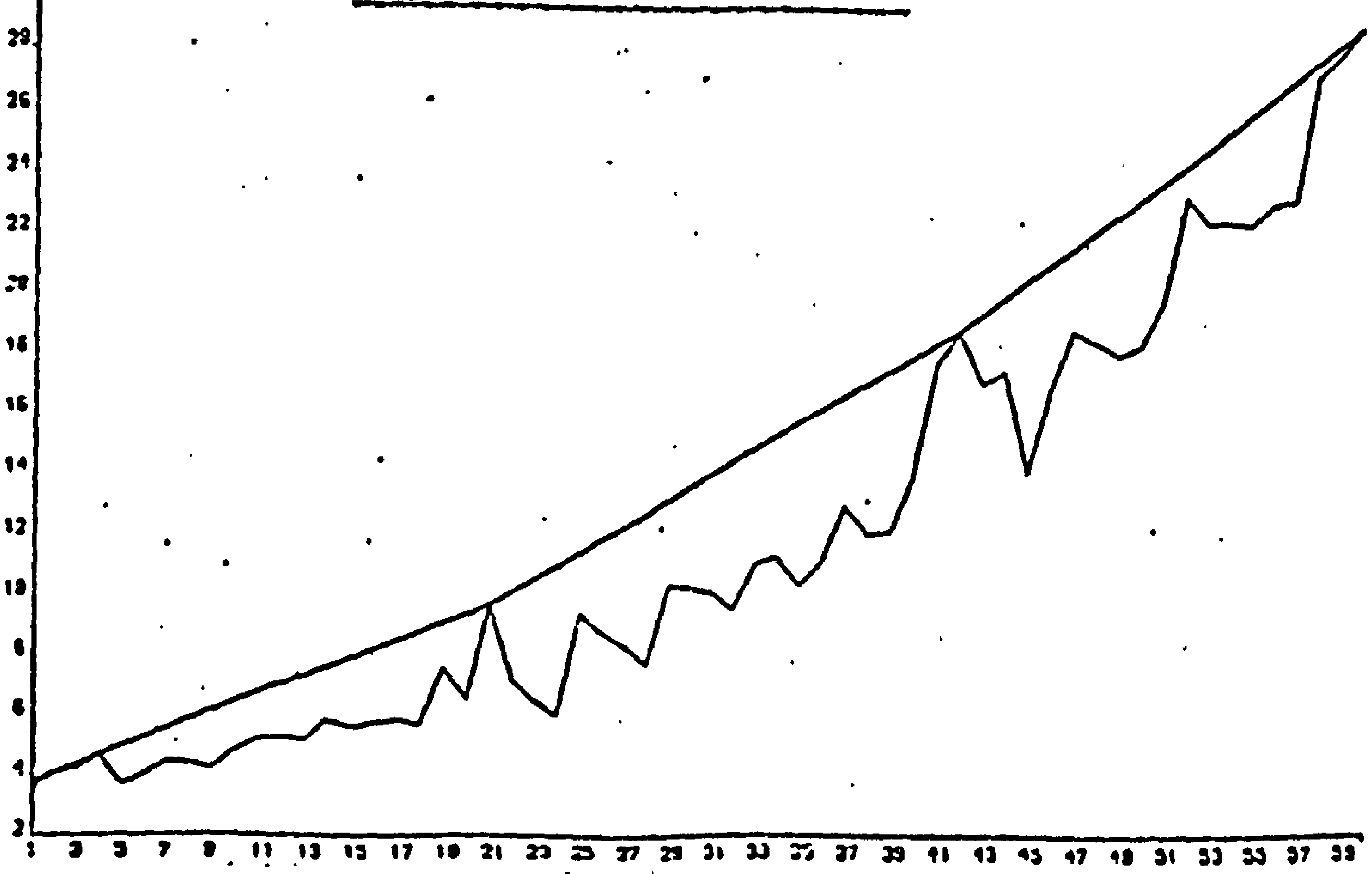


Figure A3.21: Sector 39



actual output exceeds the level of the immediately preceeding quarter and also the level of the two succeeding quarters. This is the general rule for determining the peak quarters, however, because of its generality it cannot cover all possible cases and so further rules have to be set. These rules are

(2) In the case where output stays constant, then capacity output is chosen on the basis of

(A3.71) $Q_t > Q_{t-1}$

(A3.73) $Q_t = Q_{t+i}$

(A3.74) $Q_{t+S} > Q_{t+S+i}$

where $i = 1....S$

i.e. where output remains constant then the first of the capacity output's S is chosen.

(3) Another possibility might be the case where output declines from a peak in one quarter and then returns to that level. Then on the assumption that capacity is rising over time, the first output peak Q_t is selected as the appropriate single capacity peak. Formally

(A3.71) $Q_t > Q_{t-1}$

(A3.75) $Q_t \geq \max(Q_{t+1}, Q_{t+2}) > Q_{t+3}$

(4) A rule is required to cover the possibility where actual output exceeds the line fitted by interpolation between two successive peaks. Such a situation will result to $Q_t > Q_t^c$ which will give a value W_t greater than unity. In this case a new slope is derived by fitting a linear trend from the last cyclical peak to the present value of the output index Q_t, which thus becomes an effective peak.

(5) Finally a rule is required for interpolating between peaks. Let Q_t^c and Q_{t-j}^c be peaks ($j \geqq 3$) and the slope of the line segment connecting them

$$\frac{Q_t^c - Q_{t-j}^c}{j}$$

Then let output Q_{t-k} ($K<j$) be the output of some "inter-peak" period. The Wharton method computes capacity output as

$$(A3.76) \quad Q_{t-k}^c = Q_{t-j}^c + \frac{(Q_t^c - Q_{t-j}^c)}{j}(j-k)$$

From which an index of capacity utilization in (t-k) is given as

$$(A3.77) \quad W_{t-k} = \frac{Q_{t-k}}{Q_{t-k}^c} = \frac{Q_{t-k}}{Q_t^c - \frac{k}{j}(Q_t^c - Q_{t-j}^c)}$$

The basic assumption of the Wharton method is that it assumes that capacity grows at a constant absolute amount for several periods, (interpeak periods) and then switches to growth by a different constant amount for another set of periods and so on. Compared to the time trend method it provides a better representation since the assumption of constant growth is not applied for the whole period. Compared however to other methods generating capacity output, the main disadvantage is that the Wharton procedure regards capacity output as a single function of time and does not relate output to inputs. First it is unreasonable to assume that each peak selected represents the same intensity in resource utilization. If for example the economy fails to surpass what is perceived as a major peak not because it has reached its productive potential but because of a decline in demand, then utilization rates at the neighborhood of the peak will be biased upward. Second it is also unreasonable to assume that potential output grows at a constant rate between peaks. Thirdly it is the problem of extrapolating capacity output. Since extrapolation is based on the same procedure with which output peaks are determined, then it is amenable to constant revision since the last capacity output (last peak) may not be so, depending on the new observation. If projected capacity growth is greater than actual capacity growth, the computed capacity utilization rate is biased downwards. Capacity utilization data for recent periods by using the Wharton method,should be treated with caution particularly when there are reasons to suspect that the economy has undergone a structural shift.

Nonetheless despite its obvious disadvantages the Wharton method provides for a quick and easily computable method for generating capacity utilization series.

Appendix A5

A5.1 Introduction

In this appendix we will describe the methodology by which a precise pattern of lags can be derived between unit labour and unit materials costs and prices. The analysis is based on the works by J. Carlson (1973), K. Coutts, W. Godley and W. Nordhaus (1978) (henceforth CGN) particularly chapter 3 and W. Godley and W. Nordhaus (1972). Section A5.2 discusses the derivation of the production period (θ) and provides empirical estimates of θ for the two-digit SIC sectors of Greek manufacturing. In section A5.3 the pricing policy and the pattern of lags of both unit labour and unit material costs is discussed and derived. Moreover empirical estimates of these lags are given for both ULCN and UMCN. Finally section A5.4 is concerned with the derivation of the unit labour and unit material costs that are based on the application of the lag patterns derived in the previous section.

A5.2 The production period

A crucial question facing the firm when entering the productive process is to establish a procedure by which to attribute value to the goods produced. In principle the valuation of the product is actually a problem of attributing value at the various costs incurred by the firm in the productive process. Since at any point in time the firm will employ a number of productive factors that will be stocked at least temporarily, the problem of attributing value to the product is actually similar to the problem of stock valuation. Accounting principles in valuating stocks range between two extremes: First in First out principle (FIFO) by which the firm does not adjust its final price in a period of rising prices until stocks of inputs bought at lower prices are exhausted, i.e. the valuation is based on historic costs, and Last in First out (LIFO) by which the firm adjusts its price instantaneously to a change in cost, i.e. the valuation is based on replacement costs. An intermediate accounting practice between historic and replacement pricing is the <u>average cost pricing</u> by which purchases of materials and labour are valued at average cost. It will be proved that there is a precise time lag relationship between cost and price changes irrespective of the accounting valuation practice used by the firm (it is obvious that since under replacement cost prices move simultaneously with costs this time lag is actually zero). A necessary precondition for the calculation of the time lag between cost and price changes is the derivation of the production lag.

The time elapsed from the point production on an item starts until that item emerges from the production process as a finished good is the physical production period. Here we will be concerned with the time period that elapses between the purchase of initial inputs and the final sale. (There is a slight difference between the two production lags, see CGN note 3, p.41). In what follows the production period will be derived both graphically (see CGN) and formally (see J. Carlson (1973)).

Consider two firms: <u>Firm A</u> that buys and sells commodities without any processing. The firm sells goods in the order in which it buys them, and the average length of time between a purchase and a sale - i.e. the production period - is denoted by Θ. If the firm practices historic cost pricing then a step rise of x% in costs will be transmitted into a rise in x% in prices after Θ periods (time periods throughout are assumed to be quarters). If the firm practices replacement cost pricing the rise of x% in costs will be transmitted into automatically. Consider now <u>Firm B</u> that does not buy materials, since its production consists solely of its own value added. On the assumption that value added is spread out evenly throughout the production period, then under historic cost pricing a step rise of x% in labour cost will be transmitted into a

$\frac{x}{\theta}$% rise in prices after the first and each subsequent quarter until one whole production period has elapsed. Under replacement cost pricing a x% rise in labour costs will be transmitted into a x% in prices automatically.

Making the picture more realistic we consider now a third firm, Firm C, that combines the essential features of both firms. Moreover it is necessary to suppose that a part of materials enter the productive process at the beginning and the rest (fuel, spare parts and other consumable materials) enter throughout the productive process in the same way as value added. To the extent that materials enter throughout the productive process a step increase of x% in their cost will be transmitted into prices in the same way as firm B, i.e. prices will rise $\frac{x}{\theta}$% (times the proportion of materials that do not enter in the beginning of the production process) per quarter, until θ quarters have elapsed.

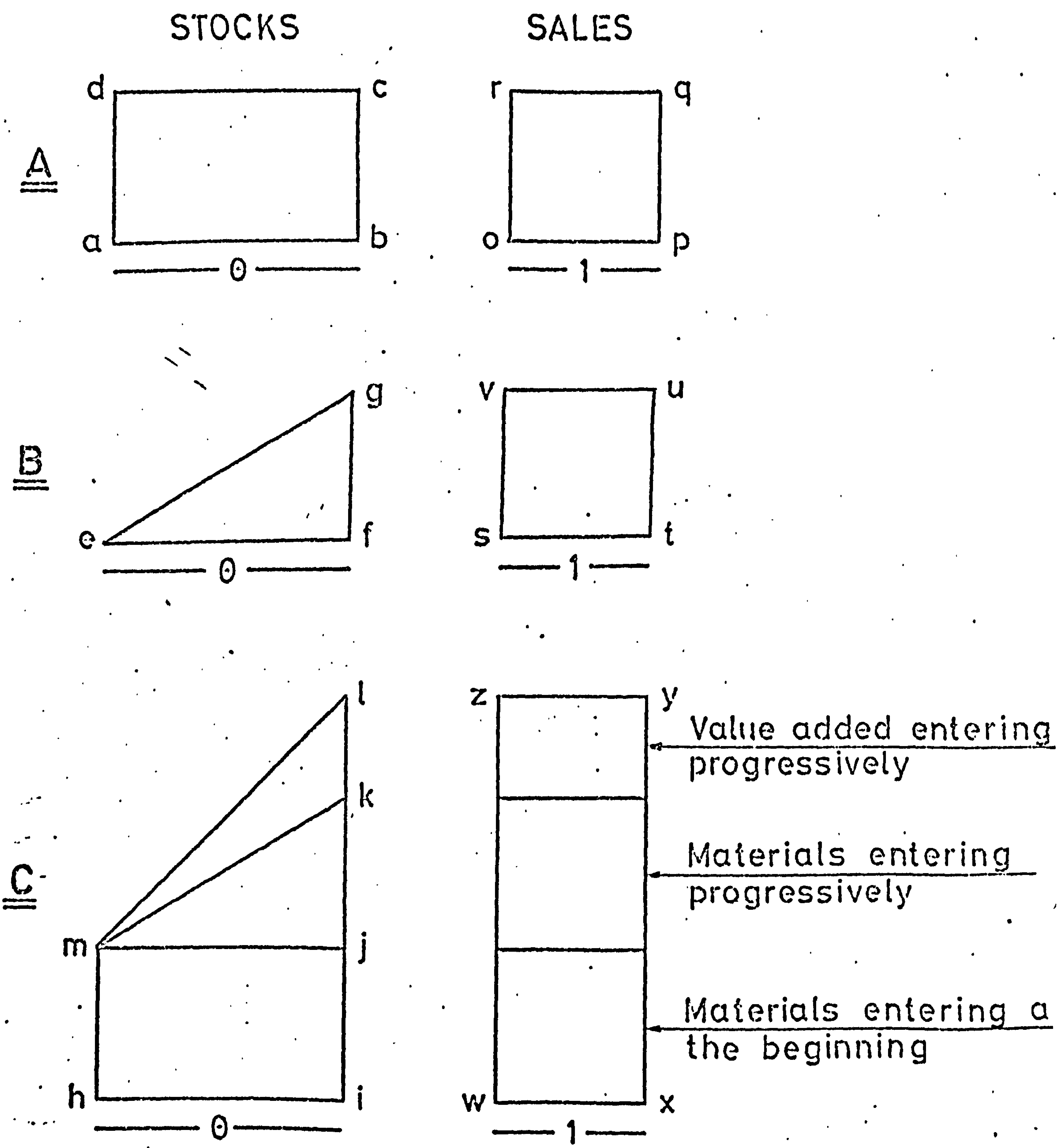
The value of θ, the production period can be estimated provided that we have data on stocks, sales and the cost composition of sales. Furthermore we need information on the proportion of materials that enter the productive process in the beginning and also we need to assume that all other inputs apart from materials that enter in the beginning (i.e. value added, fuel, spare parts, and other consumable materials) are added evenly throughout the productive process. Figure A5.1 provides a diagrammatic representation for the production process of the three typical firms discussed.

For firm A, total stocks, ab*cd, are the value of goods in process and are equal to the period of production, θ, times the quarterly volume of purchases of materials. Denoting sales by X = op*qτ, then the period of production θ is equal to the ratio of stocks over sales, i.e.

(A5.1) Firm A $$\theta = \frac{S}{X} = \frac{ab*cd}{op*q\tau}$$

For firm B, total stocks are the value of goods in

Figure A5.1


STOCKS
SALES
A
d
c
a
b
0
r
q
o
p
1
B
g
e
f
0
v
u
s
t
1
C
l
k
m
j
h
i
0
z
y
w
x
1
Value added entering progressively
Materials entering progressively
Materials entering a the beginning

process, equal to 1/2 the period of production in quarters times the quarterly volume of sales. If sales, X, is equal to st*uv and stocks, S, equals to $\frac{1}{2}$ ef*fg, then the period of production for firm B is equal to

(A5.2) <u>Firm B</u> $= \frac{2S}{X} = \frac{ef*fg}{st*uv}$

(The fact that the production period for firm B is twice as much as that of firm A, can be easily understood given that both firms A and B have the same quarterly value of sales and the same production period; then, since work in progress held by firm B will be <u>on average</u> only half completed, firm B's stocks will be worth half of those of firm A's).

Firm C has both initial entry materials and progressively added materials as well as value added which enter progressively throughout the production period. Total purchases per period are ik of which ij are bought at the beginning and jk are bought progressively while kℓ represents value added. For Firm C, the total value of stocks is equal to the value of the initial entry materials times the production period (hi*ij) plus half the product of the production period and the progressively added inputs (materials and value added) i.e. $\frac{1}{2}$ mj*jℓ = $\frac{1}{2}$ hi*jℓ

If we designate by-a-the share of materials in sales and by-b-the share of materials that enter initially out of total materials bill, then total stocks for firm C will be

(A5.3) $S = (hi*ij) + \frac{1}{2}(hi*j\ell)$

Since X = quarterly sales = wx*xy = wx*iℓ = iℓ, equation (A5.3) becomes

(A5.4) $S = (\theta*ij) + \frac{1}{2}\,\theta(i - ij) = (\theta*ij) + \frac{1}{2}\,\theta(X-ij)$

From which Θ is equal to

(A5.5) $\theta = \dfrac{S}{ij + \frac{1}{2}(X-ij)}$

Since $a = \frac{ik}{i\ell}$, $b = \frac{ij}{ik}$, $ab = \frac{ij}{i\ell} = \frac{ij}{X}$

equation (A5.5) becomes

(A5.6) <u>Firm C</u> $\theta = \frac{2S}{X(1+ab)}$

The value of θ in the three firms described so far depends on stocks and sales (for firms A and B) and also on the proportions a and b (for firm C). It is obvious that the types of firms depicted by A and B are rather unrealistic descriptions of a typical industrial firm, however they are presented in the analysis, since they constitute limiting cases of firm C. For example in (A5.6) if b=o, then all inputs enter progressively in the productive process which is the case of firm B. If b=1, then all material inputs enter at the beginning and only value added is added progressively (combination of firms A and B). Finally if a = b = 1 we have the case of firm A which only buys and sells without any productive process (merchant firm).

The previous descriptive analysis for the determination of θ can also be presented formally since it will help in understanding the limitations of the assumptions used. The model is continuous and is based on the work by J. Carlson (1973). A discrete counterpart can be found in C.C. Holt and F. Modigliani (1961). Let

$s(t,t-u)$ = work in progress at time t of items whose production began at time t-u

θ = production period

$x(t-u+\theta)$ = rate of production of finished goods at time t-u+θ, i.e. of items which emerge θ periods after work has started

$X(t)$ = sales at period t

$S(t)$ = stocks held at period t

$m(\tau)$ = rate of materials added per unit of output at time τ

$w(\tau)$ = rate of value added, added per unit of output at time τ

a = the share of materials in sales, assumed constant

b = the share of materials that enter in the beginning of the productive process in total materials

The gross value of production of finished goods equals by definition total materials and total value added used. Therefore for a unit of output we have

(A5.7) $$\int_0^\theta [m(\tau) + w(\tau)]\, d\tau = 1$$

The rate of work in progress at time t of items that began at time t-u equals the rate of finished production that will occur at time t-u+θ, multiplied by the proportion of output thatis completed after time u in production. That is

(A5.8) $$s(t,t-u) = x(t-u+\theta) \int_0^u [m(\tau)+w(\tau)]d\tau$$

In order to obtain an expression of the total value of stocks held at period t, we have to integrate over all levels of work in process

(A5.9) $$S(t) = \int_0^\theta s(t,t-u)\,du = \int_0^\theta x(t-u+\theta) \int_0^u [m(\tau)+w(\tau)]\, d\tau du$$

Work in process is seen to depend on output, the rate at which materials and value added are inserted into the productive process and the production period θ. In order to derive a specific expression about θ from equation (A5.9) further assumptions are required on the cost structure of the production process and on the rate at which the value of work in progress increases during different stages of the production process.

Assume first, that the rate of sales per period is constant

(A5.10) $$X(t) = \int_{t-1}^{t} x(v)\,dv = X$$

If we also assume that $m(\tau)$ and $w(\tau)$ are constants, then from (A5.7),

(A5.11) $$m + w = \frac{1}{\theta}$$

Substituting (A5.11) into (A5.9) and assuming that sales are constant we have

$$\text{(A5.12)} \quad S(t) = \int_0^{\theta} X \int_0^{u} \frac{1}{\theta} d\tau du = \frac{X}{\theta} \int_0^{\theta} \int_0^{u} d\tau du = \frac{X}{\theta} \int_0^{\theta} \frac{1}{2} du^2 = \frac{X\theta}{2}$$

from which by dropping the t-notation we have

$$\text{(A5.13)} \quad \theta = \frac{2S}{X}$$

Equation (A5.12) has not taken into account the division of inputs into initial entry and progressively added and furthermore that in the share of materials in production - a - there is a proportion - b - of materials that enter in the beginning. Incorporating this information together with the assumptions that progressively added inputs have value added at a uniform rate and that initial entry inputs have no value added during the production process, but have an initial value which is proportional to the rate of finished output, we can write equation (A5.13) as

$$\text{(A5.14)} \quad S(t) = \int_0^{\theta} X \left[ab + \int_0^{u} ((1-b)a \frac{1}{\theta} + (1-a) \frac{1}{\theta}) d\tau \right] du$$

which upon integrating and dropping the t-notation becomes .

$$= X \left[ab\theta + (1-ab) \frac{\theta}{2} \right]$$

The equation for the production period [(A5.6) or its equivalent (A5.14)] was based on the assumption that within the period $t-u+\theta$ production is constant at a rate x. However, (see J. Carlson (1973)) if we assume that production increases at a linear rate λ, then θ will be underestimated if it is less than 1.5, the reverse holding for linearly decreasing production. That is if

$x(t-u+\theta)$ is substituted by $x(t)\left[1+\lambda(\theta-u)\right]$, then from (A5.10) we have

$$\text{(A5.15)} \quad X_{(t)} = \int_{t-1}^{t} x(v)dv = \int_{t-1}^{t} X(t) \left[1+\lambda(\theta-u)\right] d(x-u) = X(t)(1+\frac{\lambda}{2})$$

and also from equation (A5.9) with assumption (A5.11), we have

(A5.16) $$S(t)=X(t)\int_0^{\Theta}[1+\lambda(\Theta-u)]\frac{u}{\Theta}du = \frac{X(t)}{\Theta}[\frac{1}{2}\Theta^2+\frac{1}{2}\lambda\Theta^3-\frac{1}{3}\lambda\Theta^3] = $$
$$= \frac{1}{6}X(t)(3\Theta+\lambda\Theta^2)$$

Consequently

(A5.17) $$\frac{2\,S(t)}{X(t)} = \frac{\Theta(3+\lambda\Theta)}{3+3\lambda/2}$$

which for positive λ is greater than Θ, if $\Theta > 3/2$

Despite this limitation equation (A5.6) does give a good indication of the order of magnitude of the production period in various industries, based on data for stocks, sales and materials bill. These data are available for the Greek manufacturing two digit SIC sectors from the Annual Industrial Surveys (AIS) and can be approximated as follows:

Stocks. AIS provide data on gross production value (GPV) and sales (SAL) per year and sector. Data on stocks can be approximated by using the identity

$$\Delta S_{it} \equiv GPV_{it} - SAL_{it}$$, where i=1...21, two-digit SIC sectors

In order to arrive at a figure for stocks we need the amount of stocks per sector in the beginning of the period. The issue "Results of 1960, Annual Industrial Survey", published by NSSG, provide data for stocks for total large scale manufacturing. The data for stocks for year 1960 considered as the beginning of the period for the two-digit SIC sectors were generated by assuming that the percentage of the change in stocks for each sector that existed in 1964 was the same as the percentage of each sector, during 1960; i.e.

$$\left[\frac{\sum_{i=1}^{20} STOCKS_i}{\Sigma STOCKS_{TOTAL}}\right]^{1960} = 100 = \left[\frac{\sum_{i=1}^{20} \Delta STOCKS_i}{\Sigma\Delta STOCKS_{TOTAL}}\right]$$

Sales Annual Industrial surveys, various issues

Materials bill. Materials bill is needed for the calculation of a, the share of materials in sales. It is approximated by "total consumption bill" from AIS, which includes the following items: raw and auxiliary materials, packing materials, spare parts, consumable materials, expenditure on transport means, fuel for mechanical equipment, electric energy, and payment for contract work.

In order to estimate equation (A5.6) we also need an assumption about the value of b for which data are not available. W. Godley and W. Nordhaus (1972) assume that 2/3 of materials enter at the beginning of the productive process. There is no justification for this assumption, instead they provide values of θ for the limiting cases, where $b=o$ and $b=1$ and observe that θ does not change significantly. We have used the same assumption about b and also calculated all possible values of θ that correspond to a grid on b from 0 to 1. The results are presented in table A5.1. Furthermore and as a means of testing the plausibility of our assumption we followed the disaggregation of total consumption bill, by assuming that all categories apart from raw and auxiliary materials enter progressively and that there is an (unknown) part of raw and auxiliary materials that enters progressively as well. By calculating the ratio of raw and auxiliary materials to total consumption bill it is possible to check if there is a uniform (throughout the sectors) pattern of this ratio. As it can be seen from table A5.1, values of this ratio range between 83% to 94% with the exception of 4 sectors, where it is significantly smaller, indicating perhaps that the assumption of 0.66666 for b is rather overstated (SIC: 28,31,33,34). Table A5.1 presents the results for θ for the year 1970. Column 2 gives the values of θ, column 3 the range of on the grid of values on b and column 4, the share of raw and auxiliary materials in total consumption.

Table A5.1 Production period (Θ) in quarters; two digit SIC sectors Greek manufacturing

Sector	Production Period b = 0.66666	Production Period, limiting cases b = o	b = 1	Raw+auxiliary materials / Total materials
TOT	2.11041	2.57846	1.84984	0.8411305
20	1.35519	1.70928	1.16751	0.8824263
21	1.98966	2.43755	1.74136	0.8373456
22	1.80909	2.32113	1.54467	0.9218892
23	2.12277	2.90946	1.75461	0.8494088
24	1.36907	1.67180	1.20039	0.9019354
25	1.86933	2.26227	1.64730	0.9183343
26	2.73099	3.24305	2.43290	0.9026262
27	1.90678	2.37184	1.65497	0.8460479
28	0.96584	1.11833	0.87342	0.7817662
29	2.47621	3.26274	1.91629	0.9293613
30	1.86595	2.22047	1.66025	0.8606470
31	1.49456	1.79330	1.32348	0.7160262
32	0.45389	0.57494	0.39015	0.9336793
33	2.68143	3.05922	2.44693	0.5452393
34	2.83801	3.40510	2.51322	0.6808813
35	3.00754	3.68838	2.63070	0.9094540
36	2.87782	3.03421	2.76713	0.8901113
37	2.51282	3.09399	2.19315	0.9415544
38	4.18372	4.88831	3.76284	0.8893979
39	4.23747	4.99317	3.79210	0.8608020

A5.3 Pricing policy and the pattern of lags

The production period derived in the previous section helps to determine the upper bound to the plausible length of time that takes place between a cost increase and the completion of the corresponding price increase. In this section we will determine the distribution of this lag over the production period.

In order to facilitate the analysis, in section A5.2 we assumed the existence of three types of firms: A,B and C, and three accounting practices; historic cost, replacement cost, and average cost pricing. Clearly the firm that comes closer to reality in the modern industrial world is firm C, that combines elements of firms A and B. Furthermore, average cost pricing is the accounting practice that we believe is used by most industrial firms. Again to aid exposition we will examine the pricing practice of all firms under all accounting principles. Denoting by

P_t = prices
WC_t = wage costs
MC_t = material costs
μ = markup,

we have the following relationships between costs and prices

Historic Cost Pricing (FIFO)

(A5.18) **Firm A:** $P_t=(1+\mu)MC_{t-\theta}$

(A5.19) **Firm B:** $P_t=(1+\mu)\sum_{i=o}^{\theta}(\frac{1}{\theta})WC_{t-i}$

(A5.20) **Firm C:** $P_t=(1+\mu)\left[b\,MC_{t-\theta}+\sum_{i=o}^{\theta}(\frac{1}{\theta})WC_{t-i}+(1-b)\sum_{i=o}^{\theta}(\frac{1}{\theta})MC_{t-i}\right]$

Replacement Cost Pricing (LIFO)

(A5.21) **Firm A:** $P_t=(1+\mu)MC_t$

(A5.22) **Firm B:** $P_t=(1+\mu)WC_t$

(A5.23) Firm C: $P_t = (1+\mu) \left[MC_t + WC_t\right]$

Under average cost pricing the rate at which cost increases are transmitted into price increases depends upon the rate at which the total unit value of stocks increases. Firm A will increase this value by an amount $(1/\theta)$ for every quarter until θ quarters have elapsed. For firm B the situation is rather more complex. The response will depend on the proportion of stocks that is valued with an increased rate (following a step rise in costs, during quarter t) and for each quarter until θ quarters have elapsed. If we denote this proportion by $K(t)$ then the value of stocks which is made up by increased costs in quarter t is

$$(\text{A5.24}) \quad K(t) = \frac{\sum_{t=o}^{\theta} t - \sum_{t=o}^{\theta-t} t}{\sum_{t=o}^{\theta} t} = 1 - \frac{(\theta-t)(\theta-t+1)}{\theta(\theta+1)}$$

where $o \leq K(t) \leq 1$
and $t = o \ldots \theta$ for $o \leq t \leq \theta$

Hence the proportion of a price increase that occurs in quarter t is

$$(\text{A5.25}) \quad K(t) - K(t-1) = \frac{2(\theta-t+1)}{\theta(\theta+1)}$$

The relationships therefore between costs and prices under average cost pricing are

Average Cost pricing

(A5.26) Firm A: $P_t = (1+\mu) \sum_{i=1}^{\theta} \frac{1}{\theta} MC_{t-i}$

(A5.27) Firm B: $P_t = (1+\mu) \sum_{i=o}^{\theta} \frac{2(\theta-i+1)}{\theta(\theta+i)} WC_{t-i}$

(A5.28) Firm C: $P_t = (1+\mu) \left[b \sum_{i=1}^{\theta} \frac{1}{\theta} MC_{t-i} + (1-b) \sum_{i=o}^{\theta} \frac{2(\theta-i+1)}{\theta(\theta+i)} MC_{t-i} + \sum_{i=o}^{\theta} \frac{2(\theta-i+1)}{\theta(\theta+i)} WC_{t-i} \right]$

Equation (A5.28) is the formula used for the calculation of the lags between costs and prices. Since we have two kinds of inputs: initially added (part of materials) and progressively added (rest of materials and labour costs) it is interesting to see the price response to a change in costs for the two types of inputs (Equations (A5.26) and (A5.27)). Figure A5.2 presents a typical pattern of the lag between a change in cost and the consequent price response. Firm's A reaction is depicted in line (1) and Firm's B reaction in line (2). Dotted lines represent the change in cost. Firm's C reaction is going to be somewhere between (1) and (2) depending on the value of b. θ^* is the actual production period.

In order to give precise estimates of the lags between cost and price changes we have to take into account the fact that since data on costs and prices are quarterly averages, the appropriate lag weights are the average weights for each discrete quarter of the total production period θ, which of course is not an integer. A useful assumption in order to obtain discrete data is to assume that changes occur smoothly within quarterly intervals. In what follows we will explain the generation of the lag structure for (1) initially-added inputs and (2) progressively-added inputs.

<u>(1) Initially added inputs.</u> (Initially-added inputs refer to materials exclusively. There is of course a part of materials that are progressively-added in the productive process). The distributed lag weights (fk) should express the proportional distribution of a step cost change in quarter zero over the succeeding quarters. (i.e. a change in input cost at the beginning of quarter zero which is maintained during the remainder of the quarter). Let n be an integer such that $n<\theta<n+1$. Then the initial input cost change will have the first effect on output prices in quarter n with a proportion equal to $1+n-\theta$. The remaining effect will be in quarter n+1 with a proportion equal to $\theta-n$. The weights

Figure A5.2

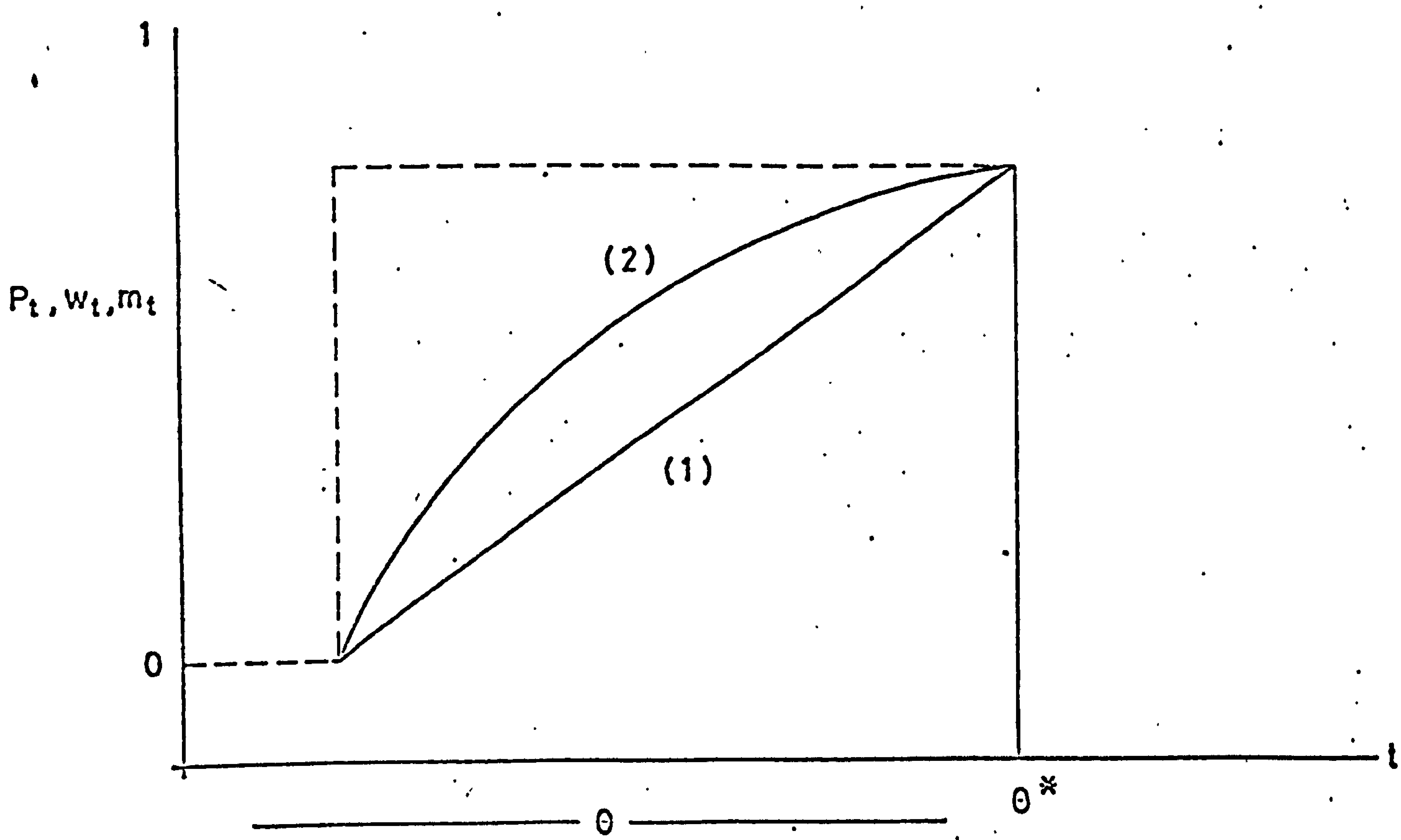


Table A5.2 Calculation of distributed lag weights for initially added material inputs. Two digit SIC sectors, Greek manufacturing

Sector	θ	n	n+1	Lags 0	1	2	3	4	5
TOT	2.11041	2	3			0.8896	0.1104		
20	1.35519	1	2		0.6448	0.3552			
21	1.98966	1	2		0.0103	0.9897			
22	1.80909	1	2		0.1909	0.8091			
23	2.12277	2	3			0.8772	0.1228		
24	1.36907	1	2		0.6309	0.3691			
25	1.86933	1	2		0.1307	0.8693			
26	2.73099	2	3			0.2690	0.7310		
27	1.90678	1	2		0.0932	0.9068			
28	0.96584	0	1	0.0342	0.9658				
29	2.47621	2	3			0.5238	0.4762		
30	1.86595	1	2		0.1341	0.8660			
31	1.49456	1	2		0.5054	0.4946			
32	0.45389	0	1	0.5461	0.4539				
33	2.68143	2	3			0.3186	0.6814		
34	2.83801	2	3			0.1620	0.8380		
35	3.00754	3	4				0.9925	0.0075	
36	2.87782	2	3			0.1222	0.8778		
37	2.51282	2	3			0.4872	0.5128		
38	4.18372	4	5					0.8163	0.1837
39	4.23747	4	5					0.7625	0.2375

fk(a) for initially added material inputs (fk(b) are the weights for progressively added material inputs, see below), can be written as

$$\text{(A5.29)}\quad fk(a) = \begin{cases} 1+n-\theta & K=n \\ \theta-n & K=n+1 \\ 0 & K\neq n,\ K\neq n+1 \end{cases}$$

Application of equation (A5.29) for the distributed lag weights for initially added material inputs for the two-digit SIC sectors are given in table A5.2.

(2) Progressively added inputs. In order to calculate the distributed lag weights for progressively added inputs we first have to define a distribution function d(t) with the following properties.

$$\text{(A5.30)}\quad \begin{array}{lll} d(t) = 0 & & t<0 \\ 0<d(t)\ 1 & \text{for} & 0\leq t<\theta \\ d(t) = 1 & & t\geq\theta \end{array}$$

Evaluation of this function for integer values of t (expressed in quarters) gives the cumulative proportion of the cost increase that has been transmitted to a price increase by the end of each quarter. The discrete cumulative distribution for progressively added inputs is given in (A5.31).

$$\text{(A5.31)}\quad d(i) = 1 - \frac{(\theta-i)(\theta-i+1)}{(\theta+1)} \quad \text{for } i = 1....n$$

where i = quarters and n was defined before. The lag weights that are considered to be centered in the middle of quarterly intervals can be defined as

$$\text{(A5.32)}\quad \begin{array}{llll} c(i) = d(i+0.5) & & i = 0 \\ c(i) = d(i+0.5)-d(i-0.5) & \text{for} & i = i...n \\ c(i) = 1-d(n+0.5) & & i = n+1 \end{array}$$

where $\Sigma c(i) = 1$ and c(o) is the lag weight on the current quarter. It should be noted that the distribution function of c(n) and c(n+1) does not follow (A5.32), the reason being that d(i) will reach unity somewhere within the interval of n+1 quarter, that is after the production period. To avoid

Table A5.3 Calculation of distributed lag weights for progressively added non-material inputs. Two digit SIC sectors, Greek manufacturing

Sector	θ	Lags 0	1	2	3	4	5
TOT	2.11041	0.3596	0.4907	0.1308	0.0189		
20	1.35519	0.5029	0.3631	0.1340			
21	1.98966	0.3765	0.4983	0.1252			
22	1.80909	0.4052	0.4660	0.1288			
23	2.12277	0.3579	0.4896	0.1330	0.0195		
24	1.36907	0.4992	0.3668	0.1340			
25	1.86933	0.3951	0.4772	0.1276			
26	2.73099	0.2926	0.4379	0.2121	0.0496		
27	1.90678	0.3891	0.4840	0.1269			
28	0.96584	0.6185	0.3815				
29	2.47621	0.3167	0.4592	0.1872	0.0369		
30	1.86595	0.3957	0.4766	0.1277			
31	1.49456	0.4679	0.3987	0.1334			
32	0.45389	0.4841	0.5159				
33	2.68143	0.2970	0.4420	0.2139	0.0471		
34	2.83801	0.2835	0.4293	0.2324	0.0548		
35	3.00754	0.2703	0.4161	0.2502	0.0633	0.0002	
36	2.87782	0.2803	0.4261	0.2369	0.0567		
37	2.51282	0.3130	0.4561	0.1922	0.0387		
38	4.18372	0.2044	0.3397	0.2475	0.1553	0.0528	0.0003
39	4.23742	0.2022	0.3368	0.2467	0.1566	0.0563	0.0014

Table A5.4 Calculation of distributed lag weights for initially and progressively added material inputs. Two digit SIC sectors, Greek manufacturing

Sector	θ	Lags 0	1	2	3	4	5
TOT	2.11041	0.11986	0.16355	0.63667	0.07991		
20	1.35519	0.16764	0.55091	0.28145			
21	1.98966	0.12551	0.17298	0.70151			
22	1.80909	0.13506	0.28261	0.58233			
23	2.12277	0.11931	0.16320	0.62914	0.08835		
24	1.36907	0.16640	0.54290	0.29070			
25	1.86933	0.13171	0.24619	0.62210			
26	2.73099	0.09752	0.14597	0.25266	0.50385		
27	1.90678	0.12971	0.22347	0.64682			
28	0.96524	0.22894	0.77106				
29	2.47621	0.10557	0.15306	0.41160	0.32977		
30	1.86595	0.13189	0.24824	0.61987			
31	1.49456	0.15598	0.46986	0.37417			
32	0.45389	0.52542	0.47455				
33	2.68143	0.09899	0.14732	0.28370	0.46999		
34	2.83801	0.09450	0.18547	0.57694			
35	3.00754	0.09009	0.13870	0.08339	0.68275	0.00508	
26	2.87782	0.09343	0.14205	0.16041	0.60412		
37	2.51282	0.10433	0.15202	0.38886	0.35479		
38	4.18372	0.06815	0.11324	0.08249	0.05176	0.56177	0.12259
39	4.23747	0.06739	0.11227	0.08223	0.05219	0.52713	0.15878

such a problem we must calculate the distribution function at the middle of the interval n, i.e. d(n+0.5) as a weighted average of the distribution in the interval where it is less than one and the interval where it equals one, i.e.

$$(A5.33)\quad d(n+0.5) = \frac{(\Theta-n)\ [d(n)+d(\Theta)]}{2} + (1-\Theta+n)$$

Application of rules (A5.31)(A5.32)(A5.33) for the distributed lag weights of progressively added non-material inputs for the two digit manufacturing sectors is given in table A5.3.

A5.4. Derivation of normal unit labour and normal unit material costs

The discussion of the previous sections has established the methodology for the calculation of the production period, has presented the results and has examined how the lag distribution of initially added and progressively added inputs can be generated. It was assumed despite the limitations that the share of materials that enter initially (b) is 0.66666. The calculation of the lags for materials inputs is therefore the weighted sum of the lags for initially and the lags for

Table A5.5. Calculation of mean lags for material and labour inputs; two digit SIC sectors, Greek manufacturing

Sector	Materials	Labour	Sector	Materials	Labour	Sector	Materials	Labour
TOT	1.67664	0.80909	26	2.16284	1.02654	33	2.12470	1.01125
20	1.11381	0.63105	27	1.51711	0.73778	34	2.24488	1.05848
21	1.57601	0.74870	28	0.77106	0.38152	35	2.37403	1.10701
22	1.44727	0.72362	29	1.96558	0.94431	36	2.13316	1.07000
23	1.68652	0.81402	30	1.48798	0.73204	37	1.84209	0.95670
24	1.12431	0.63479	31	1.21819	0.66545	38	3.18030	1.51317
25	1.49039	0.73252	32	0.47455	0.51586	39	3.33573	1.53226

progressively added materials with respective weights b and 1-b Such a calculation for materials (initially and progressively added) is given in table A5.4 and based on equation (A5.34).

(A5.34) $f_k = bfk(a) + (1-b) fk(b)$

where fk(b) refers to the weights of progressively added materials and is based on equations (A5.31) (A5.32) (A5.33)

Generation of costs can therefore be made by applying the rules discussed so far in a way that avoids the imposition of lags on the cost variables in a price determination equation. Such a generation for normal unit labour and normal unit material costs can be defined as (A5.35) and (A5.36).

(A5.35) $$ULCN^* = \sum_{i=o}^{\theta} c_i ULCN_i$$

(A5.36) $$UMCN^* = \sum_{i=o}^{\theta} (bf_{k(a)} UMCN_i + (1-b) fk(b) \; UMCN_i)$$

where ULCN, UMCN have been defined in section 5.5.3.

It is interesting to see how various sectors behave with regard to the distribution of lags for materials and labour inputs. For this reason we calculated mean lags (See A.C. Harvey (1981) pp. 233-34) for both materials and labour, presented in table A5.5. The mean lags for materials seem to correspond to the length of the productive process satisfactorily; they range from 0.47455 for sector 32 to 3.3357 for sector 39 and as a rule exhibit a shorter lag for light consumer industries and quite a longer one for heavy industries. The mean lags for labour have as expected a much shorter range, from 0.38152 for SIC:28 to 1.5323 for SIC:39

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