The University Of Sheffield.

Access to Electronic Thesis

Author:	Damien Cassells
Thesis title:	The Roles of Foreign Labour and Foreign Firms in the Irish Economy: An Empirical Analysis
Qualification:	PhD

This electronic thesis is protected by the Copyright, Designs and Patents Act 1988. No reproduction is permitted without consent of the author. It is also protected by the Creative Commons Licence allowing Attributions-Non-commercial-No derivatives.

If this electronic thesis has been edited by the author it will be indicated as such on the title page and in the text.

The Roles of Foreign Labour and Foreign Firms in the Irish Economy: An Empirical Analysis

Damien Cassells

A Dissertation Submitted in Fulfilment of the Requirements for the Degree of Doctor of Philosophy in Economics

Thesis supervisors: Professor Sarah Brown
Professor Karl Taylor

Department of Economics
University of Sheffield

July 2010

Declaration

I hereby certify that this material is entirely my own work and has not been taken from the work of others save to the extent that such work has been cited and acknowledged within the text of my work. It has not been submitted as an exercise for a degree at this or any other University. I agree that the library may lend or copy the thesis upon request.

Signed: _____

ID Number: _____

Date: _____

Abstract

The focus of this thesis is upon the role of foreign labour and foreign firms in the Irish economy. Chapter 1 presents an introduction to the overall thesis, while the historical context for the Irish economy is presented in Chapter 2. The empirical analysis presented in Chapter 3 explains occupational attainment in Ireland. With respect to occupational outcomes for foreign and indigenous workers, the Irish workers were found to be likely to occupy the professional posts. Foreign born workers who had resided in Ireland for less than ten years were less likely to find employment in the higher skilled occupations, while those workers who had resided for more than ten years in Ireland were likely to working in associate professional posts.

Chapter 4 utilises a Mincerian wage equation to examine potential earnings differentials between Irish and non-Irish workers in the Irish labour market. Random effects estimates are analysed. The findings suggest that Irish workers earned less per hour than non-Irish workers, while non-Irish workers who took up Irish citizenship received higher levels of hourly pay then those non-Irish workers without Irish citizenship.

Chapter 5 presents a production function analysis of firms in the Irish manufacturing sector. Using a Cobb-Douglas specification, firm nationality is found to have no impact upon output in the Irish manufacturing sector, while the output of Irish firms is linked to both family labour and outside piece workers, no such relationship is found for foreign firms.

Dedication

This thesis is dedicated both to the memory of my Grandmother, Margaret Dowling, and to the constant presence of my Mother, Patricia Cassells. A sincere and loving thank you to both of you for the years of love and support.

Acknowledgements

The following people deserve much thanks and praise for aiding the completion of this thesis. Firstly, to both of my supervisors, Professor Sarah Brown and Professor Karl Taylor, a sincere thank you for the huge amount of time, effort and concern you demonstrated towards me as a human being and indeed to the project itself. Without your professionalism, encouragement and talents this thesis would not have been completed. Thank you.

To the staff at the Central Statistics Office for accommodating me during my studies there and for allowing me to access to the restricted Census of Industrial Production data on site. Without this access Chapter 5 could not have been completed. Thank you.

To my parents, Patrick and Patricia, my brothers, Peter and Stephen and to my sister-in-law, Anita, thank you for the love and encouragement and support throughout my life and in particular for the duration of my PhD studies. Without your support and sacrifices throughout my life it would not have been possible for me to take my education as far as I have. Thank you.

Finally thank you to two special friends, Enda Carr of Maynooth and Antonia Colom of Majorca, thank you for the love shown, particularly in 2009. Thank you.

Table of Contents

List of Tables

CHAPTER 3

CHAPTER 4

CHAPTER 5

List of Figures

CHAPTER 2

List of Appendices

Abbreviations

CAP: Common Agricultural Policy.

CIP: The Census of Industrial Production.

CSO: The Central Statistics Office of Ireland.

DOGEV: Dogit Ordered Generalised Extreme Value Model.

EEA: European Economic Area.

ESRI: The Economic and Social Research Institute.

ESF: European Structural Funds.

EU: The European Union.

FDI: Foreign Direct Investment.

JLC: Joint Labour Committee.

GCSE: General Certificate of Secondary Education.

GDP: Gross Domestic Product.

GMM: Generalised Method of Moments.

GNP: Gross National Product.

IDA: Industrial Development Agency.

ISSDA: The Irish Social Science Data Archive.

LII: The Living in Ireland Survey.

MNC's: Multinational Corporations.

OECD: The Organisation of Economic Co-operation and Development.

OLS: Ordinary Least Squares.

PRSA: Personal Retirement Savings Account.

QNHS: The Quarterly National Household Survey.

SEM: The Single European Market.

UK: The United Kingdom.

US: The United States of America.

VAT: Value Added Tax.

Chapter 1: Introduction

The Republic of Ireland only became an independent state in 1922 and therefore the economic and social history of the country is a relatively short one. Possibly as a result of a long struggle for independence, initial attempts at economic policy were aimed at self-sufficient outcomes, so protectionist policies and agriculture dominated the economic agenda. Such insular thinking and policies created an economic island and Ireland became an economic outpost on the western periphery of Europe. Barry (1999) suggests that mass emigration to the United Kingdom (UK) and the United States of America (US) was the solution to the lack of employment in an economy where education and infrastructure were suffering the consequences of underinvestment. It is clear that such an economic environment would not attract immigrant workers, skilled or otherwise, to live and work in. With the passage of time, thinking and policies changed and successive Irish Governments tried to implement trade liberalisation policies in an attempt to aid the development of both the economy and society.

However, the country never experienced 'sound' fiscal policies so the 'correct' culture for economic growth to occur never emerged. Towards the end of the 1980's that particular failing in economic policy was addressed and the Government attempted to control spending and manage public debt in a more economically sound way. Barry (1999) contends that Ireland was now an attractive economy for both investment and employment with low corporate and income tax rates, attractive setup grants and with a well educated and English speaking work force, it quickly became the most attractive location for US foreign direct investment (FDI) within the EU. The result was the so called 'Celtic Tiger' era of the 1990's and 2000's, when for the first time in its history, Ireland recorded a prolonged period of sustained economic growth and prosperity[1]. With the economy expanding at such rapid rates there was a shortfall in the supply of labour and foreign workers were required to supplement the shortage of workers in the Irish labour market. Ireland was no longer sending more workers out of the country

[1] According to Leddin and Walsh (1998) the phrase 'Celtic Tiger' was coined by Kevin Gardner in 1996, when comparing Ireland's growth with that of the successful economies of East Asia.

than it was accepting in and this new experience for Ireland is one of the key motivations for this work: i.e. to explore how foreign labour (Chapter 3 and Chapter 4) and firms (Chapter 5) fare in a now more relatively open Irish economy. Specifically, Chapter 3 examines the outcomes for foreign and indigenous labour in terms of occupations, while the key focus in Chapter 4 is upon any wage differentials that may have accrued between the same two groups of workers. Chapter 5 utilises a production function to establish if there is any differential in performance between indigenous and foreign firms located in the Irish manufacturing sector.

Chapter 2 reviews parts of the economic history of Ireland and in so doing attempts to outline the economic climate that initially produced a stagnant economy and highlights the factors that led Ireland into the 'Celtic Tiger' economic phase of continuous higher than the EU average economic growth. It is evident from Chapter 2 that successive Irish Governments hindered economic progress through a self-sufficiency ethos and implementation of protectionist policies. The core of the Irish economy was the low yield (in terms of economic growth and returns to capital investment) agricultural sector, while little or no attention was placed upon trade, education or infrastructural advancement. It is postulated that Ireland functioned as a regional economy, with excess supplies of labour emigrating to the UK during recessionary periods and that in fact Ireland was an agricultural hinterland of the UK. The factors that contributed to the economic transformation are outlined in Chapter 2 and include the benefits of the Single European Market (SEM), the establishing of a relatively low wage structure through a wage bargaining process, industrial policies aimed at attracting inward investment into the Irish economy and the implementation and success of more sound fiscal policies which allowed for budgetary borrowings to be reduced.

The discussion in Chapter 2 points to economic stability and a greater awareness of the roles of trade, education and infrastructure as being the key drivers of economic growth recorded by Ireland in the 1990's and also highlights the creation of an economic climate that would proceed to attract investment and labour from abroad on a scale never experienced by the Irish economy prior to this. The attractiveness of the Irish

labour market gave rise to an influx of foreign workers into the economy and creates the opportunity to engage in research such as that contained in Chapter 3, which focuses upon the occupational attainment of foreign born workers in the Irish labour market. Using the Quarterly National Household Survey (QNHS) from 1999 to 2004, a multinomial logit model is applied in determining the factors that contribute to the occupational outcomes for individuals in the Irish labour market. Emphasis is placed upon nationality in the model with three different measures of nationality (nationality, country of birth and years of residency in Ireland) included in the estimations. The variation in the nationality measurements allows for commentary upon not only the role of nationality in determining the occupations of individuals, but also the impact of the duration of the foreign born individuals who stay in the Irish labour market upon the occupation attained by the individual. To the best of the author's knowledge this is the first attempt at such a study in the context of the Irish labour market, although Barrett et al. (2006) do attempt to model occupational attainment, but the model offers more restricted outcomes for the individuals sampled[2]. In keeping with Chapter 5 (a production function study based upon the Irish manufacturing sector), occupational outcomes are examined in isolation for those workers in the manufacturing sector, while the occupational attainment of males and females sampled are also examined separately.

The results from the models contained in Chapter 3 are very much in line with both what would be expected and what was identified in the literature review. Males were found to be more likely to be working in higher skilled posts than females, while being located in the eastern part of Ireland was also strongly linked with workers holding higher skilled occupations. Higher skilled posts were found to be more likely to be occupied by individuals with higher levels of educational attainment and who are parents to children under the age of five. With respect to nationality, workers of nationalities other than Irish were less likely to occupy professional posts than indigenous workers. Workers from the UK attained higher skilled occupations relative to their counterparts from other EU states with the conclusion drawn that this result

[2] Further analysis of the Barrett et al. (2006) model is presented in Chapter 3.

may possibly be linked to workers from other EU states potentially having the disadvantage of a language barrier relative to the UK workers. Foreign born workers who have less than ten years of residency in Ireland were found to be more likely working in lower skilled occupations, while those foreign born workers with more than ten years of residency tended to be more likely to be occupying the more skilled associate professional posts.

The theme of Chapter 4 is very much in keeping with that of Chapter 3 in that focus is placed upon possible differentials between indigenous and foreign workers in the Irish labour market, but in this instance with respect to earnings. A Mincerian type model of earnings is estimated and a decomposition of wage differentials analysis is presented using the Oaxaca decomposition. The Living in Ireland Survey (LII) is used to create panel data running from 1995 to 2001 and random effects estimates based upon the Mincerian equation are analysed. Although there have been several studies examining earnings in the Irish labour market, the more recent attempts such as that by Barrett and McCarthy (2007a) employ cross sectional data on one year of data only and tend to include a relatively less comprehensive selection of explanatory variables[3]. Similar to Chapter 3, the models estimated include varying measures of nationality, with both country of birth and citizenship included in estimations. The inclusion of citizenship allows for analysis of the impact of foreign born workers who have acquired Irish citizenship upon their earnings. In keeping with Chapter 3, estimation is also carried out separately for each gender.

The results were found to be consistent with both theory and the corresponding findings highlighted in the literature review, with males earning more than females and married workers receiving higher pay than their counterparts who are currently not married. Professional workers were found to earn more than workers in any of the other occupations controlled for, with workers in the agricultural sector reported as earning the least. Workers in the public sector received a wage premium relative to similar workers in the private sector, while workers who contribute to a pension

[3] Chapter 4 contains further discussions on Barrett and McCarthy (2007a).

scheme tended to earn more than workers who held no pension entitlements. A positive return on education was reported, with workers with the highest levels of educational attainment in receipt of the highest levels of hourly pay. Workers in Dublin earned more per hour than workers in equivalent positions in other parts of Ireland. Irish workers were found to earn less than their foreign born counterparts. Holding Irish citizenship was found to be statistically insignificant in determining the earnings of an individual, but foreign born workers who switched their citizenship to Irish did receive a wage premium.

Chapter 5 is the concluding empirical chapter and the motivation behind this study is much in line with the two previous empirical chapters and with the motivation for the thesis itself. This chapter contains an investigation into the differences between foreign and indigenous firms located in the Irish manufacturing sector. The approach taken is to estimate a Cobb-Douglas production function using the Census of Industrial Production (CIP) panel data from 1991 to 2000. Estimates are produced using four different methods: Ordinary Least Squares (OLS); fixed effects; Generalised Method of Moments (GMM); and system GMM. Separate models are run for all firms, Irish firms only and foreign firms only for both balanced and unbalanced panel data sets. Further to this, labour is also subdivided into six categories which allows for the relative importance of each factor input in the production process to be examined and for comparison between foreign and Irish firms in relation their usage of these inputs. It is believed that this analysis is the first of this type to be applied to the Irish manufacturing sector and is important in the context of indigenous firms learning from their foreign counterparts with respect to input usage and productivity.

Two results from the production function study stand out as potentially being particularly important findings. Firstly, the difference between foreign and indigenous firms in relation to the labour inputs of family members and outside piece workers. There is no relationship between output and these two types of labour input with respect to foreign firms in the Irish manufacturing sector, but there is a positive and significant relationship reported for indigenous firms. Secondly and in conclusion to

this chapter, nationality of ownership was also found to have no impact upon output in the Irish manufacturing sector.

Chapter 2: An Overview of Irish Economic History, Output and Employment

2.1 Introduction

This chapter is concerned with identifying some of the factors behind the history of Irish economic growth, from the protectionist policies of the 1950's through to the Government backed expansionary boom of the 1970's and up to the more recent and dramatic surge in economic expansion from the 1990's onwards. A brief overview of the Irish labour market and an examination of output in terms of both Gross Domestic Product (GDP) and Gross National Product (GNP) are also contained within this chapter. The rationale behind the inclusion of this chapter is by way of a forward to the following chapters, which are concerned with occupational attainment in Ireland (Chapter 3), earnings in Ireland (Chapter 4) and Irish manufacturing output (Chapter 5), respectively. It is also the aim of this chapter to provide a historical and economic context for the empirical work that follows in the proceeding chapters.

2.2 Ireland and Economic Growth

There is no doubting that the rise of the Irish economy throughout the 1990's was as dramatic as the fall commencing in 2008, when the Central Statistics Office of Ireland (CSO) reported a 3% fall in GNP, which is the first economic contraction experienced by the Irish economy since the commencement of the 'Celtic Tiger' period[4]. According to Clinch et al. (2002), between 1993 and 2001 the annual real growth rate (8%) of the Irish economy, in terms of GDP, was more than double the average recorded over the previous three decades (3.5%). Irish GNP is often considered to be a fairer reflection of economic activity and growth in Ireland, as these figures are by definition, net of profit repatriation abroad. Barry et al. (1999) argue that GDP is a poor measure of national income for Ireland because it includes interest payments on the economy's foreign debt and the profits of multinational corporations (MNC's) are repatriated to their home nations. Clinch et al. (2002) argue that these outflows leave on average a 15% gap between GDP and GNP in Ireland, whereas in most economies

[4] GNP figures are available at http://www.cso.ie/statistics/grossvalueadded.htm. Information on the CSO is available at www.cso.ie.

the differential between these two measures of economic activity tends to be relatively small. The Central Bank of Ireland estimated that the gap between GDP and GNP for 2002 was in the region of €24 billion, which amounts to 20% of GDP for that year (Irish Independent, 2003). However, when growth rates of GNP are examined for Ireland the economy can still be viewed as having displayed dramatic economic growth, with Barry (1999) claiming that Irish GNP expanded by 70% between 1987 and 1997, while during the same period the average growth rate in GNP experienced by the fifteen EU member states was 24%.

Irish living standards were likely to converge with that of the EU as a result of this strong economic growth and these growth rates demonstrate that the Irish economy has consistently outperformed those economies of its EU compatriots over this recent period. Barry (1999) believes that the Irish economy was shaped by a combination of events that occurred in the nineteenth century, most notably large-scale emigration resulting from the great potato famine, which left a legacy of a willingness on the part of the population to emigrate when the Irish economy experienced recession. Emigration resulting from recessionary pressure is once again being experienced by the Irish economy, with the CSO estimating a 40% increase in emigration between April 2008 and April 2009[5]. Barry (1999) further argues that as a result of the Irish labour force's tendency to emigrate, Ireland has an elastic labour supply which led to the Irish economy functioning as a regional economy.

Barry (1999) suggests that a regional economy has a population that expands or contracts as economic conditions dictate, while a national economy's population is determined by demographics, while Barry (2002) states that a regional economy differs from a national economy, in that labour can flow freely in and out of a regional economy. This dictates that wages are set in accordance with rates available in the wider encompassing economy with which the region shares an open labour market. Barry (2002) suggests that the fact that labour can flow freely has two implications for how a regional economy adjusts to shocks. Firstly, if labour can flow freely wages will

[5] Available at http://www.cso.ie/releasespublications/documents/population/current/popmig.pdf.

not be much affected by shocks and labour will flow outwards during a recession. Secondly, if labour cannot flow out, wages will decrease and new industries will develop. Krugman (1997) adds to the regional economy hypothesis by explaining the historic trend of severe Irish unemployment. In regional economies, the level of labour demand rather than the level of labour supply determines the number of jobs. Until the economic expansion of the 1990's emerged, Krugman (1997) argues that labour demand was never high enough to soak up the labour supply and this excess supply of labour continually transmitted itself into mass emigration. The fact that the Irish economy had been de-industrialised meant that economic competitiveness was dependent upon low wage rates. As transport costs were lowered across Europe, products and sectors, which previous to the industrial revolution were protected, now were faced with competition from imports. According to Barry (1999), Irish industry slipped into terminal decline and the country became the agricultural hinterland of Britain.

So for the Irish economy to experience economic growth, Barry (1999) postulates that the economy needed to acquire international competitiveness. Historically, other economies have achieved this competitiveness via low wage rates and reduced labour costs. However, given the continual pattern of emigration this particular route to economic competitiveness was not available to the Irish economy. The high levels of emigration directly translated into Irish labour market surpluses being exported abroad and therefore ensured that Irish wage rates were already at a 'floor' level. Barry (1999) highlights four key factors that he believes contributed towards Ireland being able to achieve international competitiveness during the much celebrated 'Celtic Tiger' era. The first factor was the achievement of competitiveness in wage and non-wage costs as a result of sound exchange rate policies and successive partnership agreements, which Sexton and O'Connell (1997) attribute to the Irish government learning from Germany, the Netherlands and Denmark. Secondly, Stigler's Survivor Technique (see Mansfield, 1999) applied as the firms that tended to survive prolonged recessions were by definition the most cost efficient and most export orientated. The third factor relates to the fact that indigenous industry was more heavily concentrated in sectors in which

Ireland was predicted to make gains in as a result of the 1992 SEM, while the fourth and final factor as outlined by Barry (1999) is linked with the changes in industrial policy led by the Industrial Development Agency (IDA), whom since the mid 1980's focused on problems faced by Irish firms in international markets.

As stated earlier, the phenomenal Irish growth rates recorded during the 'Celtic Tiger' period regularly outstripped growth rates across the EU. Historically this however has not always been the trend, as the Irish economy performed extremely poorly during the European economies' golden age growth period between 1950 and 1973. During this golden age, Europe experienced unprecedented growth rates in GDP, cyclical economic stability and a convergence in living standards (Barry and Crafts, 1999). Statistically and economically the Irish economy was an outlying entity during this period in terms of growth and economic performance. According to Barry (2000), during the European golden age Ireland was the only country of the EU (excluding Luxembourg) that had a GDP per capita value that was less than that of the EU average in 1950 and then proceeded to diverge away from the mean. Europe's performance gave rise to growth rates that Solow's growth and convergence models would have predicted[6]. Europe as a whole converged with the US in terms of economic growth and within Europe poorer countries grew faster than richer countries. Greece, Spain and Portugal grew faster than Switzerland, the UK, Denmark and Sweden, while Ireland fell well below its predicted level of growth (Barry and Crafts, 1999).

Barry and Crafts (1999) allocate some of the blame for the Irish under performance to the Government, while Powell (2003) suggests that the protectionist policies implemented by the Irish Government hindered economic growth throughout the period. It was argued by Barry and Crafts (1999) that poor policy choices were selected during this period and the majority of state and semi-state institutions were inefficient. Ó'Gráda and O'Rourke (1996) offer the example of the presence of state bodies with excessive rent-seeking capacities being supported by the Irish Government during this period. Barry (2000) suggests that the Irish Government missed out on the

[6] See Temin (2002) for a discussion on economic growth theories and the European golden age.

post-war European boom by delaying the opening up of the economy to trade and FDI until the early 1960's, which was virtually a decade later than the majority of the rest of Europe had chosen to do so. Considine and O'Leary (1999) support this view and state that exports accounted for just 32% of Irish GDP during the 1950's, with 75% of those exports going to the UK. According to Sachs and Warner (1995), open economies grow faster than closed economies and convergence does not occur among closed economies. Barry (2000) argues that the protectionist barriers do not show up in the export to GDP ratio due to the low value of agricultural exports: in 1960 30% of all Irish exports were live animals, while only 19% of exports were comprised of manufactured goods. After ten years of operating a relatively open economy, manufactured exports exceeded all agricultural exports in value, while the exportation of live animals represented an insignificant share of total exports. Barry (2000) estimated that the foreign firms located in Ireland had an export-output ratio of 90%, while Irish firms recorded a value of just 40% for the same ratio. Barry (2000) emphasises that EU membership enhanced the opening up of the Irish economy for two reasons. Firstly, without the EU, Ireland may have found it difficult to attract FDI and secondly, EU membership directly (by offering new markets) and indirectly (by allowing Ireland to pursue an FDI strategy) enabled the Irish economy to adopt a strategy of targeting the more rapidly growing markets of the EU instead of the slow-growth UK market.

Barry (2000) also explains that the Irish Government followed policies that rendered the economy agriculturally orientated as opposed to manufacturing driven. In the 1970's, 26% of the Irish labour force was engaged in agriculture, which was almost double the EU average at that time. Barry (2000) further argues that the economic growth literature suggests that economies with large agricultural sectors have substantially reduced growth rates per capita. This inverse relationship between economic growth and the relative size of an economy's agricultural sector can be potentially explained by the fact that the agricultural sector offers fewer opportunities for potential external economies and also less scope for learning by doing, when compared with the manufacturing sector. Barry (2000) adds two further relevant

caveats to the scenario where the Irish economy was over dependent upon agriculture. Firstly, the most difficult task for a Government that finds itself in this economic environment is to choose the correct policies to aid the economy's transition away from one dependent upon agriculture. Secondly, the Common Agricultural Policy (CAP) slowed down this transition for the Irish economy, as it hindered the development of other sectors.

The 1980's in Irish economic history may well be viewed as being a time of 'fiscal payback' for the Government led expansionary boom of the 1970's, which was largely financed via increased Government debt. Powell (2003) highlights the increase in public sector borrowing from 10% of GNP in 1977 to 17% by the turn of the decade. In an attempt to reduce this debt in the 1980's, successive Irish Governments pursued high tax policies; in 1986 the marginal income tax rate was 65% (Leddin and Walsh, 1998). Given the world recession faced by all major economies during this decade, this was in effect a contractionary fiscal policy in response to a low economic point in a business cycle. Barry (2000) also points out that the increase in taxes led to higher wage demands from workers, which was directly contributing to undermining the international competitiveness of the Irish economy. At the tail end of the decade, the Irish Government adopted an alternative remedy to cure the debt crisis in the form of controlled public expenditure, as opposed to the previous policy of higher taxation. Keynesian economists would have rationally argued that this contractionary policy would result in further contractions of the economy[7]. However, there was an upturn in economic activity, which led Giavazzi and Pagano (1990) to arrive at their 'expansionary fiscal contraction' hypothesis. Barry and Devereux (1995) put forward a potentially more plausible argument than the anti-Keynesian logic hypothesised by Giavazzi and Pagano (1990). In effect, the fiscal contraction was counter cyclical according to Barry and Devereux (1995) and was aided by the social partnership wage agreement which promised future tax cuts.

[7] See Sutherland (1997) for an example of research in this area.

Another potential root of the poor economic performance experienced by Ireland may be the lack of capital investment and failure to expand the public infrastructure by successive Governments. DeLong and Summers (1991) find strong evidence of positive returns to capital spending in a cross-sectional analysis of economies between 1960 and 1985. Barry (2000) states that between the 1950's and the 1980's the public share in gross fixed capital formation ranged between 30% and 40%. This figure fell to just 15% in the 1990's. However, the investment between 1950 and 1980, according to Barry (2000), was in the main a source of finance for state activities in a range of sectors in which state activity is difficult to justify: inefficient public concerns such as rail and air travel companies. There was very little infrastructure development during this period despite the high percentage of public investment that was taking place. It can be argued that these poor investment strategies reduced the potential of the Irish economy and also aided other destructive forces in inhibiting economic growth. Not until the 1980's did the Government begin to distinguish between the interests of the economy and the interests of state backed monopolies (Barry, 2000). One example of such a policy was that the Government led the removal of the Aer Lingus monopoly on air access routes into Ireland.

Educational investment was also neglected in Ireland and the Irish economy was not involved in the vast human capital investment that took place during the European golden age era. Fitzgerald (1999) states that the failure of successive Irish Governments to develop the education system for the first fifty years after independence was achieved in 1922 was the most glaring mistake made in domestic policy. Barry (2000) documents the expansion of educational systems that took place in Western Europe in the immediate post-war period and shows that there is a smaller gap between Ireland and the OECD (Organisation for Economic Co-operation and Development) average in terms of educational attainment for younger age groups than there is for older age groups. This suggests that Ireland has converged in terms of education attainment standards with the rest of Western Europe over time and with this increased educational attainment came significant economic growth. Koman and Marin (1996) support this view and state that Ireland started twenty years behind

Europe in terms of educational investment, but was currently reaping the rewards of higher educational attainment levels. Barry (2000) suggests that, in conjunction with a change in policies, the Irish Government also had considerable luck on their side to aid them in their attempts to boost the failing economy, with the economy and the Government benefiting from a series of concurrent expansionary shocks, some orchestrated by the Government and some exogenous to the political system. The expansionary shocks include the SEM, a reduction in public expenditure allowing tax cuts (the top rate of income tax fell from 80% in 1975 to 65% in 1985 and to 44% in 2001 (Powell, 2003)), European Structural Funds (ESF) doubled in 1989 and, as Fortin (2002) points out, the improving performance of the main trade partners of the UK and the US since 1993.

Barry (2000) analyses the impacts of the availability of ESF upon Irish economic growth. Between 1994 and 1999 the ESF programs were designed to reduce high transport costs and therefore increase international competiveness in the Irish economy. Structural funds according to Barry et al. (2001) have three positive impacts upon a recipient economy. Firstly, they help to develop an economy's stock of physical infrastructure. Secondly, they assist private sector development and thirdly they contribute to the human resource base of an economy via professional and technical training. Fitzgerald (1999) also adds that ESF influenced the Irish Government in increasing the domestic level of infrastructural investment. Barry et al. (2001) allude to the fact that structural funding will have demand (short-run) and supply (long-run) implications for an economy. The demand-side effects will impact on areas such as the materials and labour required in the short-run to complete a project, whereas the real logic behind such programmes lies in the long-run supply effects of improved human capital and infrastructural levels and therefore increased productivity. According to Barry (2000), structural funds contributed approximately 0.5% per annum to the Irish GDP growth rate of the 1990's, while similarly Fitzgerald and Keegan (1993) estimate that between 1989 and 1993 Irish GNP was 3.5% above what it would have been in the absence of European funding. Barry et al. (2001) also suggest that there may be a link between the ESF and an increase in the FDI inflows into the Irish economy. By raising

the level of US FDI inflows into Ireland, the SEM may have helped Ireland achieve the critical mass effect in various sectors, but without the correct infrastructure (implemented via structural funding) it is very difficult to attract FDI in the first instance. Barry (2000) points out that approximately 50% of Irish manufacturing employment is in foreign owned industry, which virtually mirrors levels in the Pacific Rim economies. By comparison, 20% of UK manufacturing employment is hired by foreign owned UK located employers. According to Barry (2000) much of the Irish success in attracting FDI into the economy is dependent upon factors including the country being an English speaking nation and having a first mover advantage: Ireland was one of the first economies to actively seek FDI through the work of the IDA and the offering of a low and stable corporate tax rate.

If the 'Celtic Tiger' growth is the result of a delayed catch up process in economic growth terms, then the question is raised as to why the catch up process took so long to accrue. Irish productivity has been above the EU average since the 1960's, however it took a further twenty years for living standards to converge according to Barry (1996). One of the obvious sources of this strong productivity growth is the influence of foreign owned manufacturing firms. Delayed convergence according to Barry et al. (2001) may be due to the fact that the proportion of the Irish labour force with higher levels of educational attainment lagged behind that of the EU and that the removal of trade barriers in Ireland occurred at a much later date relative to other European economies. Barry et al. (2001) hypothesise that trade liberalisation cannot be guaranteed to be beneficial to a peripheral economy, if the liberalisation leads to those economies losing their most productive or research and development intensive sectors, as a result of opening up the economy. Since the implementation of the SEM, Barry et al. (2001) point out that growth has occurred in favoured Irish sectors (sectors that had been predicted to expand) in which there was already a significant presence of MNC's. These sectors include the manufacturing of office and data processing equipment, telecommunications, pharmaceuticals and the manufacturing of medical and surgical equipment. Each of these sectors according to Barry et al. (2001) had high intra-EU export-to-import ratios prior to the SEM and therefore were considered to be the

'favoured sectors'. Employment in indigenous firms in these sectors grew which Barry et al. (2001) view as evidence of spillovers into and linkages with firms in the foreign sector. Also it should be noted that the introduction of the SEM coincided with a large increase in the FDI inflows into the Irish economy. Barry et al. (1999) attribute this growth in investment inflows to a 'bandwagon' or 'cascade' effect. This is the idea that foreign firms base themselves in a country having witnessed the success of other firms who have already decided to locate there. However, it should be noted that Görg and Ruane (2000) report that economic integration can benefit countries in the periphery, but that it is not a sufficient condition for a peripheral economy in attracting FDI.

Barry et al. (1999) point out that Ireland achieved convergence with relatively low inflation and with fiscal stability intact, however it is also suggested that convergence may have been achieved much earlier had employment growth in Ireland developed at the same rate as it did in the EU. It has been highlighted above that the Irish economy diverged away from European living standards during the golden age period. However, according to Ó'Gráda (2002), when the Irish economic performance during the 'Celtic Tiger' period is allowed for, over the entire period since 1950, growth per capita is just as predicted by the Solow growth model, given Ireland's low initial level of income per capita. This result gives rise to the delayed convergence hypothesis, the notion that through inefficient policy choices and poor investment strategies, the Irish government actually prevented or delayed convergence taking place until the 'Celtic Tiger' era, when the appropriate economic conditions arose.

Barry (2002) outlines the reasons why delayed convergence may not be the correct description of the recent rapid economic expansion in Ireland. Firstly, Ireland did not converge at all (with other European economies) during the 1960's. It could be logically argued that the delays in eliminating trade barriers and in implementing educational investment explain the actual divergence that took place. However, this does not explain how Ireland had higher levels of both of these growth determining variables than Greece, Spain or Portugal, yet these economies managed to converge

during the 1960's. Secondly, the speed and level of the 'Celtic Tiger' growth and convergence appear to be more rapid than the convergence that would have been anticipated to occur over such a relatively short period. Barry (2002) likens incorrect policies to a dam behind which the convergence forces gather and build-up so that when the correct policies are in place the dam bursts and the lost ground is recovered at an extremely rapid pace. In effect, this hypothesis suggests that poor economic policy choices inhibit an economy from growing, but when more appropriate economic policies are subsequently followed, economic growth occurs at an unusually fast pace, much like water flowing through a dam where the barrier has been breached. Barry (2002) further suggests that this type of convergence behaviour is not incorporated in any economic growth or convergence models. Barry (2002) claims that followers of the delayed convergence theory must accept this unlikely model, unless it is agreed that the large FDI inflows exaggerated the growth patterns during the 'Celtic Tiger' period.

Barry (2002) highlights further weaknesses in the convergence argument. The convergence hypothesis does not indicate the economic need for non-orthodox economic policies. Regional economy theory suggests that although there is always a need for sound economic (orthodox) policies, these policies alone are unlikely to generate growth in regional economies. Again this ties in with the Irish case where a sound fiscal approach was required and adopted at the tail end of the 1980's, but perhaps the true growth generating policy was the decision to lower corporate tax rates in an attempt to capture a large share of FDI inflows. Krugman (1997) also supports the regional economy theory of Irish economic growth and hypothesises that the rapid economic growth rate experienced by the Irish economy could be considered the workings of a regional economy that experienced a non-orthodox policy.

Dascher (2000) develops a regional boom model and finds that labour inflows disappear as housing becomes overpriced and infrastructure congested. Barry (2002) argues that even if full employment is reached in a regional economy and there is a housing crisis, if high productivity MNC's still choose to locate in that economy, then the boom will continue. This argument is based on the fact that traditionally MNC's

pay higher wages than indigenous firms and thus will not be the employers faced with a labour shortage. It can be argued that throughout the last decade there was a housing crisis in Ireland, in terms of many workers being priced out of the market, but that MNC's continued to operate within the Irish economy despite this. It may also be the case that if an economy were in this full employment situation and there is a shortage of housing, then the economy will be facing relatively high levels of inflation as house prices grow in the excess demand market. Such inflation will encourage MNC's to contract their bases in the regional economy and expand their plants in economies that are more competitive in terms of costs and wages, given that the higher inflation will feed into higher wages. However, Barry (2002) argues that labour shortages will not necessarily prohibit growth in a regional economy, but that the following four factors possibly could slow down economic growth: Firstly if US FDI dries up during a recession period; secondly if there is a change in the US corporate strategy; thirdly if the US FDI refocuses on Eastern Europe; and finally if corporate tax rates are harmonised within the EU.

It is evident that the continuous economic depressions suffered by the Irish economy were contributed to by historical tendencies to emigrate and poor fiscal choices over a prolonged period. The arrival of the 'Celtic Tiger' in the 1990's had as much to do with low corporate tax rates and the incentives on offer to MNC's as it had with fiscal stability and EU aided infrastructure development. As Powell (2003) argues, it may not be the case that one particular policy is responsible for turning around the Irish economy, but rather it is the impact of several policies in opening up economic freedom[8]. Barry (2002) reiterates the fact that the Irish economy's export base was a key driver of the unheralded growth rates during the 'Celtic Tiger' era and he attributes both the low corporate tax rate and EU membership as the two most important reasons why Ireland was so successful at attracting MNC's from which the bulk of these exports emanated from. Both of these factors were in place in the Irish economy long before the boom commenced, so Barry (2002) attributes the resolving of the fiscal crisis and an era of industrial peace as two crucial co-factors in the attempt to attract

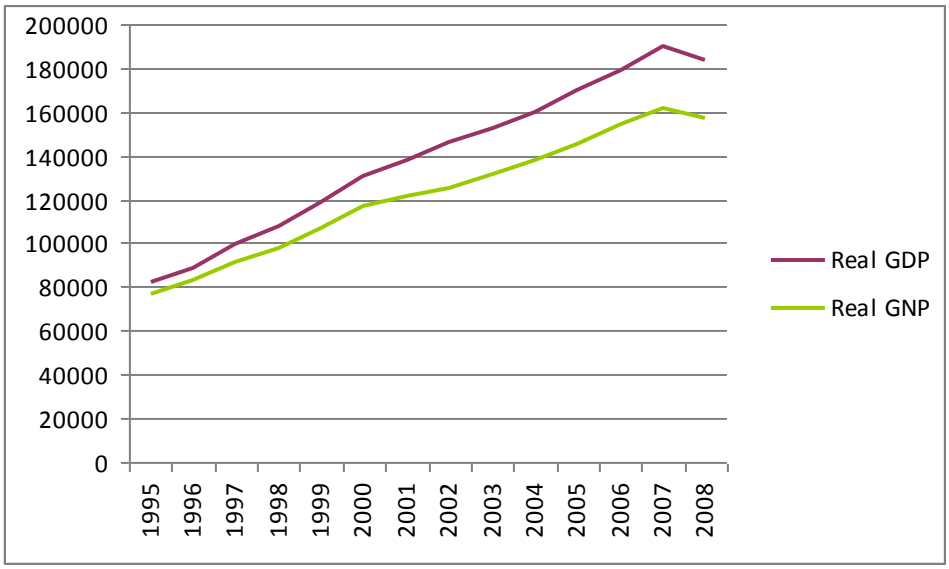
[8] See Barro (1991) for evidence of the links between economic freedom and economic growth.

large FDI inflows. The remainder of this Chapter presents a brief overview of the Irish labour market in terms of occupations, employment and Irish output levels, in terms of GDP.

2.3 Output and the Labour Market in Ireland

In order to provide a background to Chapter 3, an occupational attainment study, and Chapter 4, an analysis of wages, brief examinations of the Irish labour market and occupations within the Irish labour market are outlined in this section. Firstly, and in keeping with the production function study presented in Chapter 5, real GDP and real GNP for Ireland between 1995 and 2008 are plotted below in Figure 2.1.

Figure 2.1: Real GDP and Real GNP, Ireland 1995-2008.

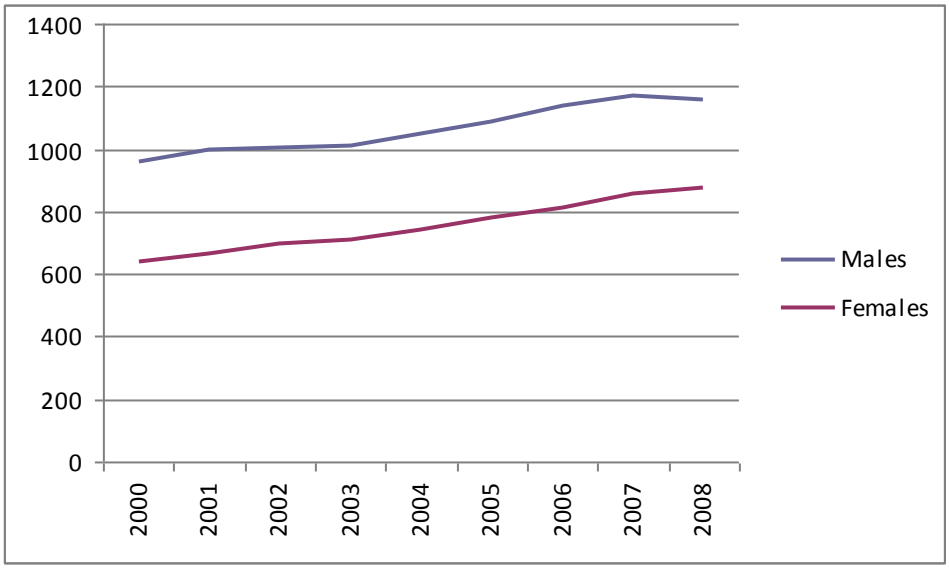


Source: Central Statistics Office of Ireland. Measured in Millions of 2007 euros.

Ignoring the contraction experienced in 2008, Irish GDP grew on average by over 7% between 1995 and 2007 and when the 2008 figure is included this figure falls to just less than 6.5%. GNP over the entire period increased on average by just over 5.5% per annum. However, the gap between the GDP and GNP has more than doubled over the period, from just under a 7% differential in 1995 to just under a 15% difference by 2008. The widening differential between GDP and GNP over the fourteen year period is of concern to an economy where output appears to be linked to the productivity of

foreign firms located within the Irish economy. This may suggest overdependence upon foreign firms and could also partly explain the depth of the current recession being experienced by the Irish economy. Perhaps it is fair to state that one of the failures of the 'Celtic Tiger' era is the failure to grow Irish industries which may have weakened the dependence upon foreign firms. The Irish labour market experienced relatively large increases in labour supply and Figure 2.2 below presents the number of males and females (Irish and foreign) in employment between 2000 and 2008[9].

Figure 2.2: Number of Males and Females in Employment, Ireland 2000-2008.



Source: Central Statistics Office of Ireland. Measured in Thousands.

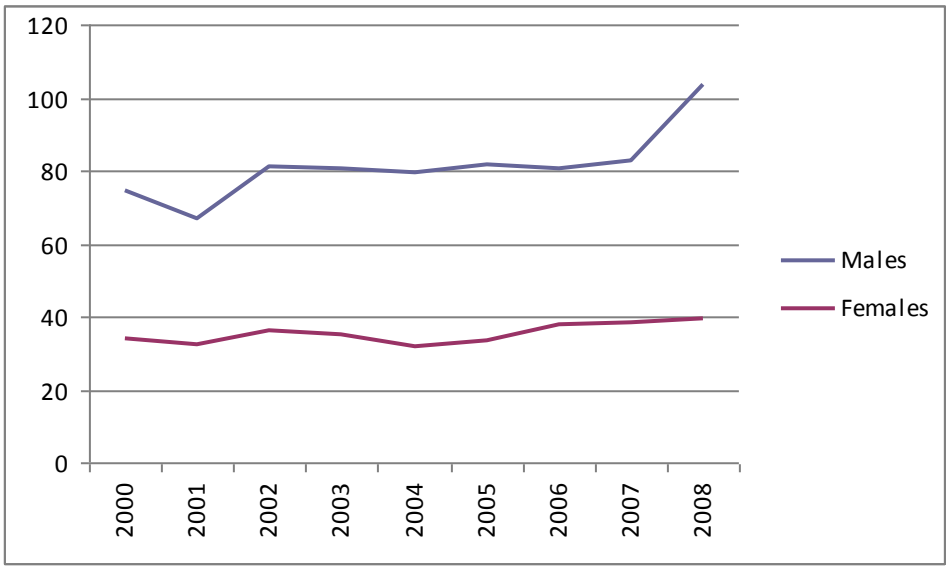
The average annual increase in the number of females entering the labour market (4.08%) is almost double the figure reported for Irish males (2.32%) between 2000 and 2008[10]. Over the entire period there was a 27% increase in the number of individuals in employment, with 38% more females in employment in 2008 than was reported in 2000. However, with the Irish economy currently below full employment equilibrium, this growth in employment does not reflect the current state of the labour market. It is reported by Behan et al. (2008) that 82% of the working age population were in full-

[9] Figures 2.2 to 2.7 include both Irish and foreign workers in the Irish labour market.
[10] In employment is defined by the CSO as "persons who worked in the week before the survey for one hour or more for payment or profit, including work on the family farm or business and all persons who had a job but were not at work because of illness, holidays etc. in the week".

time employment in 2007 and it would be anticipated that any Irish labour market reports based upon 2009 data would reflect much higher levels of both unemployment and emigration in response to the fall in demand in the labour market[11].

Figure 2.3 below presents unemployment figures for males and females in the Irish labour market between 2000 and 2008[12]. The unemployment figures are dominated by the dramatic increase experienced in 2008, particularly for male workers, where just under 25% more males were unemployed in 2008 relative to the previous year. Although female labour market participants also suffered in 2008, it was at a smaller level, with just over 3% more females experiencing unemployment in 2008 when compared with 2007.

Figure 2.3: Number of Males and Females Unemployed, Ireland 2000-2008.



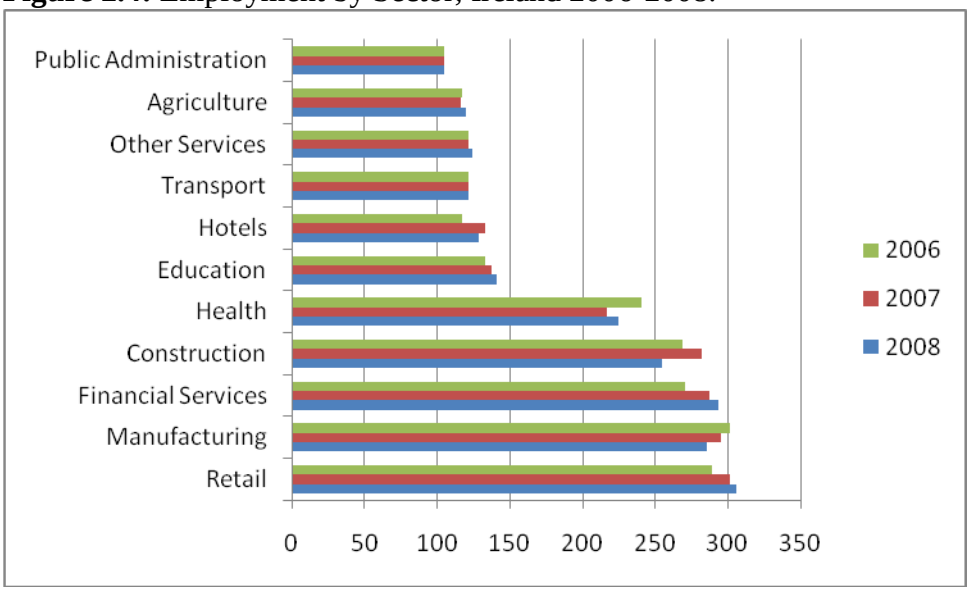
Source: Central Statistics Office of Ireland. Measured in Thousands.

Figure 2.4 below presents employment by sector in the Irish economy, as recorded between 2006 and 2008. In general, by 2008 each of the four leading (in terms of employment numbers) sectors employed in the region of 300,000 workers, with the

[11] The working age is considered by Behan et al. (2008) to be between the ages of 15 and 64.
[12] Unemployed is defined by the CSO as "persons who, in the week before the survey, were without work and available for work within the next two weeks, and had taken specific steps, in the preceding four weeks, to find work".

remaining workers being employed evenly across the other sectors (excluding health). It is anticipated that a similar analysis for 2009 would provide evidence of sharp decreases in employment in the leading four sectors. The hotel sector recorded the largest increase in employment over the two years (10.2%), while there were 6.6% less people employed in the health sector in 2008, relative to 2006[13].

Figure 2.4: Employment by Sector, Ireland 2006-2008.



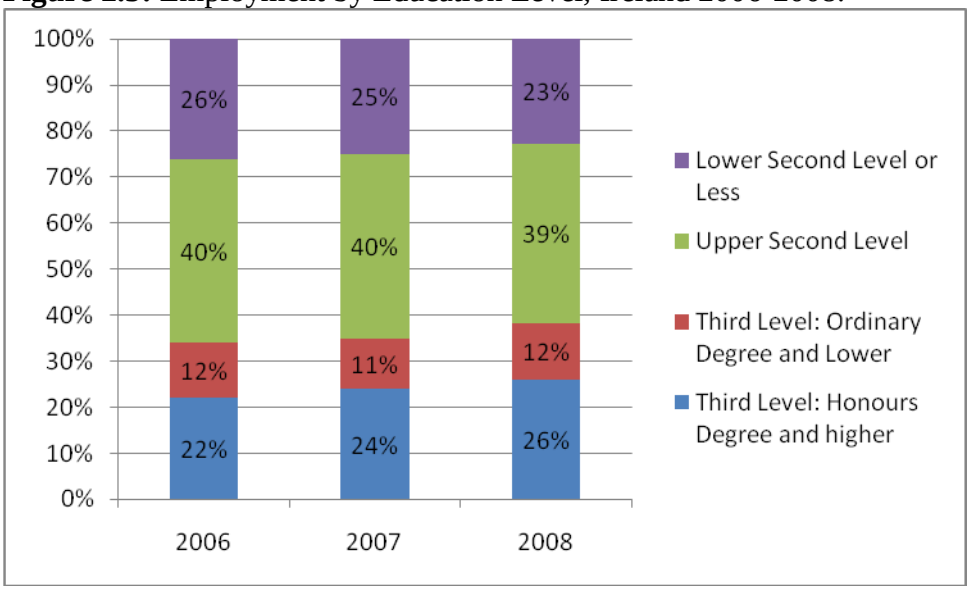
Source: Behan et al. (2009), Behan et al. (2008) and Behan et al. (2007). Measured in Thousands.

Figure 2.5 below shows employment by education level for Ireland in 2007 and 2006. From Figure 2.5 it is evident that approximately a quarter of employees in the Irish economy have only attained a lower second level (the equivalent of the General Certificate of Secondary Education (GCSE) in the UK) education at most. This is a worrying statistic given the stated policy of moving the Irish economy toward a knowledge-based economy. The national skills strategy as outlined in 2004 suggests that in order for the Irish economy to operate as a knowledge-based economy, 45% of the workforce will be required to hold third level qualifications (ranging from Ordinary degrees to PhD)[14]. However, the 2010 budget has cut funding to all education levels,

[13] Figures 2.4, 2.5, 2.6 and 2.8 present only three years of data (the most recently available) for comparisons, as earlier versions of the National Skills Bulletin do not contain comparable statistics.
[14] Available at http://www.skillsstrategy.ie/pdfs/egfsn070306_skills_strategy_report_webopt.pdf.

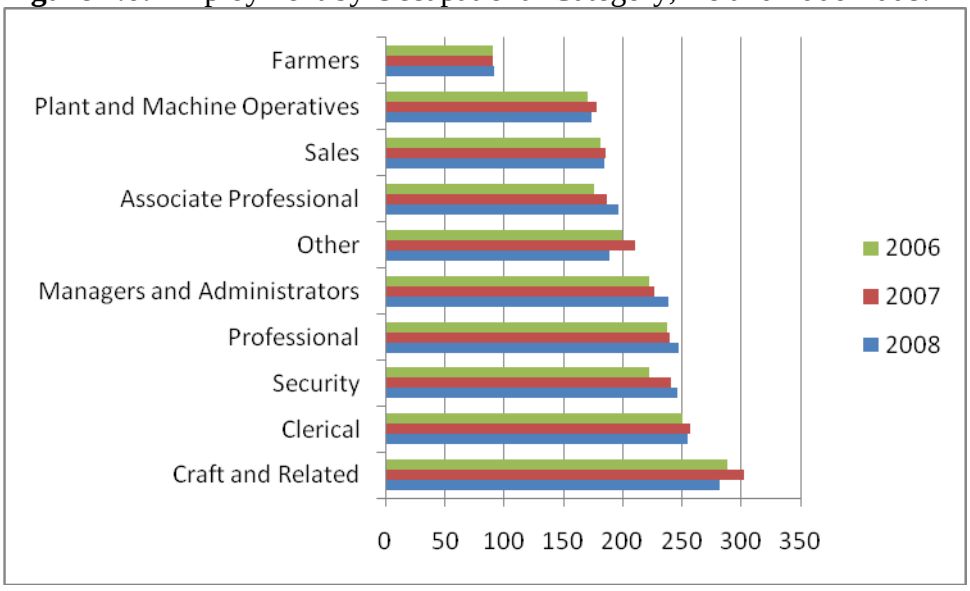
with the total education budget over 5% less than that of 2009 (Flynn, 2009), so the aspiration to move towards a knowledge-based economy is arguably not being supported with the required levels of investment.

Figure 2.5: Employment by Education Level, Ireland 2006-2008.



Source: Behan et al. (2009), Behan et al. (2008) and Behan et al. (2007).

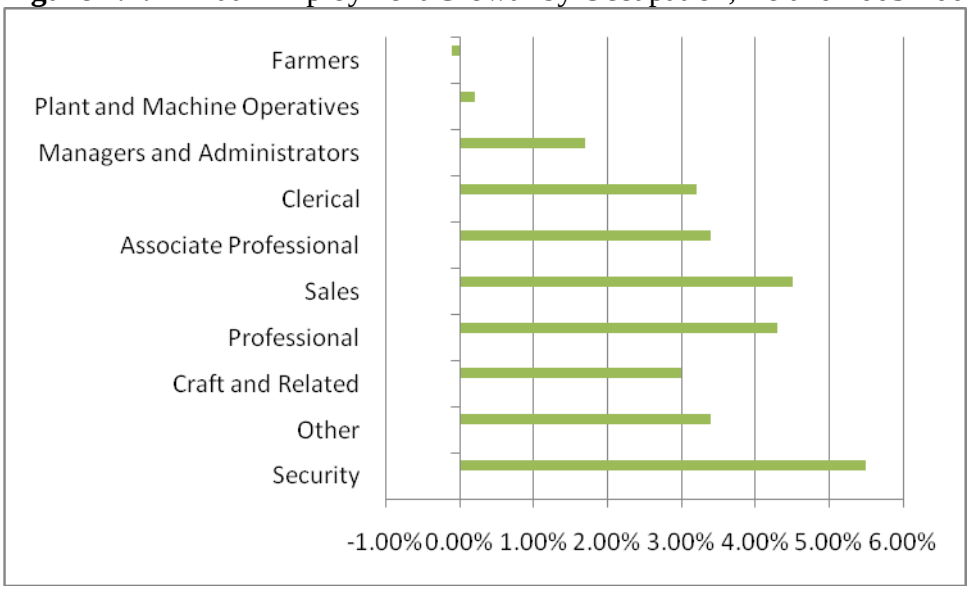
Figure 2.6: Employment by Occupational Category, Ireland 2006-2008.



Source: Behan et al. (2009), Behan et al. (2008) and Behan et al. (2007). Measured in Thousands.

Figure 2.6 above shows employment across occupational categories in Ireland. Much in line with the commentary of Figure 2.5, Figure 2.6 highlights the gap between workers occupying skilled occupations such as associate professional roles, which arguably acts as a barrier in moving towards a knowledge-based economy. By 2008, approximately 37% of the Irish workforce was employed in craft, clerical or security type occupations, while just 12% of the Irish workforce was engaged in a professional occupation, with this figure growing by approximately 4% during the period. Given the education profile of workers outlined in Figure 2.5 above this statistic is perhaps not surprising, but again it underlines the need for further investment in education in general and for greater participation at third level in particular.

Figure 2.7: Annual Employment Growth by Occupation, Ireland 2003-2008.



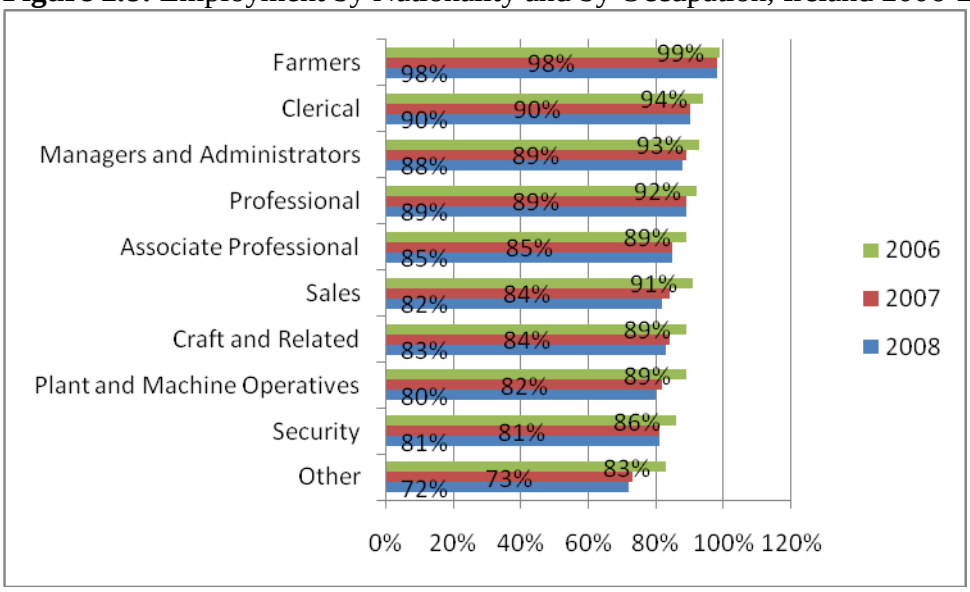
Source: Behan et al. (2009).

Figure 2.7 above shows the growth in each of the occupational categories in the Irish labour market between 2003 and 2008. Both the professional (4.3%) and associate professional (3.4%) occupational categories experienced an increase in the number of workers occupying these types of roles over the period, but neither could match the growth recorded in the security (5.5%) and sales (4.5%) occupations. Again, an economy moving towards a knowledge-based economy would be arguably expected to demonstrate stronger growth in the more skilled occupational categories and lower

growth in the lower skilled occupational categories. Further empirical analysis on occupational types in the Irish labour market is provided in Chapter 3.

In keeping with the overall theme of this thesis, i.e. the role of, and rewards for, foreign capital and foreign labour in the Irish economy, Figure 2.8 below highlights the breakdown of occupational categories by nationality for Ireland between 2006 and 2008. By 2008, foreign born workers occupied at least 10% of the posts in each occupational category, except in the case of farming which is an occupation with a declining number of workers, as Figure 2.7 above demonstrates. As further discussed in Chapter 3, the majority of foreign born workers in the Irish labour market tend to occupy posts in lower skilled occupational categories, with 28% of the non-skilled 'other' category comprising non-Irish workers in 2008, rising from 17% in 2006.

Figure 2.8: Employment by Nationality and by Occupation, Ireland 2006-2008.



Source: Behan et al. (2009), Behan et al. (2008) and Behan et al. (2007).

2.4 Conclusion

From both the statistics presented and the literature reviewed in this chapter, it is evident that the Irish economy has transformed from being an economic Island intent on protectionism and self-sufficiency, to currently being an open economy that both foreign capital and foreign labour view as an attractive location for investment and

employment. The remaining chapters in this thesis are concerned with how foreign capital, in terms of foreign firms located in the Irish manufacturing sector, and labour, in terms of occupational attainment in and earnings from the Irish labour market, perform in the Irish economy. To be specific, the proceeding chapter of this thesis Chapter 3, is an occupational attainment study which examines the roles occupied by foreign and native workers in the Irish labour market. Chapter 4 presents a Mincerian style earnings function analysis to examine the determinants of earnings of workers in the Irish labour market and specifically focuses upon wage differentials between indigenous and foreign labour market participants. The focus of Chapter 5 is upon how productive are the capital and labour employed in the Irish manufacturing sector and this analysis is carried out using a Cobb-Douglas type production function. As was the case in Chapter 3, particular attention is given to the relative differences between Irish and foreign firms in the sector.

Chapter 3: Occupational Attainment and Nationality in Ireland

3.1 Introduction

The success, status and esteem of an individual are often indicated by the career path that the individual has chosen and the success that they have achieved in their occupation, while, increasingly, university and college degrees and other educational programs are becoming more specifically orientated toward professions, notably in the areas of information technology and finance. For example, in Irish Universities a degree in Accounting and Finance tailored to suit the professional Accounting bodies is now a standard offering. So it is inevitable that there is a relatively vast bank of research in the labour economics field examining the occupational attainment of individuals dating back to Strong (1935) with substantial attempts at developing a cohesive theoretical framework, for example, by Blau et al. (1956). The empirical analysis presented in this chapter is the first detailed study in the Irish context, although Barrett et al. (2006) do examine occupational attainment in the context of a labour market model. To be specific, they estimate an occupational choice model as an input in their labour market model for Ireland. The model used however is relatively basic in that it uses a probit model which distinguishes between only two levels of occupational attainment, which are management/associate professional/professional and 'other'.

In Ireland, traditionally individuals involved in professions that required relatively high levels of qualifications tended to emigrate to the UK or the US to gain employment within their chosen occupation. This outflow of labour gave rise to the 'brain drain' era of the 1970's and 1980's, when the economic climate was such that skilled labour could not expect to work in their chosen occupation within Ireland and where emigration was the global solution to a domestic economic problem. With the dramatic economic turnaround during the 1990's came high levels of employment, resulting in virtual full employment in the labour market. Traditionally Ireland supplied the migrant labour into economies (see the discussion of the regional economy debate in Chapter 2 for a historical analysis of the migration of labour from Ireland) where labour shortages were experienced during boom periods for the host

economy, with the UK during the 1950's and 1960's as a primary example of such migration patterns, particularly in the construction sector. Now Ireland is being supplied with emigrant labour which is required to prevent the Irish labour market from stagnating and it is this influx of foreign labour into the Irish market for the first time that is a source of motivation for the empirical analysis presented in this chapter. The focus of this chapter is upon the occupational attainment of the members of the workforce sampled from 1999 to 2004. The data gathered is such that it allows for the impact of nationality, country of birth and years of residency in Ireland, upon occupational attainment to be examined, which to the author's knowledge is the first study of this type applied to the Irish labour market.

According to the FÁS report authored by Behan et al. (2005), between 1999 and 2004 the Irish population expanded by 8%, which was accounted for by a 6% increase in the number of Irish nationals and an 82% increase in non-nationals[15]. The Irish population in 2004 stood at approximately 4 million people, 5.4% of which were of foreign origin. This translates to approximately 215,000 non-national individuals. This figure was split evenly between EU (UK, 1.9% and rest of the EU, 0.8%) and non-EU nationals (US, 0.3% and other nationalities, 2.4%), while almost 70% of the non-Irish EU nationals were UK nationals.

Non-EU nationals are permitted to work in the Irish economy provided they have received a work permit from the Department of Enterprise, Trade and Employment and that the employee has the relevant qualifications, skills or experience to fill the post. Currently both employers and employees can apply for work permits for potential foreign national employees in the Irish labour market for an initial period of up to two years, which can then be renewed for a further three year period and, after this five year period, the permit can be renewed indefinitely. Employers thus have access to labour force participants from outside of the EU, provided that the post was attempted to be filled unsuccessfully (the labour market needs test consists of advertising the job

[15] FÁS (the Gaelic word for growth) is Ireland's national training and employment authority. For more information see www.fas.ie.

for three days in local and national papers), from the indigenous and the European Economic Area (EEA) labour pool[16].

In accordance with the guidelines issued by the Department of Enterprise, Trade and Employment, work permits are issued to a specific employer as permission to employ a specific individual for a specific period of time and occupation, but employees are allowed to switch employer but must apply for a new permit to do so[17]. According to the Department of Enterprise, Trade and Employment the current recruitment focus is on foreign professionals in the information technology, construction and medical fields, however the figures would suggest that the minority of occupations filled are in skilled occupations. Table 3.1 below highlights the level of work permits issued to workers from non-EEA.

Table 3.1: Number of Work Permits by Sector in 2005.

Sector	New Permits	Renewals	Group Permits	Issued	Refused
Agriculture	329	1810	0	2139	63
Catering	1309	5654	13	6976	564
Domestic	145	539	0	684	27
Education	269	456	1	726	19
Entertainment	86	92	784	962	6
Industry	416	1263	1	1680	34
Medical	1300	1383	0	2683	55
Services	3259	7683	10	10952	444
Sport	121	89	3	213	3
Total	7234	18969	812	27015	1215

Source: The Department of Enterprise, Trade and Employment.

Behan et al. (2005) examine the breakdown of new work applicants for the first half of 2005 and find that approximately 40% of new permits were issued to employees in the higher skilled managerial, associate professional and professional sectors. Most permits were issued to emigrant employees seeking employment in personal and protective security occupations.

[16] The European Economic Area is defined as the member EU states along with Iceland, Liechtenstein and Norway.
[17] For more detail on the visa material see http://www.entemp.ie/.

Table 3.2 below reports the breakdown of permits issued as highlighted by the Behan et al. (2005) report. When the educational attainment levels of the non-Irish work force are examined, the question of job matching is clearly raised. Behan et al. (2005) found that 44% of the non-national work force in Ireland held third level qualifications, with 73% of those qualifications being degree or higher order qualifications. Only 23% of the non-national work force reported primary education as being their highest level of educational attainment.

Table 3.2: New Work Permits by Occupation January 2005 to June 2005.

Occupation	Issued	% Issued	Refused	% Refused
Machinery Operatives	146	4.1%	20	3.2%
Security	868	24.4%	332	53.1%
Craft and Related	471	13.3%	75	12.0%
Clerical	144	4.0%	22	3.5%
Sales	85	2.4%	14	2.2%
Management	320	9.9%	33	5.3%
Associate Professional	518	14.6%	33	5.3%
Professional	582	16.4%	33	5.3%
Other	418	11.8%	63	10.1%
Total	3552	100%	625	100%

Source: Behan et al. (2005).

Despite the Government policy of recruiting skilled professionals from non-EU origins, the question arises as to whether Irish employers are hiring skilled labour to occupy less skilled roles. Barrett et al. (2006) allude to a similar finding in their profiling of the immigrant labour pool in the Irish labour market and refer to the phenomenon of overeducated migrants filling less skilled roles as an "occupational gap". If the trend of migrant labour generating 'occupational gaps' continues, it is important to ascertain what are the long term impacts upon productivity in the economy: arguably all skilled labour needs to be utilised to maximise productivity, not just those workers from the indigenous pool.

In this chapter a multinomial logit model is employed to analyse the occupational attainment of both indigenous and foreign labour in the Irish labour market. The nationality of the foreign individuals sampled is modelled using three separate measures (nationality, country of birth and years of residency), which allows for an examination of the effect of nationality upon the occupational attainment of foreign workers in the Irish labour market, while the years of residency variable will highlight the impact of duration in Ireland upon occupational attainment. The EU and other nationality variables (given that EU employees do not require work permits to gain employment in Ireland) allow for a contribution to the debate as to whether, as Minns (2005) believes, the work permit system is a prohibitive factor for migrants seeking employment in Ireland, or whether the alternative view held by Barrett et al. (2006) that it is in fact the inability of some migrants to speak English that is the true barrier to occupational success for the migrant work force in Ireland. In relation to language, it should be noted that the native Irish language, Gaeilge, is a requirement for some occupations, notably in the public sector (and in particular teaching) and therefore the ability to speak the native language may have an impact upon occupational attainment in the Irish labour market[18]. In accordance with Chapter 5, which is a production function study of the Irish manufacturing sector, the occupational attainment of manufacturing workers is analysed while the occupational attainment of both males and females are estimated separately. The data set used is the QNHS running from 1999 to 2004 which in total consists of 236,601 observations. The QNHS is chosen over the Living in Ireland (LII) data set due to the time span it covers, to be specific the LII survey was not carried out after 2001[19].

The stated objective of this chapter of investigating the occupational attainment of both indigenous and non-nationals in the Irish labour market, is in keeping with the overall aim of the thesis, to explore the relative successes of Irish and non-Irish components of

[18] For further information on Irish language requirements for teaching in Ireland see https://www.into.ie/ROI/InformationforTeachers/InspectionandProbation/NewlyQualifiedTeachersProbationandInduction/IrishLanguageRequirementandServiceinRestrictedSettings/.

[19] Unfortunately the QNHS does not contain wage data and therefore it is the LII dataset that is employed in Chapter 4 to analyse the wage equations.

the economy (Irish and foreign workers through analysis of Mincerian earnings functions in Chapter 4 and foreign firms and Irish firms in Chapter 5 via a production function analysis). The remainder of the chapter comprises of the following structure; in Section 3.2 the relevant literature in the field is summarised and reviewed, while Section 3.3 contains both a description of the methodology employed and some summary statistics of the key variables in the data set. Section 3.4 presents the results from the econometric analysis while conclusions drawn from the empirical analysis can be found in Section 3.5.

3.2 Literature Review

This section of the chapter focuses on the relevant existing literature in the area of occupational attainment. Occupational attainment is determined by several key factors including human capital (such as education and training), the family background of an individual and their social contacts, the role of intergenerational factors, wages and the uncertainty surrounding the future wages associated with a particular occupation, liquidity constraints, social class and nationality. The role of these factors and the debate surrounding occupational choice is reviewed below.

Constant and Zimmermann (2003) postulate that occupation determines the success of participants in the German labour market and can also reflect the general socio-economic standing of individuals[20]. Harper and Haq (1997) emphasise the importance of occupational attainment for an individual's life by arguing that occupational attainment will be an important determinant of the level of consumption, self esteem and indeed the status in society of the individual. It is for these critical reasons that occupational attainment has become a key research area in the labour economics field.

The study by Blau et al. (1956) was one of the first to attempt to build a conceptual framework to house the occupational attainment theories. In doing so Blau et al. (1956) examined the psychological characteristics of individuals and how people

[20] The literature review presented draws heavily on the work of Brown et al. (2008) and Constant and Zimmermann (2003).

operated within the social and economic structures that acted as boundaries within which people's psychological characteristics had to function. The influence of wage structures and other relevant economic factors on channelling labour into differing occupations was also built into the framework. Earlier attempts to examine occupational attainment such as those by Strong (1935), Super and Wright (1940) and Stewart (1947), all US based studies, are criticised by Blau et al. (1956) on the grounds that in these studies occupational attainment is determined either by employees' interests in the occupation chosen, the job market conditions associated with the chosen occupations or the individual's intelligence, but none of the three studies attempt to measure the influence of more than one of these determinants. Blau et al. (1956) argue that looking at only one individual approach, as those studies do, will mean excluding important variables that help determine occupational attainment and that elements from all three disciplines, psychology, sociology and economics, ought to be included in any study involving occupational attainment in order to generate a more inclusive framework. Blau et al. (1956) conclude that eight key factors determine entry into an occupation and that these variables are split between those factors related to the characteristics of an individual and those factors related to the prevailing market forces.

Early empirical studies in the area of occupational attainment tended to utilise the neoclassical human capital framework in determining the labour market choices of individuals (see Becker (1964) for an example of such work using US data). Boskin (1974) applying a conditional logit model on US data presented three key hypotheses:

1) Workers choose occupations that maximise the discounted present value of potential lifetime earnings;
2) Workers choose occupations that require the lowest training costs;
3) Workers choose occupations that offer the lowest discounted present value of earnings foregone during unemployment.

Boskin's (1974) findings were based upon research of men and women in the US. The second and third hypotheses were found to be less significant for white males in the

sample. Schmidt and Strauss (1975) adopted a multinomial logit approach to analyse occupational attainment and found that factors reflecting human capital (e.g. education and experience) increased the probability of an individual being engaged in a professional occupation in the US. However, their findings also indicated that both race and gender were key determinants of occupational attainment in the labour market.

Nickell (1982) also examined the impact of human capital upon occupational attainment and reported positive linkages between the two. Higher levels of education and experience increased the likelihood of obtaining a higher skilled position, while unemployment tended to be linked with lower occupational status in the UK labour market. Other studies supporting the human capital approach include Greenhalgh and Stewart (1985) who found a positive relationship between occupational success and higher levels of schooling regardless of gender for UK workers, while Zalokar (1988) employing a conditional logit model found that females in the US with greater levels of human capital accumulation tended to have higher labour force participation rates. Dolton et al. (1989) found that earnings were not a significant influence on the occupational attainment of individuals and that in fact for graduates the choice of their primary degree subject was more influential in choosing a profession, where in this case the profession was teaching as chosen by individuals in the UK.

Egerton (2001a) examines occupational attainment among mature graduates against that of conventionally aged graduates in the UK. The study suggests that mature graduates are disadvantaged on entry to the labour market, but after approximately fifteen years of employment they have achieved similar attainment to that of their early graduate counterparts. Egerton (2001a) points out that mature graduates primarily work in the public and welfare services, while increasingly the trend is for conventional aged graduates to find employment in the private sector. Interestingly, Egerton (2001a) suggests that mature women and those mature men with postgraduate qualifications tend not to suffer upon entry to the labour market and tend to do as well as the conventionally aged graduates. Bradley (1996) reporting on an employment

survey across various economies including the UK and the US suggests that employers are reluctant to appoint women over thirty five years of age and men over the age of forty. Thomas (1994) however points out that the lower occupational attainment of mature graduates is in effect due to the signalling impact that returning to college later in life has upon corporations who perceive these mature graduates as having been 'failures' in their earlier lives. Egerton (2001b) compares the occupational attainment among mature graduates from working class origins against that of middle class graduates from the UK. The key finding is that working class mature students are more likely to have studied in less prestigious colleges and at an older age than their middle class counterparts. These characteristics tend to be associated with lower occupational attainment.

The role of an individual's endowments in terms of their family background became the focus of studies in the area, as researchers sought evidence of the influence of other (than the human capital variables) explanatory variables on occupational attainment. Mayhew and Rosewell (1981) found that education alone did not explain the occupational attainment of individuals in the UK, but the family background of employees had a determining role to play in the occupational attainment of individuals. Miller and Volker (1985) also included family background as an explanatory variable in their study of Australians' occupational attainment, while Robertson and Symons (1990) in examining the occupational attainment of males in the UK found that family background does indeed have a bearing on the occupational success experienced by individuals. Connolly et al. (1992), in researching the success of young men in the UK who left school at sixteen, state that family background is the key determinant of occupational attainment as it provides access to the contacts and resources necessary to forge a successful career, while Harper and Haq (1997) in researching the occupational attainment of thirty three year old UK males showed that family background is an important factor in occupational outcomes. Sjögren (2000) examines a model of occupational attainment and human capital investment for the case of Sweden. The author states that allowing for family background provides the opportunity for occupational attainment to be influenced by access to economic resources in much the

same way that Connolly et al. (1992) have argued. Applying a multinomial logit model, Sjögren (2000) concludes that individuals are more sensitive to economic incentives when considering occupations that differ to that of their parents and that the occupational attainment of the less well off individuals in the labour market are more sensitive to economic incentives than their wealthier counterparts. Others to highlight the significance of the role of the family in occupational attainment include Osterman (1980) who examined the evidence for the US and Atkinson et al. (1983) in the case of the UK.

Another variable often utilised in occupational attainment studies but rarely observed and strongly linked to family background is the social network of the individual. Holzer (1988) in utilising the US National Longitudinal Survey highlights the positive role of social contacts in helping people find jobs, while Montgomery (1991) finds that the share of US workers reporting to have found jobs via their social network ranges from 24% to 74% depending on the occupation and location of the individual. The evidence of the success of such an occupational attainment strategy in terms of remuneration is mixed. Granovetter (1974), in examining the US labour market, reports that those individuals who found jobs through a personal contact had higher incomes than their colleagues whom acquired their posts through a more formal process. Similarly, Simon and Warner (1992) using US data, found that those who acquired jobs through social networks had higher wages than those who were not occupying posts through the help of a social contact and Kugler (2002) finds that industries with a higher percentage of "referred" workers paid higher wages than industries where social networks were not utilised as frequently in occupational attainment in the US labour market. However Bentolila et al. (2010) argue that social networks may help people to find jobs, but in occupations that will not fully exploit their abilities, thus social contacts can generate a mismatch between a worker's current occupation and the occupation where their comparative advantage actually lies. Bentolila et al. (2010) suggest that economies that rely upon social networks can exhibit low labour force quality coupled with low returns to firms' investments and that social networks are inefficient. Bentolila et al. (2010) examine US and European data

and find that jobs obtained via social contacts do lead to lower wage levels in the order of 6% to 7%. In conclusion, Bentolila et al. (2010) suggest that social networks can generate underemployment traps whereby employment rates are high but individuals are in the 'wrong' occupations so productivity is low. Others to report negative findings in this area include Corcoran et al. (1980) in the case of black females in the US and Pistaferri (1999) who analysed an Italian data set.

Constant and Zimmermann (2003) provide a comprehensive review of the studies involving occupational attainment, intergenerational influences and associated issues. Behrman and Taubman (1976) examined the influence of the father's socio-economic background on the son's socio-economic status using US data and found that for white males there is indeed a positive correlation between the two. Heckman and Hotz (1986) find that parental education has a positive effect on the earnings potential of Panamanian men, while Behrman and Wolfe (1984) present similar results for women in Nicaragua. Behrman and Taubman (1990) in revisiting an extended version of their original data set, found that the intergenerational elasticity of earnings is greater for sons and non-whites. Solon et al. (1991), using a US data set, report that the father's employment is strongly significant for those in self-employed occupations, although further examination of this relationship using a US data set by Hout and Rosen (1999) demonstrates that there are racial differences with this outcome. Couch and Dunn (1997) highlight the positive and significant correlation between the earnings of fathers and sons for both the US and Germany. The same result is reported for mothers and daughters, although the outcome is deemed insignificant for Germany. Dolton and Mavromaras (1994), building on the work of Willis and Rosen (1979) and Dolton (1990), examine intergenerational occupational attainment with specific reference to teaching in the UK. The findings suggest that the 1970 cohort of teachers was much more responsive to wage increases than the 1980 cohort and that women were more likely to enter the profession than men regardless of any potential pay increases. Zarkin (1985) in another analysis of the teaching profession (in the US) finds that demand (proxied by birth levels) is a significant factor for teaching graduates to take into account when selecting the occupation.

Harper and Haq (1997) in examining a data set of UK males conclude that the determinants of occupational success are in place from an early age in life and that the father's social class at birth is found to be one of those important variables. Gang and Zimmermann (2000) established that the father's educational levels are more important than that of the mother's in determining the occupational attainment of German children. Interestingly, Ermisch and Francesconi (2000) find that females involved in full-time occupations during the early childhood of their offspring tend to generate a negative effect upon the educational attainment of children in the UK. Epstein and Lecker (2001) examine first, second and third generation earnings in Israel. The estimated earnings profile has an inverse u-shape, with the second generation of workers having higher earnings than both their own parents and their own children. The earnings of the third generation are also higher than that of their grandparents, i.e. the first generation. This result accords with Rosholm et al. (2002) reporting similar findings for Denmark. Iannelli (2002) found significant direct and indirect impacts of parental education upon children's occupational outcomes for the EU. Black et al. (2005) analyse the Norwegian experience of parental educational levels influencing children's educational levels, and report a positive relationship between the two. Ginther and Pollak (2003), using a variety of US data sets, find that the role of family structure on occupational attainment is less relevant when controlling for the mother's educational level, parental employment and the family's income.

Constant and Zimmermann (2003) adopt the Schmidt and Strauss (1975) framework and apply it to a German panel data set. The focus of the study lies in the impact of neoclassical human capital theories and the importance of family background upon occupational attainment. Using a multinomial logit model of occupational attainment, they examine the results for children of both individuals born in Germany and immigrants and, in general, find similar results for both groups. Some stylised findings are reported such as: gender affects occupational attainment; and higher levels of human capital in the form of experience and schooling are associated with individuals acquiring higher skilled positions in the labour market. Individuals born in Germany are more likely to choose occupations similar to their father's occupation when the

father is a professional or white collar worker. In contrast, immigrant children's occupational attainment is more likely to be influenced by their mother's educational level and not by their father's occupation. In conclusion, Constant and Zimmermann (2003) state that individuals select their occupation as young adults and tend to stick with it, but that individuals with different family backgrounds do not face the same set of opportunities as each other.

Other intergenerational studies have tended to focus on occupational mobility. For example, Chiswick (1978a) suggests that immigrants will experience downward occupational mobility on arrival in a host country, but with additional years of experience and residence their occupational status can improve. This is a result of particular relevance to the Irish context, given the transition of the labour market from a depressed equilibrium where excess supply led to mass emigration to one where labour shortfalls are now filled by an influx of international labour market participants. Bauer and Zimmermann (1999) looked at the occupational mobility of ethnic Germans and found evidence of downward mobility by gender. However they conclude that higher skilled workers are able to reach their chosen occupational category within fourteen years of residence in Germany.

Several studies on intergenerational income mobility in the US, notably Solon (1992) and Zimmermann (1992), report that there is actually less mobility than was previously believed. Siow (1984), utilising US data on lawyers, suggests that the main econometric problem faced while estimating models of occupational attainment is that the individual's forecasts of future wages are unobservable. This problem also incorporates other components within the model, for example how agents choose between two occupations that require differing schooling durations. Smith (1938), Becker (1964) and Mincer (1974) all assume that agents will decide between the two occupations by comparing the expected present value of income between the two occupations. Siow (1984) argues that, although this decision rule is well known, the aforementioned problem of uncertain wages hinders econometric work in this area and that most studies utilise cross-sectional or short panel data sets thus the total lifetime

wages of agents remain unobserved. Rosen (1977) extends the theoretical problem by highlighting the reality of dropouts from occupations. The uncertainty of total lifetime wages is further complicated by the changing wage patterns associated with individuals leaving a chosen profession. Freeman (1971, 1975a, 1975b) using various US data sets attempts to solve the problem of wage uncertainty by examining how demand conditions in a market influence the supply of new students in this area. The concept is based upon the premise that current students use current wages in selecting an occupation. However Siow (1984) states that given that the forces of supply and demand will inevitably fluctuate, the prevailing price of labour, i.e. current wages, may end up being a poor predictor of future wages. This creates a systematic forecast error in wage prediction, which causes cycles in the supply of new entrants into a profession. This cyclical model is known as the cobweb model.

Siow (1984) attempts to solve this wage uncertainty problem by assuming that agents have rational expectations and by examining the effects of arbitrage both within and between cohorts. Siow (1984) examines the market for lawyers in keeping with work by Freeman (1975a) and Pashigian (1977) (both using US data) by estimating two time series regressions, one each for supply and demand for the occupation. The results of these regressions enabled estimates to be obtained for the rates of return to education and the direct costs of education. In order to estimate these equations, Siow (1984) utilises Mincer's (1974) schooling model to examine occupational attainment under uncertainty. The model is an integration of the supply side factors with the effects of demand conditions in the theory of occupational attainment. Siow (1984) postulates that the benefits of this approach include:

1) A solution can be obtained to the problem of unobservable future wages;
2) Estimates of direct schooling costs of an occupation are produced;
3) The problem of uncertainty of tenure is factored into the model, therefore the estimated returns to education remain unbiased;
4) The model is an alternative to the cobweb model used for forecasting the supply of new entrants into an occupation.

Overall, Siow's (1984) model performs well in examining the supply side of the market, but does not function as adequately for the demand side. Connelly's (1989) theoretical work augments Siow's (1984) research by allowing for experience and education as determinants of earnings.

The impact of being an immigrant in a host country on occupational attainment is the key research question in this chapter and there are several important studies in relation to this concept. Chiswick (1978a) suggests that immigrants should experience occupational change in their host country due to imperfect transferability of language, job skills and labour market information and outlines four hypotheses based upon immigrant occupational mobility:

1) Immigrants should experience a decline in occupational status from their country of origin to their host labour market, which should be followed with an increase in occupational status over the duration of stay in the host economy;
2) The occupational mobility of immigrants in a host country should display a U-shaped pattern over time and should be very shallow for immigrants who are low skilled and relatively steep for those immigrants that are more skilled;
3) The U-shaped pattern of occupational attainment should be shallow for those immigrants from countries with a language and labour market set-up similar to that of their host country;
4) The U-shaped pattern of occupational attainment should be steepest for refugees, less step for family migrants and least step for economic migrants.

Stewart (1983) highlighted the lack of immigrant based occupational attainment studies for the case of the UK and used the work of Hall and Kasten (1973) in examining the occupational attainment of black workers in the US as an example of the type of research that should be carried out. Stewart (1983) concentrated on the occupational differences between black immigrants and white UK-born individuals and reported an

11.6% differential between the occupational positions of both groups, with the premium associated with white UK-born workers. It was found that black immigrant workers in the UK tended not to move up the occupational ladder with experience, but could expect to move up a salary scale within an occupation. With respect to wage levels, Stewart (1983) concluded that poor spoken English accounted for 9% of the wage gap between black immigrant and white workers, that returns to education were higher for white workers across all educational levels and that black immigrant workers experienced flatter experience profiles than their white counterparts. Carmichael and Woods (2000) went beyond the typical black/white labour market debate by examining the occupational attainment of black, Indian, Pakistani and Bangladeshi workers in the UK and found that "ethnic penalties" experienced by minority workers could not be fully explained by differences in human capital acquisition. Having controlled for human capital and other relevant personal characteristics, the influence of ethnicity on occupational attainment was found to be negative and statistically significant and they concluded that, in line with the work of Heath and McMahon (1995), there is an ethnic penalty incurred by non-white workers in the labour market. Carmichael and Woods (2000) suggest that, in terms of occupational attainment, this ethnic penalty is most severe for black men and Indian women in the UK. In a more recent UK based study, Elliot and Lindley (2008) report an occupational differential for non-white immigrants and non-white natives, with all non-white natives and immigrant groups experiencing a penalty in terms of obtaining employment in the higher skilled occupations.

Forrest and Johnston (2000) explore the occupational attainment of fifty two immigrant groups working in Australia as defined by their country of birth. The work extends previous studies in the area where the occupational attainment of only five (Vaughan, 1992) and six (Wooden, 1994) groups respectively were considered. In line with the findings of Miller and Neo (1997), Forrest and Johnston (2000) report that immigrants with higher educational attainment and qualifications, who can speak the English language well and who stay in Australia longer, are more likely to be employed in higher paid occupations. Chiswick et al. (2003) also focus upon the occupational

attainment of immigrants in Australia and report results in line with his earlier hypotheses (Chiswick, 1978a): a U-shaped pattern of occupational change from the pre-immigration post through to the job occupied by the immigrant after three and half years in Australia; the U-shape is shallower for immigrants originating from countries similar to Australia in terms of language and labour market structure; the U-shape is steeper for immigrants who are refugees than for family or economic migrants.

Barrett et al. (2006) use an occupational attainment model as an input into a larger framework that examines the impact of immigrants in the Irish labour market. Using the 2003 QNHS, the same data set as utilised in this chapter, a probit model is employed to predict occupational attainment[21]. Barrett et al. (2006) report that being older, better educated, being male and having longer durations of stay with the employer, all increase the likelihood of being employed in higher skilled occupations. The coefficient on immigrants was found to be negative, but Barrett et al. (2006) discount the structure of the Irish work permit system argument, as put forward by Minns (2005), as being the cause of immigrants occupying lower skilled posts. This is because when the immigrant variable is split into different nationalities, the EU-15 are reported as having lower occupational attainment and this group does not require work permits. The coefficients on both the UK and US workers are positive and Barrett et al. (2006) interpret this as signalling poor spoken English as being the reason behind the aggregate immigrant variable being negative. From the overall model, Barrett et al. (2006) estimate that GNP is between 3.5% and 3.7% higher as a result of the immigrant work force in Ireland.

Some of the recent work in the area of occupational attainment has questioned the traditional methodology applied. For example, Brown et al. (2008) argue that there is no econometric framework in place to help determine the occupational attainment of an individual accurately as the standard practice of using a multinomial logit model to estimate occupational attainment is flawed due to the fact that it ignores the potential

[21] Unlike the eight occupational categories that are analysed in this Chapter, Barrett et al. (2006) split occupations into only two categories and so specify a binary probit model.

ordering in occupational attainment with respect to skill levels. In Brown et al.'s (2008) critique of the multinomial logit model the maximisation of random utility and the ease of specification and estimation associated with the multinomial logit model are highlighted as being the main reasons for its frequent usage. However, the fact that the multinomial logit model collapses supply and demand factors together and that it does not differentiate between ordered and unordered outcomes are the reasons why Brown et al. (2008) have implemented a new econometric framework. They highlight the importance of differentiating between supply side and demand side factors in modelling occupational attainment as initially it is the supply side of the market that determines the distribution of workers, but the demand side takes effect where excess supply or demand exists in a labour market. Brown et al. (2008) construct an economic framework that allows the separation of the supply and demand sides and which also allows for potential ordering across occupations. The procedure applied is labelled the parameterised dogit ordered generalised extreme value model (DOGEV) which integrates the ordered features of Small's (1987) ordered generalised extreme value model and the push pull characteristics of Gaudry and Dagenais's (1979) dogit model. Analysing data from the US, Brown et al. (2008) determine that there is indeed an ordering of occupations and that the acquisition of skills through on-the-job training and/or experience is insufficient in breaking down barriers into occupations generated by educational qualifications and therefore education can actually operate as a barrier to entry into higher level occupations. The logical policy implications from such a finding relate to the importance of investment in education in order to receive the returns from qualifications throughout a career.

It is evident that the key determinants of occupational attainment are education and experience, but that other non-human capital characteristics of individuals such as gender and social networks can also impact upon the occupations acquired by individuals. Importantly from this study's perspective, it is clear that immigrant workers in a host economy initially tend to work in occupations involving lower skills and pay than posts which may have been previously held in their country of origin.

The reasons given for this include language difficulties, poor transferability of skills from one economy to another and in the case of Ireland work permit systems.

3.3 Methodology and Data

The traditional methodology used to determine the impacts of relevant variables on an individual's occupational attainment has been to apply a multinomial logit model to the available data. In this section the multinomial logit method will be described, as it is the multinomial logit model that is utilised in the estimation process in Section 3.4. As stated above, Brown et al. (2008) argue that the multinomial logit is the most commonly employed estimation technique when examining occupational attainment due to the fact that this strategy leads to the maximisation of random utility and also the relative ease of specification and estimation associated with the multinomial logit model. Examples of works utilising the multinomial logit methodology in examining occupational attainment include Schmidt and Strauss (1975), Brown et al. (1980), Sjögren (2000) and Constant and Zimmermann (2003). The key strength of the multinomial logit model is in the flexibility of the model. Unlike the alternative estimation method, the ordered probit model, which reports one set of estimated coefficients, the multinomial logit model provides a set of marginal effects for each occupational category. This in essence is the key strength of the multinomial logit method and is the key driver in choosing to estimate the occupational attainment models in this chapter using the multinomial logit technique. The debate over ordered and unordered outcomes is far from solved and in the interim the multinomial logit model arguably remains part of the best practice solution, as well as allowing a comparison of the findings presented in this chapter with the existing literature.

3.3.1 The Multinomial Logit Model

Greene (2003) states that discrete choice models in general are appropriate when the economic outcome to be modelled is a discrete choice among a set of alternatives, rather than a continuous measure of some activity[22]. According to Gujarati and Porter

[22] The review of the multinomial logit methodology presented in this subsection is adapted heavily from Greene (2003).

(2009) the multinomial logit model is a necessary estimation tool where the regressand consists of three or more unordered categories, while Borooah (2002) suggests that the multinomial logit procedure is an appropriate technique to use when dealing with multiple outcome models where the outcome is not ordered. Cameron and Trivedi (2005) attribute the model to the work of Luce (1959)[23]. Unordered choice models can be motivated by a random utility model. In the occupational attainment setting, assume that the i^{th} labour market participant is faced with j occupations. The utility of occupation j is given by:

$$U_{ij} = X_{ij}'\beta + \varepsilon_{ij}. \qquad (3.1)$$

If the individual does decide to make choice j in particular then it can be assumed that U_{ij} is the maximum of all the J utilities. The probability of choice j being made by the individual is represented by equation (3.2) below:

$$\text{Prob}\,(U_{ij} > U_{ik}) \text{ for all } k \neq j. \qquad (3.2)$$

The model of occupational attainment as adopted in this chapter contains eight occupational categories. The dependent variable (O_i) is defined as follows[24]:

$$O_i = \begin{cases} 0 & \text{if Individual 'i' is employed as a plant and machinery operative.} \\ 1 & \text{if Individual 'i' is employed in personal and protective security post.} \\ 2 & \text{if Individual 'i' is employed in a craft or related post.} \\ 3 & \text{if Individual 'i' is employed in a clerical or secretarial post.} \\ 4 & \text{if Individual 'i' is employed in a sales related post.} \\ 5 & \text{if Individual 'i' is employed as a manager or administrator.} \\ 6 & \text{if Individual 'i' is employed in an associate professional or in a technical post.} \\ 7 & \text{if Individual 'i' is employed in a professional post.} \end{cases}$$

[23] The main drawback of the multinomial logit model is the property of the independence of irrelevant alternatives. For a discussion on this topic see Borooah (2002).

[24] Unemployed individuals have been excluded from the estimations as key variables such as occupational affiliation, year started work and sectors worked in are not recorded for the unemployed. Just under 5% of the working age individuals sampled were unemployed.

The model of occupational attainment can be represented by equation (3.3) below assuming that O_i is a random variable that indicates the choice made by the individual:

$$\text{Prob}\,(O_i = j) = \frac{e^{\beta_j' X_i}}{\sum_{k=0}^{7} e^{\beta_k' X_i}},\ j = 0, 1, 2, 3, 4, 5, 6, 7. \tag{3.3}$$

The model represented by equation (3.3) is the multinomial logit model. When estimated, a set of equations will be produced that will provide a set of probabilities for the J + 1 choices that the individual with characteristics, X_i, faces. Greene (2003) highlights the need to remove an indeterminacy in the model at this point of the methodology. In doing so, the following identity is set for any vector, q:

$$\beta_j^* = \beta_j + q. \tag{3.4}$$

The probabilities are then recomputed using β_j^* instead of β_j. This result produces the identical set of probabilities as before (i.e. equation (3.3)) as all terms involving q drop out of the system. The normalisation $\beta_0 = 0$ solves this mathematical problem, so only J parameter vectors are required to determine the J + 1 probabilities. The relevant probabilities can be estimated using the following equation:

$$\text{Prob}\,(O_i = j \mid X_i) = \frac{e^{\beta_j' X_i}}{1 + \sum_{k=1}^{J} e^{\beta_k' X_i}},\ j = 0, 2, \ldots, J,\ \beta_0 = 0. \tag{3.5}$$

Now J log-odds ratios can be estimated:

$$\ln\left[\frac{P_{ij}}{P_{ik}}\right] = X_i'(\beta_j - \beta_k) = X_i'\beta_j,\ \text{if } k = 0. \tag{3.6}$$

The log-likelihood function can be derived by defining for each agent that $d_{ij} = 1$ if occupation j is attained by individual i, and $d_{ij} = 0$ if this condition is not met, for the J – 1 possible selections. The log-likelihood function in this instance is represented by equation (3.7) below:

$$\ln L = \sum_{i=1}^{n} \sum_{j=0}^{J} d_{ij} \ln \text{Prob}(O_i = j). \tag{3.7}$$

The derivatives of the function can be calculated as follows:

$$\frac{\delta \ln L}{\delta \beta_j} = \sum_i (d_{ij} - P_{ij}) X_i, \text{ for } j = 1, \ldots, J. \tag{3.8}$$

The second derivative of the function has the following format:

$$\frac{\delta^2 \ln L}{\delta \beta_j \delta \beta_l'} = -\sum_{i=1}^{n} P_{ij} [1(j = l) - P_{il}] X_i X_i'. \tag{3.9}$$

where 1(j=l) equates to one if j = l and zero alternatively.

Cameron and Trivedi (2005) highlight the use of marginal effects for interpretation purposes with the multinomial logit model[25]. The reason such focus is put on the marginal effects of the multinomial logit model when dealing with the choice probabilities is due to the situations where there may not be a one-to-one correspondence between coefficient sign and coefficient probability. With discrete choice models, the marginal effects will vary with the independent variables and therefore the interpretation of the coefficient can be meaningless. The traditional solution is to calculate the marginal effects where the respective independent variables

[25] For a thorough discussion on why marginal effects should be treated as the values containing more accurate information from discrete choice models see Greene (2003) and Anderson and Newell (2003).

are set equal to their mean values. By differentiating equation (3.5), the marginal effects of the characteristics on the probabilities can be obtained:

$$\delta_j = \frac{\delta P_j}{\delta x_i} = P_j\left[\beta_j - \sum_{k=0}^{J} P_k \beta_k\right] = P_j\left[\beta_j - \overline{\beta}\right]. \tag{3.10}$$

Every subvector of β enters every marginal effect both via the probability and the weighted average that appears in δ_j. In order to calculate the appropriate standard errors associated with the marginal effects, it is assumed that a fixed 0 vector is included for outcome 0 and that:

$$\beta = \left[0, \beta_1', \beta_2', ..., \beta_j'\right]. \tag{3.11}$$

The standard errors are calculated using the delta method[26].

Equation (3.12) below, an occupational attainment model, is estimated utilising a multinomial logit approach using Irish data from the QNHS from 1999 to 2004:

$$O_i = \alpha + \beta X_i + \varepsilon_i. \tag{3.12}$$

where the dependent variable is the occupational attainment index ranging from 0 to 7 as defined above, X_i is a vector of explanatory variables, which draws on the existing literature, and include, age, gender, nationality, marital status, industry, year dummy variables, labour market experience, region, and number of children, β measures the marginal effect of the relevant variable, while ε_i is a normally distributed error term. Three separate models are specified and differ only in the variable included to represent nationality. Model 1 incorporates nationality, model 2 utilises country of birth while model 3 includes years of residency. Four separate samples are examined

from the data set; all workers, manufacturing workers only, male workers only and female workers only[27]. For a detailed description of both the dependent and independent variables, see Table A3.1 in the Appendix at the end of the chapter.

3.3.2 Data Description

The QNHS data set, although collected by the CSO, was provided by the Irish Social Science Data Archive (ISSDA). The CSO describes the QNHS as follows[28];

> *"The Quarterly National Household Survey (QNHS) is a large-scale, nationwide survey of households in Ireland. It is designed to produce quarterly labour force estimates that include the official measure of employment and unemployment in the state (International Labour Organisation basis). The survey began in September 1997, replacing the annual April Labour Force Survey (LFS)."*

The QNHS cross-sectional data set is used as the data source in this chapter since it provides the most up to date data. The alternative data set available, LII, was not collected after 2001 and so the QNHS which is available to 2004 was deemed to be more suitable for an occupational attainment study examining immigrant labour, given the influx of migrant labour into Ireland in latter years[29]. There are six years (1999 - 2004) utilised in the occupational attainment models analysed in this chapter totalling in 236,601 observations[30]. The yearly breakdown of the sample sizes of the QNHS used in the occupational attainment study in this chapter is presented in Table 3.3 below.

---

[26] Standard errors are generated via the linear approximation approach (delta method). See Greene (2003) for a full discussion of the delta method.

[27] Only respondents from the ages of 15 to 64 were included in estimations. Those over 64 years of age are in an age category of 65 plus and are likely to be retired, or very close to retirement, while the first working age category is 15 to 19 years of age.

[28] Source: http://www.cso.ie/qnhs/what_is_QNHS.htm. For more information on the ISSDA see http://www.ucd.ie/issda/.

[29] The QNHS does not contain wage data, so the wage study in Chapter 4 does utilise the LII data set.

[30] The QNHS commenced in 1998 but the first wave of data did not contain information on educational attainment. 2004 was the most recent data available at the time of estimation.

The number of usable observations falls in 2004, which reflects a fall in the overall sample size[31]. In 1999 111,342 people were surveyed while in 2004 the equivalent figure was 86,545. In terms of the nationalities of the individuals in the data set there are five categories; Irish, UK, the rest of the EU (excluding the UK and Ireland), the US and other nationalities.

Table 3.3: QNHS, Number of Usable Observations from 1999 to 2004.

Year	Number of Observations
1999	40,500
2000	40,658
2001	41,042
2002	41,163
2003	39,892
2004	33,346

Source: The Quarterly National Household Survey, 1999 - 2004.

The number of individuals in each of these nationalities reported in the data set is set out on a yearly basis in Table 3.4 below. As would be expected, the Irish dominate the responses in the survey with on average 95% of the respondents being Irish, with the UK and other nationalities each comprising just under 2% of the nationality of the individuals in the survey. One would anticipate that the equivalent figures will change substantially from 2005 onwards, given the 2004 EU accession treaty which opened the door to Eastern European citizens to the Irish labour market with immediate effect. Only the UK and Sweden adopted a similar stance and this policy coupled with the strong Irish labour market at the time would suggest that the EU figure may surpass the UK figure from 2005 onwards.

[31] Usable observations refer to the individuals included in the estimations. This group is defined as being in either full-time or part-time employment and aged between 15 and 64, without missing values

Table 3.4: QNHS, Number of Individuals by Nationality from 1999 to 2004.

Year	Irish	UK	EU	USA	Other
1999	39086	844	324	84	162
2000	39166	793	384	71	244
2001	39186	886	415	84	471
2002	39017	884	436	85	741
2003	37506	923	457	66	940
2004	31403	0	0	76	1867

Source: The Quarterly National Household Survey, 1999 - 2004. For a percentage breakdown of these figures see Table A3.2 in the Appendix.

The breakdown of each of the eight occupational categories over the six years of the survey is displayed in Table 3.5 below.

Table 3.5: QNHS, Number of Individuals by Occupation from 1999 to 2004.

Year	Plant	Security	Craft	Clerical	Sales	Management	Technical	Professional
1999	4,585	4,342	6,206	5,685	3,606	7,884	3,719	4,473
2000	4,865	4,491	6,143	5,546	3,681	7,736	3,724	4,472
2001	5,033	4,367	6,134	5,629	3,739	7,752	3,877	4,511
2002	4,771	4,399	5,831	5,851	3,748	7,731	4,007	4,825
2003	4,220	4,522	5,873	5,357	3,610	7,427	4,028	4,855
2004	3,207	3,788	4,863	4,502	3,104	6,267	3,376	4,239

Source: The Quarterly National Household Survey, 1999 - 2004. For a percentage breakdown of these figures see Table A3.3 in the Appendix.

The most populated category in the sample (18.93%) is management, while sales occupations are filled by the lowest proportion of individuals in the sample (9.08%).

---

for the variables used in the empirical analysis.

Over one in five (21.18%) of the workers in the sample are employed in the two most skilled occupational categories of associate professional/technical and professional, while 22.23% of the individuals sampled are engaged in the least skilled jobs of plant and machinery operatives and personal and protective security agents. Table 3.6 below presents the annual breakdowns (in levels) of the eight occupational categories by the five nationalities recorded in the Quarterly National Household Survey.

Table 3.6: Occupation by Nationality and by Year.

Plant and Machinery					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	4468	88	16	4	9
2000	4749	78	16	5	17
2001	4878	79	28	4	44
2002	4573	82	23	6	87
2003	3991	78	22	2	127
2004	3043	0	0	2	162
Security					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	4164	85	60	3	30
2000	4283	81	83	8	36
2001	4104	95	64	4	100
2002	4065	94	55	8	177
2003	4093	111	87	5	226
2004	3455	0	0	7	326
Craft and Related					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	6009	143	34	7	13
2000	5950	134	33	7	19
2001	5907	131	31	5	60
2002	5577	135	31	7	81
2003	5593	137	28	4	111
2004	4606	0	0	8	249
Clerical and Secretarial					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	5538	86	37	8	16
2000	5400	75	46	6	19
2001	5442	91	58	6	32
2002	5624	91	69	5	62
2003	5087	111	80	5	74
2004	4333	0	0	7	162

Table 3.6 (Continued): Occupation by Nationality and by Year.

Sales					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	3526	38	24	9	9
2000	3588	41	35	1	16
2001	3594	56	46	4	39
2002	3568	63	59	6	52
2003	3429	60	46	5	70
2004	2929	0	0	5	170
Management					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	7637	151	51	18	27
2000	7482	133	67	12	42
2001	7447	170	64	21	50
2002	7428	161	64	21	57
2003	7104	170	60	17	76
2004	6006	0	0	16	245
Associate Professional					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	3530	117	39	16	17
2000	3509	127	41	17	30
2001	3633	115	58	16	55
2002	3690	117	69	14	117
2003	3703	119	57	12	137
2004	3099	0	0	16	261
Professional					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	4214	136	63	19	41
2000	4205	124	63	15	65
2001	4181	149	66	24	91
2002	4492	141	66	18	108
2003	4506	137	77	16	119
2004	3932	0	0	15	292

Source: The Quarterly National Household Survey, 1999 - 2004. For a percentage breakdown of these figures see Table A3.4 in the Appendix.

As one would expect, the Irish participants strongly dominate all occupations in the survey, however it is anticipated that this finding will change significantly in more recent surveys, particularly in the lower skilled occupations, when the impact of the most recent EU expansion (with Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia joining) filters through to the Irish

labour market. Employees from the rest of the EU in the plant and machinery (arguably the lowest skilled) category only account for less than 1% of the respondents, while UK nationals account for just under 2% of the surveyed workers in this occupation. It would be expected that this ordering will be reversed when post EU accession data is released, given the influx of Eastern European labour into Ireland. Behan et al. (2008) report that the labour force participation rate of immigrant workers in Ireland is 74% and that those workers arriving from the countries that gained access to the EU in 2004 have the highest participation rate of all immigrant groups.

The differential between UK workers and workers from the rest of the EU employed in the personal and protective security occupation is smaller than that reported in the 'lower' skilled plant and machinery category. Also of interest in both of these relatively lower skilled occupations is the continuous growth in terms of the level of workers of 'other' nationalities engaged in these posts over the six year period. It could be argued that these figures at some level reflect the influx of Eastern European workers into the Irish economy in pre-accession times. In relation to the US employees' figures, overall the level of US nationals reported in the surveys is low but as the occupations become more skilled, marginal increases in the number of US workers engaged are apparent. This may be explained by the use of skilled US labour by multinational corporations based in the Irish economy.

The main point of note when examining the craft occupations is the increased involvement of UK workers in this occupational category relative to the occupations of plant and machinery and personal and protective security. Although in terms of levels, there are more workers from the rest of the EU engaged in this occupation than the previous two described above, they do account for a lower percentage of total workers in the sector than the personal and protective sector. The personal and protective security group is made up by almost 2% of workers from the rest of the EU, while the corresponding craft and related activities figure is approximately 0.5%.

The clerical occupations are comprised of less UK nationals in percentage terms than any of the occupations discussed above. In contrast, the equivalent descriptor for US nationals is in fact marginally higher than for the previous three occupational categories examined. The pattern of employment in the sales sector is consistent with the majority of employment categories in the QNHS with the Irish workers dominating the employment levels. Perhaps the only surprising outcome from the sales occupation figures is that the UK and US nationals are not represented more in this occupation given their comparative language advantage over the rest of the EU and other nationalities.

Perhaps the most interesting statistic with respect to management roles occupied by non-Irish nationals is the continuing increase in the level of US nationals employed in such roles. Again the argument can be put forward that perhaps the MNC's create management roles for US nationals. To a lesser extent, the same finding and logical argument is applicable in the case of management workers from the UK. Over 3% of the associate professional and technical workers originated from the UK. This represents a significant increase in the proportion of UK nationals represented in an occupational sector relative to the six occupations discussed previous to this. Again the increased participation in this sector perhaps is attributable to the skill levels of the individuals required as well as the comparative language advantage which they hold over non-English speaking foreign workers. The participation of US and other nationalities in this component of the work force has also increased, but not to the same extent as their UK counterparts. The conclusions drawn from the levels of professional workers as distributed by their nationality is similar to that arrived at for the previous occupational category of associate professional examined. Again the UK national's presence in the sector is the strongest outside that of indigenous workers.

Table A3.5 in the Appendix contains summary statistics (mean, standard deviation, the maximum and the minimum) for the explanatory variables used in the model of occupational choice for the 236,601 observations in the all employees sample. A

complete list of variable definitions is contained in Table A3.1 in the Appendix at the end of this chapter. The majority of workers in the sample are in the 25 to 44 age bracket, with marginally more males than females included in the data set. With respect to nationalities included in the sample, one point of note is the differential between the mean figure reported for born in Ireland (0.91) and the corresponding value for those claiming Irish nationality (0.95), indicating both the uptake of Irish citizenship amongst the emigrant population and the repatriation of children with Irish parentage. There is only a marginal differential between those non-Irish workers who resided in Ireland for less than ten years (0.04) and those non-Irish workers who have been residents of the Republic of Ireland for more than ten years (0.05). Again it would be expected that the more recent QNHS will show increases in these values, particularly in the shorter term residency measure, with the influx of migrant labour from the most recent EU accession states.

The most populated sector in the sample is the manufacturing sector followed by the wholesale/retail sector. Most individuals in the sample commenced their careers at some point between 1961 and 1990, which would be expected given the age profile of the respondents discussed earlier. Approximately three quarters of the respondents are located in the eastern and southern regions, which given that it houses the largest city and therefore the largest fraction of the population, is representative of the distribution of labour throughout Ireland. The average weekly hours worked is only 31 but this figure deviates by 18 hours on average over the sample, while only a very small minority of individuals sampled hold a second job[32]. Marginally more individuals hold third level qualifications, both non-degree and degree and higher, than the upper secondary level of schooling, while over two thirds of the respondents occupy a permanent post.

It is evident that Irish workers dominate all types of occupations analysed and that the manufacturing and retail sectors accommodate the biggest share of workers. With the

[32] Both part-time and full-time workers are included in the sample.

2004 EU expansion from the EU15 to the EU25, Ireland has experienced an influx of workers in both these sectors and therefore it is anticipated that these figures will evolve, with a shift towards non-Irish workers in the lower skilled sectors.

3.4 Results

In this section results for the models outlined in Section 3.1 are presented and discussed. A multinomial logit estimation procedure is applied to three different models, with the models differing only in the inclusion of the independent variables that capture nationality as a determinant of occupation[33]. The first specification includes nationality (model 1), the second is estimated with country of birth rather than nationality (model 2), while the final specification utilises years of residency in Ireland (model 3) as the 'nationality' explanatory variable. Three different measures of nationality are modelled as the thesis in general is concerned with the impacts of both foreign capital and labour on the Irish economy and nationality is therefore one of the key variables in the study. Potentially foreign born 'Irish' nationals may fare better in the labour market than those labour market participants that have not acquired Irish citizenship and secondly those migrant workers who are in the country for longer periods may be more successful than the more recently settled foreign workers. In effect, the use of different measures of nationality may help in determining if workers are progressing in the market with respect to occupational attainment through for example education and experience, regardless of their nationality.

The same three multinomial logit models are then estimated again, but for workers in the manufacturing sector only (in keeping with Chapter 5 which is based on a production function estimated for the Irish manufacturing sector), then, given the long term debate around gender based labour market discrimination, the three models are analysed independently for each gender. All individuals included are between the ages of 15 and 64 respectively. In all estimations, plant and machinery operatives are set as the base category and all regressions were estimated with the aid of robust standard

[33] Ordered probit results were also analysed and were much in line with the multinomial logit estimates. The ordered probit estimates are available upon request.

errors as developed by White (1980)[34]. Tables reporting the main estimates (marginal effects and associated T statistics) are included in the Appendix.

3.4.1 Multinomial Logit Estimates for All Workers for Model 1

There are 236,601 observations in this sample and Tables A3.6, A3.7 and A3.8 respectively (Appendix) report the key findings. Table A3.6 contains the associated marginal effects and T statistics from the multinomial logit regression based on model 1.

In accordance with Constant and Zimmermann (2003), gender is found to be a significant determinant of occupational attainment and this result holds across all occupations sampled. Relative to plant and machinery operatives, males are less likely to be found in clerical/administration (which is the strongest effect of all occupations at almost 30 percentage points less likely than plant and machinery occupations) and sales positions and are more likely to be occupying craft related (being the strongest positive effect at almost 20 percentage points), management, professional or associate professional/technical posts. This result is in line with the findings of Barrett et al. (2006) where males in the Irish labour market were found to be more likely employed in the higher skilled management, associate professional or professional posts. One explanation as to why females appear to be penalised in terms of lower occupational attainment relative to males, is based upon a human capital acquisition argument. The contention is that females acquire less human capital over their careers, due to breaks taken for child caring duties. There are two schools of thought with respect to why this divergence in human capital levels between the genders occurs. Goldin and Polachek (1987) suggest that it is the women themselves who choose to acquire less human capital than men because they remain in the home caring for their children and therefore choose to invest less in human capital acquisition prior to having a family, on the premise that children will disrupt their future careers. An alternative view is taken by Marini (1989), who argues that women are consistently channelled by educators and

[34] Estimates were generated by STATA SE/8 and the software bases the robust standard errors calculations upon White's (1980) work.

employers into occupations predominately filled by females and that it is often the case that such occupations will require less skill and pay less. These arguments are explored in greater detail in Section 4.2 of Chapter 4.

The nationality results presented in Table A3.6 are relative to the Irish workers in the sample, with the most striking result being that that all nationalities are less likely to obtain professional posts than the indigenous workers. Workers from the EU and the US are 2.8 percentage points and 1.7 percentage points respectively, less likely to be engaged in a professional post, when compared with the Irish cohort sampled. The EU result coupled with the fact that EU workers do not require a work permit to gain employment in Ireland, contradicts Minns' (2005) suggestion that immigrant workers fare poorly in the Irish labour market due to the negative impact of the permit system they face in seeking employment. The argument put forward by Barrett et al. (2006), that poor spoken English is a potential cause of immigrants' lower occupational attainment, may well be supported by the EU result, although no language variable or country breakdown is available to fully validate the argument. The language difficulty faced by immigrant workers in a host economy is a consistent theme throughout the occupational attainment literature: Stewart (1983) in examining the UK labour market; Forrest and Johnston (2000) and Chiswick et al. (2003), who both utilise Australian data, reporting lower occupational attainment for immigrants who originate from economies with different language to their host economy. However, when the professional occupation result for the US is examined the language barrier argument is inapplicable, but the work permit theory may hold. Finally, the US workers are just over 4 percentage points less likely to be employed in clerical work, relative to Irish workers, with the result statistically significant at the 10 % level only.

When the other occupational categories are examined, the language barrier argument of Barrett et al. (2006) may be supported. Workers from the UK, who by definition do not require a work permit but do speak English, are more likely to be employed in management (2 percentage points) and technical/associate professional (1.5 percentage points) posts, than Irish workers. However, when the same two occupational

categories are analysed for EU workers, who do not require a work permit but who may have poor spoken English, the EU workers are less likely to be employed in management (7.3 percentage points) and technical/associate professional (1.7 percentage points) jobs, relative to the Irish workers. However, it must be reiterated that unfortunately no language or country of origin variable in the context of the EU, is included in the estimations due to lack of data availability.

The results for 'other' nationalities suggest that relative to the Irish workers sampled, this group of labour force participants are more likely to be involved in the occupations of security (4 percentage points), craft (6 percentage points) or sales related posts (1 percentage point), than the base category of plant and machinery operatives. This is consistent with what the Irish economy is experiencing at the moment with either low skilled workers migrating from the formally centrally planned economies of Eastern Europe or from Africa, or more highly skilled workers from these locations taking interim lower skilled posts. The logic as to why this phenomenon is occurring is twofold. Firstly, the impact of poor spoken English as suggested by Barrett et al. (2006) in the context of migrants in the Irish economy is potentially applicable and secondly, Chiswick (1978a) contends that immigrants often experience lower occupational success in a host country on arrival due to the imperfect transferability of labour market skills from country of origin to the host labour market. Finally in relation to nationality and occupational attainment, an interaction term comprised of gender and nationality was constructed[35]. The results suggest that relative to Irish females, foreign born males are 2.5 percentage points more likely to be employed in a professional occupation and 3.8 percentage points less likely to be employed in a management role, than be employed in an occupation in the base category.

Other explanatory variables of interest examined include region, education, experience, age of the children of the worker, the tenure (e.g. permanent contract) of the worker and the hours worked by the individual. From a regional perspective, those workers

[35] Interaction terms comprising of sector and nationality and sector and gender are also presented in Table A3.6.

based in the less affluent Border, Midland and Western regions relative to those living in Eastern and Southern regions, are more likely to be employed in the security (1 percentage point) or craft (3 percentage points) occupations than in the plant and machinery type occupations. Workers from the Border, Midland and Western regions are underrepresented in the higher skilled management (4 percentage points) and associate professional/technical (1 percentage point) occupations, relative to workers from Eastern and Southern regions of Ireland. As there is no variable to capture the effect of living/working in Dublin, one has to assume the Eastern/Southern impact upon occupational attainment, particularly in the higher skilled posts, is driven by the Dublin basin area and that the marginal effects are potentially underestimated as a result of the way this variable is constructed. Employment, investment and infrastructure in Ireland are so concentrated in the Dublin area that Government policies in this decade, such as the National Spatial Strategy of 2002 and the Government's decentralisation strategy of 2003, are solely aimed at generating employment and investment in regions outside of the Dublin basin. In this context, it is not surprising that the Eastern and Southern regions appear to present better employment opportunities, but the failure of the Government to implement the regional policies outlined above is potentially worrying. From a policy perspective, higher skilled posts need to be created outside of the Dublin region in order for all of Ireland to truly share in the 'Celtic Tiger' success.

The educational category excluded from the estimations is third-level education, degree or higher. The results suggest that individuals who have attained an education level from primary through to third level certificates and diplomas, are more likely to be employed in a plant and machinery post than either a security, craft or sales job and are more likely to be in either technical or professional roles than in a plant and machinery post. The marginal effects in the case of the professional category increase monotonically with the educational level attained by the individual, ranging from 2.5 percentage points for those individuals with primary education to 57 percentage points for those workers with third-level certificates and diplomas. This set of effects highlights the returns to schooling with respect to occupational attainment: those with

higher educational levels are more likely to be employed in more professional roles, with the probability of employment in these occupations increasing with the education level of the individual. Similar impacts of schooling upon occupational attainment are also reported by Greenhalgh and Stewart (1985) for the UK, Constant and Zimmermann (2003) for Germany and Barrett et al. (2006) for Ireland. Finally with respect to education, individuals who have achieved primary (3.2 percentage points), lower secondary (3.1 percentage points) or upper secondary (5.9 percentage points) levels of schooling are more likely to be employed in a clerical post than plant and machinery work, relative to those individuals who hold a degree or higher level of education.

The impact of the other measure of human capital included in the set of explanatory variables, experience (proxied by the year the individual started work), upon occupation, accords with the previous findings in the area. Schmidt and Strauss (1975) in the case of the US and Nickell (1982) in the case of the UK, both found a positive relationship between the level of experience of an individual and their occupational status. Relative to those who started working in 2004, workers who commenced work prior to 2002 are more likely to be in a professional occupation than in a plant and machinery post, with the largest marginal effect (4.6 percentage points) reported for those workers with the most labour market experience. The same trend is evident when the results for management occupations are analysed, with individuals who commenced work prior to 2003 more likely to acquire management posts than work in a plant and machinery role, relative to those who started their careers in 2004, with again the largest marginal effect being reported for those who started work in 1960 or earlier. Interestingly, the highest marginal effect in this instance (28 percentage points) is six times larger than that reported in the case of professional workers, which may suggest experience has a larger role to play in management posts than in professional occupations. This can be potentially explained by people skills and experience accrued over time being rewarded in management posts.

Individuals are more likely to be employed as plant and machinery operatives than in clerical occupations, regardless of their level of experience, relative to those who started working in 2004. The same statement applies to security workers who commenced work prior to 2003, with both occupational categories reporting the highest marginal effect for those workers with the most experience. Employees who started working in 1960 or prior to that year are 49 percentage points less likely to be employed in security work than in a plant and machinery post, relative to those employees who started working in 2004. One potential explanation for such a high marginal effect in this instance is that the type of and conditions of work involved in this post are arguably more suited to a younger worker. Interaction terms combining experience and nationality were constructed with the most striking results linked to professional occupations. Relative to Irish workers who commenced work in 2004, foreign born workers who commenced work in 1997 are 5 percentage points more likely to be employed in a professional post than as a plant and machinery operative, with the corresponding effects for those foreign born workers who commenced work in 1995 and 1996 being 7 percentage points and 4 percentage points respectively. In general, the education and the experience findings support the positive role of human capital in occupational attainment.

Individuals sampled with children less than five years old, are 1 percentage point more likely to be in a professional occupation than in a plant and machinery post, relative to those individuals without children. The opposite is true of the lower skilled occupational categories of security, craft and clerical work where individuals are less likely to be engaged in those occupations than in a plant and machinery post if they have children under the age of five. When the variable representing children aged between fifteen to twenty is examined, it is found that clerical and sales workers who have children in this age range are more likely to be employed in their current posts, than in a plant and machinery post, relative to those workers sampled who are not parents. The interpretation for the results of the 'children' variables may rest with the effects of excessive child care costs in Ireland acting as a barrier to entry to the labour market for those employees in the lower paid occupations. Professional workers can

afford higher child care costs relative to the lower paid occupations and are therefore more likely to have a child and an occupation simultaneously. The lower paid clerical and sales workers may find it easier to enter the labour market when their children are past the age of fifteen and are no longer burdened with child care fees. Kennedy (2008) suggests that parents can expect to pay 20% of their income for child care costs, which is double the EU average, while successive Government Budgets since 2006 have allocated subsidies for workers with private child care fees.

In general, those workers in permanent posts are more likely to be engaged in lower skilled positions of security (3 percentage points), clerical (13 percentage points) and sales (3 percentage points) than in plant and machinery work, relative to those without a permanent post. Those without permanent posts are more likely to be employed in the skilled occupations of management (20 percentage points) and professional (1 percentage point) than in a plant and machinery occupation. This finding would tie in with the freedom of movement of human capital that is now the norm in the labour market. It would be anticipated that those employees with a greater skills base would have shorter termed, yet higher paid contracts than those working from a lower skills base.

The effect of hours worked each week by the individual is significant across all occupations, but all the marginal effects are very small, suggesting that differences in the length of the working week do not have a large influence upon occupational attainment. Individuals who have a second job are 5 percentage points more likely to be employed in a clerical role and 10 percentage points less likely to be in a management occupation, than in a plant and machinery job, relative to those individuals who do not have a second job. Clerical work by nature can often be part-time or flexitime and allows for the potential for a second job to be acquired, whereas management posts can often be more than the forty hour week, relative to clerical posts. Other explanatory and control variables such as age and sector of employment are included in the specification and year controls are included in all models.

3.4.2 Multinomial Logit Estimates for All Workers for Model 2

The key findings for model 2 (i.e. country of birth and gender) are located in Table A3.7 in the Appendix. With respect to country of birth being included as an alternative variable to capture the effect of non-Irish labour, there are some marginal changes in the results when compared with those from model 1 discussed above. The previous positive marginal effect with UK workers gaining employment in a craft related occupation is now statistically insignificant. All other marginal effects for UK workers accord with the effects from model 1, with some marginal changes in the magnitude of the effects. Relative to Irish workers, individuals from the UK are still less likely to work in clerical and sales jobs than in plant and machinery posts, but the magnitude of the marginal effect has diminished marginally in both cases. The same findings hold for the occupations where UK workers are likely to be employed where the magnitude of the positive effects have diminished when compared with model 1.

The outcomes for EU workers, just as in the case of UK workers, only marginally change when model 2 is compared with model 1. Relative to the Irish workers sampled, EU workers are still more likely to be occupying security, craft and sales jobs as opposed to plant and machinery work, but the positive marginal effect produced by model 1 linking the EU workers to occupations in the clerical sector is not supported by model 2. The results produced from model 2 for US workers do vary with those produced by model 1. Workers from the US are 4.3 percentage points less likely to work in clerical posts than in a plant and machinery job, relative to the Irish workers, but this result is now significant at the 5% level as opposed to the 10% level when examining model 1. Relative to the Irish workers, US workers are now (as compared to model 1) less likely to be employed in security than in plant and machinery work (1.2 percentage points, significant at the 10% level), while there is a positive marginal effect associated with US nationals ending up in sales (2.3 percentage points more likely than plant and machinery) and technical (2.7 percentage points more likely than plant and machinery) roles. Finally with respect to US nationals, the negative marginal effect reported of US nationality on the probability of being in professional occupations as found in model 1 is not supported by the results of model 2.

Relative to the Irish workers in the sample, all other nationalities are still more likely to work in security (3 percentage points) and craft related (5.1 percentage points) roles than in plant and machinery occupations and less likely to be employed in management (10.7 percentage points less likely than plant and machinery). There is no longer a statistically significant effect for clerical and sales posts, while the negative marginal effect reported on technical posts (1.2 percentage points) is a reversal of a statistically insignificant relationship between the two as estimated by model 1. The impact of gender on occupations has remained unchanged from model 1. Overall, the results for model 2 provide weaker estimates in that more of the marginal effects are statistically insignificant than was the case in model 1, but the results still provide evidence that the Irish workers are the most likely group to occupy professional posts.

3.4.3 Multinomial Logit Estimates for All Workers for Model 3

The third model controls for the length of time that workers have been resident in Ireland and the results of this estimation are presented in Table A3.8 in the Appendix. As was the case when model 1 and model 2 were compared, the relationships between occupations and gender also remain the same. Relative to workers born in Ireland, those individuals who have spent ten years or less in Ireland are more likely to be working in sales (0.6 percentage point), security (2.4 percentage points) or craft related (2.7 percentage points) occupations, than in plant and machinery roles. Also, migrant workers based in Ireland for ten years or less are less likely to work in professional (1.1 percentage points) or management (41 percentage points) than in a plant and machinery occupation, relative to indigenous workers. This pattern of migrant labour occupying lower skilled occupations was predicted by Chiswick (1978a) as being the result of lack of transferability of job specific skills between labour markets and this may possibly account for the large marginal effect associated with management occupations. As outlined in Section 3.1, this trend would also describe the general pattern of emigration into Ireland in recent years, in that labour market shortages that accrue in low skilled areas are often filled by the emigrant labour population, or where higher skilled emigrant labour takes short run employment in less skilled occupations. This is a particular problem in some of the heavily monopolised sectors in the Irish

economy such as law, accounting, dentistry, medicine and pharmacy, where highly skilled foreign practitioners are prevented from entering these occupations by strongly imposed legal barriers of entry. Pillinger (2006) highlights these issues for migrant women in the Irish labour market.

By contrast and relative to the indigenous workers sampled, migrants who have resided in the Republic of Ireland for more than ten years are less likely to be found in the clerical (almost 2 percentage points) occupations and are more likely to be involved in the more skilled associate professional/technical (just under 1 percentage point) occupations, than in the base category of plant and machinery. The improvement of migrant occupational status over time is also reported by Chiswick (1978a) for the US, Bauer and Zimmermann (1999) in the case of Germany and Forrest and Johnston (2000) and Chiswick et al. (2003) both in the case of Australia. Perhaps the ten year period gives migrant labour enough time to develop skills to move into better paid roles, or gives skilled migrant labour time to move out of interim lower skilled roles.

3.4.4 Estimates for the Manufacturing Workers

Manufacturing estimates are examined in keeping with the focus of Chapter 5 which is an empirical study of the production function based on data from the Irish manufacturing sector. There are 41,304 observations in this sub sample and the multinomial logit results for manufacturing employees only are presented in Tables A3.9 to A3.11 in the Appendix. When using nationality as an independent variable (Table A3.9), the multinomial logit results suggest that relative to the females sampled, males in the manufacturing sector are more likely to be engaged in either craft related activities (24 percentage points more likely) or professional (1.4 percentage points more likely) occupations, than in plant and machinery work. Females in the Irish manufacturing sector are more likely to be working in clerical (18.8 percentage points more likely than plant and machinery) or management (11.1 percentage points more likely than plant and machinery) roles, relative to their male counterparts. The gender results again are consistent with Barrett et al. (2006) in the Irish context in that males are more likely to be occupying the professional roles, while the strong marginal effect

linking females to clerical posts supports the concept of females being channelled into posts that are stereotypically female jobs either by themselves (Polachek, 1987) or through the education system (Marini, 1989). The channelling of females argument is further supported when examining the equivalent marginal effects under the alternative specification (with country of birth being the proxy for nationality, see Table A3.10 in the Appendix). There is one marginal change, with males now 1.2 percentage points more likely to be involved in a management role than a plant and machinery post, relative to the females in the sample, a result which is a reversal of model 1.

With the exception of the positive marginal effect (4.2 percentage points more likely than plant and machinery, relative to Irish workers) linking UK nationals to craft jobs in the manufacturing sector, there are no statistically significant outcomes for UK nationals. However, when country of birth (Table A3.10) is included as the nationality measure, it is clear that UK workers are less likely to be occupying security (0.2 percentage point less likely than plant and machinery posts) or technical (1 percentage point less likely than plant and machinery posts) posts within the manufacturing sector, relative to Irish workers. Relative to the Irish workers in the sample, workers from other EU states are 11 percentage points less likely to be occupying professional occupations and 2.5 percentage points (significant at the 10% level, the result is insignificant in model 2, see Table A3.10) less likely to be in management, than be employed in a plant and machinery post. Relative to the Irish nationals in the sample, US nationals are more likely to be occupying craft (10.9 percentage points more likely, statistically significant at the 10% level) jobs and less likely to be in security (0.5 percentage points less likely), clerical (6.2 percentage points less likely) or professional (1.6 percentage points less likely) posts than be employed in an plant and machinery post within the Irish manufacturing sector. When country of birth is examined as an explanatory variable there are three varying outcomes for US workers (only the security effect remains statistically significant) when compared against model 1 for the manufacturing workers.

The results for other nationalities suggest that relative to the Irish nationals in the sample, workers of 'other' nationality are 7.6 percentage points more likely to be employed in a craft related post within the manufacturing sector than in a plant and machinery post. With the exception of the statistically insignificant effect associated with security posts, all other occupational categories have negative and statistically significant marginal effects. In effect the results suggest that workers from other nationalities who are employed in the Irish manufacturing sector are unlikely to gain employment in a skilled post. When the results for each nationality are examined two key findings stand out. Firstly, as was the case with the entire sample, Irish workers are more likely than any other nationality to gain a professional post and secondly, all nationalities (relative to the Irish and excluding EU workers where the positive marginal effect is statistically insignificant) appear likely to gain work only in the craft related posts in the manufacturing sector as opposed to plant and machinery work. Although this finding does support Minns' (2005) permit argument in the case of US and other nationalities and Barrett et al.'s (2006) poor spoken English hypothesis in the case of the EU nationals, neither argument can explain the UK nationals result. Taking the craft and the UK effects in tandem, it is possible to argue that workers who migrate to Ireland to work in the manufacturing sector, do so with the view to seeking a post where they have already established a craft skill in their country of origin and where this skill is easily transferable into the Irish manufacturing sector.

With respect to the duration of workers' stay within the Republic of Ireland (see Table A3.11 in the Appendix) those manufacturing employees who have less than ten years of residency in Ireland are 3.9 percentage points more likely to be employed in a craft post, than in a plant and machinery post relative to the Irish workers in the sample and are unlikely to be employed in the higher skilled posts associated with management, technical or professional work. Residing in Ireland for more than ten years does not increase the likelihood of non-Irish nationals gaining employment in more skilled roles within the manufacturing sector. The only result of statistical significance is the negative marginal effect associated with technical posts.

3.4.5 Estimates for the Male Workers

Given the continued debate on the impact of gender in terms of labour market success, the occupational attainment models were also estimated independently for each gender. In doing so, the analysis accords with the wage study in Chapter 4. In all, there are 136,459 males included in this estimation sample and the results for the multinomial logit estimates of male workers in the sample are contained in Tables A3.12 to A3.14 in the Appendix[36].

Model 1, which contains nationality as an independent variable (Table A3.12), suggests that relative to indigenous workers, UK nationals are 3.4 percentage points more likely to be employed in a craft occupation than in a plant and machinery role, with the equivalent marginal effect for associate professional posts being 1.3 percentage points. The other group of English speaking males, US workers, are 4 percentage points more likely to be employed in an associate professional post than in a plant and machinery post, relative to Irish workers. When the results for the two other groups of workers are examined, there may be evidence in support of Barrett et al.'s (2006) finding that workers with poor spoken English face a disadvantage in terms of occupational attainment. Relative to the Irish workers sampled, workers from the rest of the EU are 3.9 percentage points more likely to be in a sales post than in a plant and machinery post, while workers of other nationalities are 1.9 percentage points and 9.6 percentage points respectively, more likely to be employed in either security or craft work, than in plant and machinery work. Given that EU and other nationalities will contain non-English speaking workers, this result may be regarded as indicating the impact of language barriers upon occupational attainment. When country of birth is included as an explanatory variable (see Table A3.13 in Appendix 2) there are some marginal changes in the estimates, but the main conclusion drawn above holds. The positive marginal effect associated with UK workers being employed in the craft sector is now statistically insignificant in this specification, while EU workers are now 2.2 percentage points more likely to be employed in a clerical post than in a plant and

[36] This sample contains all male workers between the ages of 15 and 64 engaged in part-time or full-time work.

machinery post, relative to the indigenous workers in the sample. Also worth noting is the result that Irish males are more likely to be employed in professional posts than any other nationality, a result consistent with the all workers and the manufacturing workers samples.

The estimates of the impact of length of residency in Ireland on occupational attainment are presented in Table A3.14 in the Appendix. Those non-Irish workers residing in Ireland for less than ten years are more likely to occupy the posts of security (under 1 percentage point more likely) and craft (5 percentage points more likely) and less likely to occupy roles in management (6.2 percentage points less likely) and professional (under 1 percentage point less likely) occupations, than be employed in a plant and machinery role, relative to the Irish workers in the sample. For those migrant workers residing within Ireland for more than ten years, there is evidence of movement up the occupational ladder. These workers are 0.8 percentage points more likely to be employed in an associate professional/technical role than in a plant and machinery post, relative to Irish workers. This finding of migrant workers improving their occupational status with the duration of stay in their host country is in line with the findings of Forrest and Johnston (2000) and Chiswick et al. (2003), who both report a similar finding for migrants in the Australian labour market.

3.4.6 Estimates for the Female Workers

There are 100,142 females in this estimation sample and the results for the multinomial logit estimates of female workers in the sample are contained in Tables A3.15 to A3.17 in the Appendix[37]. Relative to the Irish females in the sample, females of UK nationality (see Table A3.15) are 2.8 percentage points (significant at the 10% level) more likely to be engaged in a management role, 1.6 percentage points less likely to be in a sales role and 1.5 percentage points less likely to be in a professional occupation, than be employed in the base category of plant and machinery. The results for UK nationals from model 2 (see Table A3.16) produce only one statistically significant

[37] This sample contains all female workers between the ages of 15 and 64 engaged in part-time or full-time work.

result, with this group of female employees 2.2 percentage points more likely to be employed in a management post, than in a plant and machinery post, relative to the Irish females sampled. The females of US nationality sampled (see Table A3.15) are 2.4 percentage points less likely to be occupying a professional post, 5.4 percentage points less likely to be employed in a management role, 7.2 percentage points less likely to be working in a clerical post, 2.8 percentage points less likely to be employed in a security role, (significant at the 10% level only, significant at the 5% level in model 2) and are 2 percentage points more likely to be working in a craft occupation, 2.4 percentage points more likely to be in a sales position and 2.5 percentage points more likely to be working in an associate professional role, than in a plant and machinery post, relative to the Irish females sampled. As was the case for the UK workers, the results for US workers are not consistent (across models 1 and 2 respectively) when model 2 (see Table A3.16) is examined. As mentioned above the security result is statistically significant at the 5% level under this specification and the only other statistically significant result reported is the positive marginal effect associated with management employees, which is significant only at the 10% significance level.

Relative to the Irish females in the sample, females from other EU states (other than the UK and Ireland) are more likely to be found in the occupations of security (5 percentage points more likely), craft (1.1 percentage points more likely, significant at the 10% level under model 1 and at the 5% level for model 2), clerical (3.9 percentage points more likely, significant at the 10% level, no statistically significant relationship found in model 2) and sales (4 percentage points more likely), than in a plant and machinery post, the base category occupation. Interestingly, females from the EU are less likely to be found working in the top three skilled occupational categories, a result which is consistent across models 1 and 2.

Female workers of all other nationalities, relative to the Irish female workers, are more likely to find employment (according to model 1, see Table A3.15) in security (5.7 percentage points) or sales (4.8 percentage point, significant at the 10% level in model

1 and at the 5% level in model 2), while they are less likely to find employment in a professional (1.6 percentage points less likely) post, than securing a plant and machinery post. When model 2 is examined (Table A3.16), the likely occupational categories where female workers of other nationalities can be found also include craft and sales, while the occupations where this group of workers are less likely to find employment also extends (relative to the results from model 1) to clerical and management posts. Overall, the same pattern that was highlighted for the male sample is also evident for the female cohort, in that the English speaking components of the labour market (UK and US nationals) have more chance of being employed in higher skilled occupations (management in the case of UK workers and associate professional in the case of the US workers) than the potentially non-English speaking EU and workers of other nationalities, who are more likely to be found in the lower skilled occupations. Again this ties in with the findings of Barrett et al. (2006) who suggest that the inability to speak good English is a stumbling block for migrants seeking higher skilled posts. Once again, it is the Irish who are the most likely nationality to be found working in the professional occupations.

Females residing in Ireland for under ten years (see Table A3.17) are less likely to be employed in a professional (2.1 percentage points less likely than plant and machinery work) or management (1.6 percentage points less likely than plant and machinery work, significant at the 10% significance level) role, but can be expected to be working in security (3.2 percentage points more likely than plant and machinery work), craft (0.8 percentage points more likely than plant and machinery work) and sales (1.3 percentage more likely than plant and machinery work) positions, relative to Irish born females. When the duration of stay is extended to beyond ten years the only result of statistical significance is that relative to the Irish females in the sample, this group of migrant workers is unlikely to be occupying a clerical (2.7 percentage points less likely than plant and machinery work) role. This result is in contrast with the finding for the migrant males in the sample, where progression to associate professional posts was a likely outcome.

3.5 Conclusion

The research area of occupational attainment is currently particularly important in the context of the new Irish economy where, for the first time, people no longer need to emigrate to work within their chosen occupation and where labour shortfalls are balanced through an emigrant labour pool. It is this new element of the Irish labour force that is of particular interest to this empirical study; i.e. how do foreign workers fare in the Irish labour market relative to their Irish counterparts. The theories relating to the determinants of occupational attainment are well defined with the key driver identified in the literature review being human capital, as measured by education, training and labour market experience. The empirical analysis presented in this chapter attempts to extend the research in the occupational attainment field by incorporating nationality as an explanatory variable in the occupational attainment model for Ireland, thus exploring the potential impact of being foreign in a historically closed and depressed labour market. In doing so, it expands the work of Barrett et al. (2006) who use a probit model distinguishing between just two levels of occupational attainment to analyse one year of data (2003), in an attempt to examine the occupational attainment of migrant workers in Ireland. The QNHS data set was utilised, incorporating 236,601 observations between 1991 and 2004 and multinomial logit estimates were obtained for occupational categories. Three separate models were analysed with the difference between each of the models being the measurement of nationality included in the specification. Model 1 included nationality as an independent variable which was replaced by country of birth in model 2, while model 3 used number of years of residency in Ireland as a proxy for nationality. The different samples of workers estimated are all workers, manufacturing workers only, male workers only, and female workers only.

In general, the impact of key variables upon occupational attainment in Ireland tends to follow the pattern predicted by prior research. Gender is a significant variable in determining the occupational success of individuals with males more likely to be employed in professional and management roles and females tending to be linked with clerical and sales jobs. Such findings tie in with other studies in the field notably that

of Constant and Zimmermann (2003) in the case of the German labour market and also the Irish case as presented by Barrett et al. (2006). This result raises the question of gender imbalances and genuine equality in the labour market and perhaps further investigation is required on a continuing basis to observe changes in employment policy over time, if any. Uniquely for Ireland, Dublin is the key location with respect to employment in Ireland with industry very much based in the basin surrounding Dublin on the east coast. This geographical fact as expected has an impact upon occupational attainment, with the likelihood of obtaining a post in the top three skilled occupational categories being strongly linked to the Dublin region. However, it should be noted that the true impact of being located in Dublin upon occupational attainment is possibly masked by the construction of the region variable, in that Dublin is included in the Eastern and Southern region in the QNHS, and one would expect the marginal effects to be higher for Dublin if region was measured in a less aggregated fashion. The question of decentralisation has been debated within Irish economic and political circles since the 1960's with the both the 2002 National Spatial Strategy and the 2003 budget attempt by the Government to lead a decentralisation plan yet again failing to take shape. This is perhaps the most important economic problem that Ireland faces and one that can only be solved by serious infrastructural expenditure to signal to investors that locating industry en-mass outside the greater Dublin region is a viable option into the future.

Greenhalgh and Stewart (1985) highlighted the importance of education in occupational attainment in the UK and the results for Ireland concur. The impact of education on occupational attainment is first observed at the clerical level where those employees with leaving certificates and post-leaving certificate qualifications increase their chances of gaining employment in that area. The returns to schooling concept is apparent within the Irish results presented in this chapter as higher education levels are positively associated with working in higher skilled occupations, a finding that was also reported by Constant and Zimmermann (2003) for German workers and by Barrett et al. (2006) for Irish workers. As with the findings of Schmidt and Strauss (1975) in the US and Nickell (1982) in the UK, human capital in the form of experience is a

significant variable in the occupational attainment model. Those individuals in the sample with greater labour market experience are more likely to gain employment in a professional occupation, with those workers who commenced work more recently less likely to be found in professional roles. The largest marginal effect for professional occupations is reported for the most experienced workers, a result similar to management occupations. The marginal effect for the most experienced workers is 6 times higher for management occupations than for professional occupations, which suggests experience is particularly important in management.

Respondents with children under the age of five tend to be engaged in professional occupations, while having children of that age tends to decrease the chances of the individual working in a lower skilled occupation. In contrast, workers with 'children' over fifteen years of age are more likely to be working in the lower skilled occupations. This is perhaps an indicator of the impact of child-care fees upon occupation; those workers at the margin of entry and exit from the labour market are better off not working in lower paid jobs given child-care costs, with professionals being able to afford the 'luxury' of child-care. This is currently an important political issue in Ireland and one that was paramount in the 2007 elections with the Government establishing child-care support schemes as elements of the previous two budgets. Molony (2006) however points out that Government attempts to subsidise child care costs are not as effective due to increasing costs in the sector and that the Government subsidy covers approximately 10% of the cost. One other interesting finding from the Irish data is that permanent jobs tend to be linked with lower skilled occupations. This ties in with the modern model of a young professional worker who tends to switch jobs far more frequently than the previous generation of equivalent skilled worker, due in part at least to current availability of jobs relative to the 1980's and before.

When the estimates of nationality are examined for all workers in the sample the most striking result is that all other nationalities are less likely to occupy a professional post than the Irish workers in the sample. The key finding in terms of nationality concerns the roles of language barriers and the work permit system in preventing migrant labour

from securing skilled posts. The results for UK nationals suggest that this group of workers is likely to occupy roles in management and associate professional occupations, while other EU workers, who like UK nationals do not require a work permit to secure a post in the Irish labour market, are less likely to be employed in either of these two occupations. The conclusion drawn is that EU nationals may have poorer spoken English than the UK nationals and that this may be a prohibitive factor in terms of occupational attainment. Forrest and Johnston (2000) and Chiswick et al. (2003) both highlight the impact of poor spoken English on the occupational attainment of migrant in Australia, while Barrett et al. (2006) demonstrate the same result for migrants in the Irish labour market. This finding undermines the impact of work permits upon occupational attainment, an argument supported by Minns (2005) in the case of Ireland. Workers of 'other nationalities' are more likely to be employed in lower skilled occupations, a finding that is difficult to pinpoint the cause of given that this group of workers require work permits and may also have poor spoken English. Also Chiswick (1978a) hypothesises that when workers move from their country of origin to their new host economy, they may experience a fall in occupational attainment, due to the imperfect transferability of labour market skills from origin to host labour markets.

With respect to the duration of workers' stay in Ireland, migrants resident in Ireland for less than ten years are likely to be working in the lower skilled roles of sales, security and craft, while those residing in Ireland for more than ten years may have worked their way up the occupational ladder to associate professional posts. This duration of residency result concurs with Chiswick (1978a) in the case of migrants in the US, Bauer and Zimmermann (1999) in the case of migrants in Germany, Forrest and Johnston (2000) and Chiswick et al. (2003) in the case of migrants in Australia who all find evidence that emigrants tend to increase their occupational attainment over time. This finding has policy implications in terms of supporting emigrant workers' educational aims. It should be noted and is highlighted below, than the non-Irish females in the sample did not experience this occupational improvement over time.

With respect to the three sub-samples analysed, it was found that non-Irish (with the exception of the EU nationals where no effect was found) manufacturing workers are most likely to end up in craft posts, relative to the Irish workers in the sample. The potential reason for this may have little to do with poor spoken English or the work permit system, but may be the result of craft workers migrating to Ireland to work in a craft post where they can directly transfer their skills base from their country of origin. Indeed, migrants residing in Ireland for more than ten years are unlikely to move up the occupational ladder within the manufacturing sector. It was also noted that as was the case for all workers, no nationality is more likely than the Irish to occupy professional occupations, a result that was also found when the models were estimated for each gender independently.

The estimates from the sample containing males only provided further evidence of the potential effect of English language upon migrants' occupational attainment. Male workers from the UK and the US are most likely to acquire associate professional roles in the Irish labour market, while EU nationals are likely to be employed in a sales role and other nationalities most likely to find work in security or craft related posts. Also the duration of stay for males does have an impact upon their occupational status. Non-Irish males residing in Ireland for less than ten years are most likely to be employed in security and craft work, but with those with more than ten years experience in the Irish labour market are likely to gain employment in an associate professional role.

The pattern of results reported for males is generally repeated for the female sample, in that there is a differential between the English speaking UK and US nationals and the potentially non-English speaking EU and other nationalities. Females from the UK are likely to be employed in management roles, while female US nationals are most likely to be employed in associate professional posts. Female EU nationals are more likely to find employment in the lower skilled, security, craft and clerical occupations, while all other nationalities are most likely to be working in a security or sales post. Again the Barrett et al. (2006) English language barrier concept may be supported by this finding.

Unlike their male counterparts, female migrants do not appear to climb the occupational ladder when the duration of their stay in Ireland goes beyond ten years. Those female migrants residing for ten years or less in Ireland are most likely to be working in the lower skilled occupations of security, craft and sales, while those migrant females who stay longer are most likely to be involved in clerical work.

It should be acknowledged that there are some shortcomings in the empirical analysis presented in this chapter. For example, there are some key omitted variables. The literature review identifies the family background of an individual and their social contacts, the role of intergenerational factors, wages and the uncertainty surrounding the future wage of a profession, liquidity constraints and social class as being important determinants of occupational attainment, however information on such characteristics is not available in the dataset. In addition and in the Irish context, the work would be enhanced by the inclusion of more detailed information on the location of the individuals sampled. Unfortunately Dublin is not isolated as a location on its own and some of the intuitive hypotheses one would expect from an Island economy dominated by one city are difficult to prove, although the findings in terms of region do lend themselves to such arguments. Similarly, more detailed nationality splits would isolate which nationalities were faring better in the Irish labour market. As it stands, the easiest alignment to make in terms of nationality is to examine the English speaking US and UK workers relative to the potentially non-English speaking EU and 'other nationality' workers, although information on language spoken would further improve the analysis. The current nationality split does however allow for potential work permit impacts upon occupational attainment to be examined, given the EU and UK workers will be the only migrant workers in the sample not requiring a work permit to operate in the Irish labour market.

Overall the stylised results hold; education, experience and gender are important drivers of occupational success in Ireland. In the Irish context there is a regional divide in terms of Dublin versus the rest of the country which is reflected in the location of higher skilled occupations. In addition, childcare appears to be an issue that affects the

lower skilled sectors in terms of potentially prohibiting workers at the margin of entry to and exit from the labour market from participating in the labour market. With respect to nationality, no nationality is doing as well from the 'Celtic Tiger' in terms of occupational attainment as the Irish. Although, male migrant workers do receive some benefit in terms of occupational attainment from staying in Ireland for more than ten years, the findings suggest that female migrant workers do not receive such benefits. The empirical results also suggest that poor spoken English may be a barrier for migrants acquiring higher occupational attainment.

Appendix to Chapter 3: Results and Variable Definitions

Table A3.1: Variable List and Definitions.

Variable Name	Variable Description	Variable Values		
Occupation (O_i)	Dependent Variable	0	=	Plant and machine operatives.
		1	=	Personal and protective security.
		2	=	Craft and related.
		3	=	Clerical and secretarial.
		4	=	Sales.
		5	=	Managers and administrators.
		6	=	Associate professional and technical.
		7	=	Professional.
1999	Dummy variable for year of survey	1	=	1999.
		0	=	Otherwise.
2000	Dummy variable for year of survey	1	=	2000.
		0	=	Otherwise.
2001	Dummy variable for year of survey	1	=	2001.
		0	=	Otherwise.
2002	Dummy variable for year of survey	1	=	2002.
		0	=	Otherwise.
2003	Dummy variable for year of survey	1	=	2003.
		0	=	Otherwise.
2004	Dummy variable for year of survey	1	=	2004.
		0	=	Otherwise.
Male	Sex of Respondent	1	=	Male.
		0	=	Female.
Age 15-19	Age Group	1	=	15-19.
		0	=	Otherwise.
Age 20-24	Age Group	1	=	20-24.
		0	=	Otherwise.

Table A3.1 (Continued): Variable List and Definitions.

Variable Name	Variable Description	Variable Values		
Age 25-34	Age Group	1	=	25-34.
		0	=	Otherwise.
Age 35-44	Age Group	1	=	35-44.
		0	=	Otherwise.
Age 45-54	Age Group	1	=	45-54.
		0	=	Otherwise.
Age 55-59	Age Group	1	=	55-59.
		0	=	Otherwise.
Age 60-64	Age Group	1	=	60-64.
		0	=	Otherwise.
Single	Marital Status	1	=	Single.
		0	=	Otherwise.
Married	Marital Status	1	=	Married.
		0	=	Otherwise.
Widowed	Marital Status	1	=	Widowed.
		0	=	Otherwise.
Divorced	Marital Status	1	=	Divorced/Separated.
		0	=	Otherwise.
Irish	Nationality	1	=	Irish.
		0	=	Otherwise.
UK	Nationality	1	=	UK.
		0	=	Otherwise.
EU	Nationality	1	=	Rest of EU.
		0	=	Otherwise.
Other Nat.	Nationality	1	=	Other/Not Stated.
		0	=	Otherwise.
USA	Nationality	1	=	American.
		0	=	Otherwise.

Table A3.1 (Continued): Variable List and Definitions.

Variable Name	Variable Description	Variable Values		
Born UK	Country of birth	1	=	UK.
		0	=	Otherwise.
Born EU	Country of birth	1	=	Rest of EU.
		0	=	Otherwise.
Born Other	Country of birth	1	=	Other.
		0	=	Otherwise.
Born USA	Country of birth	1	=	American.
		0	=	Otherwise.
≤ 10 Years	Years of residence in Ireland for immigrants	1	=	1 to 10 years.
		0	=	Otherwise.
> 10 Years	Years of residence in Ireland for immigrants	1	=	Over 10 years.
		0	=	Otherwise.
Not stated	Years of residence in Ireland for immigrants	1	=	Not stated.
		0	=	Otherwise.
Agriculture	NACE Economic Sector	1	=	Agriculture, forestry and fishing .
		0	=	Otherwise.
Mining	NACE Economic Sector	1	=	Mining and quarrying.
		0	=	Otherwise.
Manufacture	NACE Economic Sector	1	=	Manufacturing.
		0	=	Otherwise.
Electricity	NACE Economic Sector	1	=	Electricity, gas and water supply.
		0	=	Otherwise.
Construction	NACE Economic Sector	1	=	Construction.
		0	=	Otherwise.
Retail	NACE Economic Sector	1	=	Wholesale and retail.
		0	=	Otherwise.

Table A3.1 (Continued): Variable List and Definitions.

Variable Name	Variable Description	Variable Values		
Hotel	NACE Economic Sector	1	=	Hotels and restaurants.
		0	=	Otherwise.
Transport	NACE Economic Sector	1	=	Transport, Storage and communication.
		0	=	Otherwise.
Finance	NACE Economic Sector	1	=	Financial intermediation.
		0	=	Otherwise.
Real Estate	NACE Economic Sector	1	=	Real estate, renting and business activities.
		0	=	Otherwise.
Defence	NACE Economic Sector	1	=	Public administration, defence and social security.
		0	=	Otherwise.
Education	NACE Economic Sector	1	=	Education.
		0	=	Otherwise.
Health	NACE Economic Sector	1	=	Health.
		0	=	Otherwise.
Other Sector	NACE Economic Sector	1	=	Other.
		0	=	Otherwise.
Start 1960	Year in which person started working for this employer	1	=	1960 or before.
		0	=	Otherwise.
Start 1990	Year in which person started working for this employer	1	=	Between 1961 and 1990.
		0	=	Otherwise.
Start 1991	Year in which person started working for this employer	1	=	1991.
		0	=	Otherwise.

Table A3.1 (Continued): Variable List and Definitions.

Variable Name	Variable Description	Variable Values		
Start 1992	Year in which person started working for this employer	1 0	= =	1992. Otherwise.
Start 1993	Year in which person started working for this employer	1 0	= =	1993. Otherwise.
Start 1994	Year in which person started working for this employer	1 0	= =	1994. Otherwise.
Start 1995	Year in which person started working for this employer	1 0	= =	1995. Otherwise.
Start 1996	Year in which person started working for this employer	1 0	= =	1996. Otherwise.
Start 1997	Year in which person started working for this employer	1 0	= =	1997. Otherwise.
Start 1998	Year in which person started working for this employer	1 0	= =	1998. Otherwise.
Start 1999	Year in which person started working for this employer	1 0	= =	1999. Otherwise.
Start 2000	Year in which person started working for this employer	1 0	= =	2000. Otherwise.
Start 2001	Year in which person started working for this employer	1 0	= =	2001. Otherwise.
Start 2002	Year in which person started working for this employer	1 0	= =	2002. Otherwise.
Start 2003	Year in which person started working for this employer	1 0	= =	2003. Otherwise.
Start 2004	Year in which person started working for this employer or as self employed	1 0	= =	2004. Otherwise.
Hours	Usual number of weekly hours			

Table A3.1 (Continued): Variable List and Definitions.

Variable Name	Variable Description	Variable Values		
Second Job	Whether person in employment has a second job	1 0	= =	Yes. Otherwise.
EDU1	Highest education level attained	1 0	= =	No formal/primary education. Otherwise.
EDU2	Highest education level attained	1 0	= =	Lower secondary. Otherwise.
EDU3	Highest education level attained	1 0	= =	Upper secondary. Otherwise.
EDU4	Highest education level attained	1 0	= =	Post leaving cert. Otherwise.
EDU5	Highest education level attained	1 0	= =	Third level – non degree. Otherwise.
EDU6	Highest education level attained	1 0	= =	Third level – degree or above. Otherwise.
EDUNS	Highest education level attained	1 0	= =	Other/not stated. Otherwise.
Child 5	Children's ages in family	1 0	= =	Couple/Lone parent with children under 5. Otherwise.
Child 15	Children's ages in family	1 0	= =	Couple/Lone parent with children between 5 and 14. Otherwise.
Child 20	Children's ages in family	1 0	= =	Couple/Lone parent with children 15 to over 20. Otherwise.

Table A3.1 (Continued): Variable List and Definitions.

Variable Name	Variable Description	Variable Values		
Permanent	Employment status	1	=	Permanent.
		0	=	Otherwise.
Region	Location of Respondent	1	=	Border, Midland and Western.
		0	=	Eastern and Southern.
Foreign	Nationality	1	=	Not an Irish National.
		0	=	Otherwise.

Table A3.2: QNHS, Percentage of Individuals by Nationality from 1999 to 2004.

Year	Irish	UK	EU	USA	Other
1999	96.5%	2.1%	0.8%	0.2%	0.4%
2000	96.3%	2.0%	0.9%	0.2%	0.6%
2001	95.5%	2.2%	1.0%	0.2%	1.1%
2002	94.8%	2.1%	1.1%	0.2%	1.8%
2003	94.0%	2.3%	1.1%	0.2%	2.4%
2004	94.2%	0.0%	0.0%	0.2%	5.6%

Source: The Quarterly National Household Survey, 1999 - 2004.

Table A3.3: QNHS, Percentage of Individuals by Occupation from 1999 to 2004.

Year	Plant	Security	Craft	Clerical	Sales	Management	Technical	Professional
1999	11.3%	10.7%	15.3%	14.0%	8.9%	19.5%	9.2%	11.1%
2000	12.0%	11.0%	15.1%	13.6%	9.1%	19.0%	9.2%	11.0%
2001	12.3%	10.6%	14.9%	13.7%	9.1%	18.9%	9.5%	11.0%
2002	11.6%	10.7%	14.2%	14.2%	9.1%	18.8%	9.7%	11.7%
2003	10.6%	11.3%	14.7%	13.4%	9.1%	18.6%	10.1%	12.2%
2004	9.6%	11.4%	14.6%	13.5%	9.3%	18.8%	10.1%	12.7%

Source: The Quarterly National Household Survey, 1999 - 2004.

Table A3.4: Occupation by Nationality and by Year.

Plant and Machinery					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	97.4%	1.9%	0.4%	0.1%	0.2%
2000	97.6%	1.6%	0.3%	0.1%	0.4%
2001	96.9%	1.6%	0.5%	0.1%	0.9%
2002	95.9%	1.7%	0.5%	0.1%	1.8%
2003	94.6%	1.9%	0.5%	0.0%	3.0%
2004	94.9%	0.0%	0.0%	0.1%	5.0%
Security					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	95.9%	1.9%	1.4%	0.1%	0.7%
2000	95.4%	1.8%	1.8%	0.2%	0.8%
2001	94.0%	2.2%	1.4%	0.1%	2.3%
2002	92.4%	2.1%	1.3%	0.2%	4.0%
2003	90.5%	2.5%	1.9%	0.1%	5.0%
2004	91.2%	0.0%	0.0%	0.2%	8.6%
Craft and Related					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	96.8%	2.3%	0.6%	0.1%	0.2%
2000	96.9%	2.2%	0.5%	0.1%	0.3%
2001	96.3%	2.1%	0.5%	0.1%	1.0%
2002	95.7%	2.3%	0.5%	0.1%	1.4%
2003	95.2%	2.3%	0.5%	0.1%	1.9%
2004	94.7%	0.0%	0.0%	0.2%	5.1%

Table A3.4 (Continued): Occupation by Nationality and by Year.

Clerical and Secretarial					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	97.4%	1.5%	0.7%	0.1%	0.3%
2000	97.4%	1.4%	0.8%	0.1%	0.3%
2001	96.7%	1.6%	1.0%	0.1%	0.6%
2002	96.1%	1.5%	1.2%	0.1%	1.1%
2003	94.9%	2.1%	1.5%	0.1%	1.4%
2004	96.2%	0.0%	0.0%	0.2%	3.6%
Sales					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	97.8%	1.1%	0.7%	0.2%	0.2%
2000	97.5%	1.1%	1.0%	0.0%	0.4%
2001	96.1%	1.5%	1.2%	0.1%	1.1%
2002	95.2%	1.7%	1.6%	0.1%	1.4%
2003	95.0%	1.7%	1.3%	0.1%	1.9%
2004	92.3%	0.0%	0.0%	0.2%	5.5%
Management					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	96.9%	1.9%	0.7%	0.2%	0.3%
2000	96.7%	1.7%	0.9%	0.2%	0.5%
2001	96.1%	2.2%	0.8%	0.3%	0.6%
2002	96.1%	2.1%	0.8%	0.3%	0.7%
2003	95.7%	2.3%	0.8%	0.2%	1.0%
2004	95.8%	0.0%	0.0%	0.3%	3.9%
Associate Professional					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	94.9%	3.1%	1.1%	0.4%	0.5%
2000	94.2%	3.4%	1.1%	0.5%	0.8%
2001	93.7%	3.0%	1.5%	0.4%	1.4%
2002	92.1%	2.9%	1.7%	0.4%	2.9%
2003	91.9%	3.0%	1.4%	0.3%	3.4%
2004	91.8%	0.0%	0.0%	0.5%	7.7%
Professional					
Year	**Irish**	**UK**	**Rest of EU**	**USA**	**Other**
1999	94.2%	3.1%	1.4%	0.4%	0.9%
2000	94.0%	2.8%	1.4%	0.3%	1.5%
2001	92.7%	3.3%	1.5%	0.5%	2.0%
2002	93.1%	2.9%	1.4%	0.4%	2.2%
2003	92.8%	2.8%	1.6%	0.3%	2.5%
2004	92.8%	0.0%	0.0%	0.3%	6.9%

Source: The Quarterly National Household Survey, 1999 - 2004.

Table A3.5: QNHS 1999 – 2004: Summary Statistics.

Variable	Mean	Standard Deviation	Max	Min
Occupation	3.52	2.21	7	0
YD99	0.17	0.38	1	0
YD00	0.17	0.38	1	0
YD01	0.17	0.38	1	0
YD02	0.17	0.38	1	0
YD03	0.17	0.37	1	0
YD04	0.14	0.35	1	0
Male	0.58	0.49	1	0
Age 15-19	0.01	0.21	1	0
Age 20-24	0.13	0.33	1	0
Age 25-34	0.26	0.44	1	0
Age 35-44	0.26	0.44	1	0
Age 45-54	0.21	0.41	1	0
Age 55-59	0.06	0.24	1	0
Age 60-64	0.04	0.19	1	0
Single	0.41	0.49	1	0
Married	0.54	0.50	1	0
Widowed	0.01	0.11	1	0
Divorced	0.04	0.19	1	0
Irish	0.95	0.21	1	0
UK	0.02	0.13	1	0
EU	0.01	0.09	1	0

Table A3.5 (Continued): QNHS 1999 – 2004: Summary Statistics.

Variable	Mean	Standard Deviation	Max	Min
Other Nat.	0.02	0.14	1	0
USA	0.00	0.04	1	0
Born Ireland	0.91	0.28	1	0
≤10 Years	0.04	0.20	1	0
>10 Years	0.05	0.21	1	0
Not Stated	0.00	0.01	1	0
Born UK	0.06	0.23	1	0
Born EU	0.01	0.11	1	0
Born Other	0.02	0.13	1	0
Born USA	0.00	0.06	1	0
Agriculture	0.06	0.24	1	0
Mining	0.00	0.06	1	0
Manufacture	0.18	0.38	1	0
Electricity	0.01	0.09	1	0
Construction	0.09	0.29	1	0
Retail	0.15	0.36	1	0
Hotel	0.06	0.23	1	0
Transport	0.06	0.24	1	0
Finance	0.04	0.21	1	0
Real Estate	0.09	0.28	1	0
Defence	0.05	0.23	1	0
Education	0.07	0.25	1	0

Table A3.5 (Continued): QNHS 1999 – 2004: Summary Statistics.

Variable	Mean	Standard Deviation	Max	Min
Health	0.09	0.29	1	0
Other Sector	0.05	0.22	1	0
Start 1960	0.01	0.08	1	0
Start 1990	0.30	0.46	1	0
Start 1991	0.02	0.13	1	0
Start 1992	0.02	0.14	1	0
Start 1993	0.02	0.14	1	0
Start 1994	0.03	0.16	1	0
Start 1995	0.03	0.18	1	0
Start 1996	0.04	0.02	1	0
Start 1997	0.06	0.23	1	0
Start 1998	0.09	0.28	1	0
Start 1999	0.09	0.29	1	0
Start 2000	0.08	0.28	1	0
Start 2001	0.06	0.23	1	0
Start 2002	0.02	0.13	1	0
Start 2003	0.02	0.15	1	0
Start 2004	0.01	0.08	1	0
Hours	31.24	18.13	80	0
Second Job	0.01	0.11	1	0
Region	0.24	0.43	1	0
EDU1	0.11	0.31	1	0

Table A3.5 (Continued): QNHS 1999 – 2004: Summary Statistics.

Variable	Mean	Standard Deviation	Max	Min
EDU2	0.17	0.38	1	0
EDU3	0.28	0.45	1	0
EDU4	0.13	0.34	1	0
EDU5	0.11	0.31	1	0
EDU6	0.18	0.38	1	0
EDUNS	0.02	0.14	1	0
Child 5	0.08	0.27	1	0
Child 15	0.04	0.20	1	0
Child 20	0.06	0.24	1	0
Permanent	0.68	0.47	1	0

Source: The Quarterly National Household Survey, 1999 - 2004.

Table A3.6: Nationality and Occupational Choice: Multinomial Logit Results.

	Security	**Craft**	**Clerical**	**Sales**	**Manage.**	**Technical**	**Professional**
UK	0.001	0.017	-0.025	-0.015	0.022	0.015	-0.005
	(0.22)	(2.61)	(-2.87)	(-5.06)	(1.99)	(2.55)	(-1.29)
EU	0.030	0.024	0.030	0.045	-0.073	-0.017	-0.028
	(4.83)	(1.98)	(2.20)	(5.42)	(-5.01)	(-2.62)	(-8.82)
USA	-0.005	0.019	-0.043	0.015	0.008	0.028	-0.017
	(-0.40)	(0.83)	(-1.63)	(1.04)	(0.25)	(1.60)	(-2.26)
Other Nat.	0.040	0.059	-0.026	0.009	-0.115	-0.003	-0.005
	(7.50)	(6.62)	(-2.72)	(2.18)	(-11.02)	(-0.60)	(-1.51)
1999	-0.003	-0.01	0.033	0.006	-0.028	-0.003	-0.009
	(-1.82)	(-0.51)	(6.76)	(2.74)	(-5.12)	(-0.87)	(-4.18)
2000	-0.000	-0.006	0.016	0.006	-0.016	-0.006	-0.009
	(-0.02)	(-1.95)	(3.24)	(2.94)	(-2.88)	(-2.09)	(-4.15)
2001	-0.003	-0.008	0.009	0.003	0.001	-0.006	-0.009
	(-1.73)	(-2.99)	(1.88)	(1.42)	(0.14)	(-2.09)	(-4.04)
2002	-0.005	-0.010	0.008	0.002	0.004	-0.005	-0.006
	(-2.91)	(-3.49)	(1.65)	(0.96)	(0.79)	(-1.62)	(-2.93)
2003	-0.009	0.003	-0.020	-0.009	0.039	-0.007	-0.005
	(-5.20)	(0.90)	(-4.62)	(-5.27)	(6.69)	(-2.22)	(-2.41)
Male	0.004	0.198	-0.303	-0.037	0.046	0.019	0.029
	(4.47)	(75.28)	(-100.56)	(-29.03)	(14.37)	(11.52)	(22.62)
Age 15-19	0.111	0.188	-0.014	0.058	-0.281	-0.034	-0.042
	(11.24)	(14.81)	(-1.45)	(8.03)	(-56.10)	(-5.15)	(-9.51)
Age 20-24	0.082	0.112	-0.006	0.015	-0.201	-0.006	-0.021
	(11.81)	(12.67)	(-0.73)	(3.41)	(-30.52)	(-1.18)	(-6.21)
Age 25-34	0.042	0.053	-0.036	-0.001	-0.075	0.001	-0.020
	(9.65)	(8.94)	(-4.82)	(-0.17)	(-9.55)	(0.15)	(-5.94)
Age 35-44	0.022	0.046	-0.034	-0.005	-0.012	-0.013	-0.021
	(5.99)	(8.38)	(-4.82)	(-1.53)	(-1.54)	(-2.72)	(-6.82)
Age 45-54	0.012	0.030	-0.023	-0.003	0.001	-0.010	-0.014
	(3.40)	(5.67)	(-3.14)	(-0.82)	(0.16)	(-2.10)	(-4.31)
Age 55-59	0.001	0.015	-0.022	0.003	0.013	-0.004	-0.014
	(0.27)	(2.58)	(-2.75)	(0.66)	(1.43)	(-0.74)	(-3.96)
Single	0.003	-0.016	-0.028	-0.002	0.060	-0.009	-0.007
	(2.38)	(-6.93)	(-8.25)	(-1.36)	(14.81)	(-4.19)	(-4.43)
Married	0.018	-0.003	-0.012	-0.003	0.032	-0.017	-0.017
	(3.61)	(-0.35)	(-1.25)	(-0.60)	(2.29)	(-2.65)	(-3.70)
Divorced	0.016	-0.002	-0.027	0.004	0.034	-0.014	-0.016
	(5.28)	(-0.32)	(-4.53)	(1.26)	(3.93)	(-3.44)	(-5.33)
Mining	0.035	-0.026	-0.035	-0.004	-0.321	-0.042	-0.026
	(1.28)	(-3.10)	(-1.60)	(-0.30)	(-136.42)	(-2.95)	(-2.69)
Manufacture	-0.004	0.114	-0.025	0.027	-0.457	0.052	-0.002
	(-0.43)	(13.80)	(-2.22)	(3.16)	(-123.61)	(4.06)	(-0.34)
Electricity[38]	0.035	0.074	0.106	-0.001	-0.327	0.059	-0.016
	(1.54)	(5.80)	(4.43)	-	(-142.03)	(2.87)	(-2.00)
Construction	-0.033	0.412	-0.046	-0.028	-0.394	-0.023	0.013
	(-5.12)	(32.03)	(-4.05)	(-6.23)	(-140.75)	(-2.56)	(1.57)

[38] T score not produced, 48 people in this category all are Irish.

Table A3.6 (Continued): Nationality and Occupational Choice: Multinomial Logit Results.

	Security	**Craft**	**Clerical**	**Sales**	**Manage.**	**Technical**	**Professional**
Retail	-0.010	0.001	0.015	0.490	-0.383	-0.078	-0.035
	(-1.17)	(0.10)	(0.93)	(16.80)	(-97.90)	(-13.57)	(-7.31)
Hotel	0.888	-0.107	-0.170	-0.035	-0.330	-0.105	-0.067
	(71.96)	(-57.47)	(-29.24)	(-9.17)	(-106.63)	(-44.20)	(-36.62)
Transport	0.168	-0.051	0.051	0.002	-0.367	-0.024	-0.049
	(5.29)	(-13.13)	(2.80)	(0.21)	(-138.56)	(-2.48)	(-14.71)
Finance	-0.003	-0.109	0.404	0.046	-0.335	0.107	-0.033
	(-0.28)	(-57.39)	(16.19)	(3.56)	(-123.77)	(5.22)	(-7.04)
Real Estate	0.214	-0.074	0.043	0.038	-0.384	0.145	0.052
	(6.14)	(-23.33)	(2.34)	(3.34)	(-127.84)	(6.53)	(4.15)
Defence	0.659	-0.103	0.033	-0.060	-0.357	-0.062	-0.054
	(16.92)	(-50.08)	(1.11)	(-35.97)	(-133.13)	(-8.89)	(-17.93)
Education	0.478	-0.085	-0.113	-0.057	-0.387	0.002	0.231
	(10.16)	(-30.51)	(-11.67)	(-32.67)	(-150.70)	(0.14)	(6.84)
Health	0.560	-0.081	-0.141	-0.055	-0.415	0.215	-0.022
	(12.52)	-(28.46)	(-20.82)	(-28.59)	(-151.33)	(5.97)	(-3.73)
Other Sector	0.636	-0.062	-0.127	-0.041	-0.367	0.052	-0.040
	(15.80)	(-11.52)	(-12.14)	(-12.83)	(-140.30)	(2.34)	(-8.41)
Start 1960	-0.49	-0.038	-0.145	-0.037	0.281	0.002	0.046
	(-20.64)	(-5.29)	(-16.84)	(-10.34)	(13.09)	(0.14)	(3.06)
Start 1990	-0.030	0.005	-0.118	-0.034	0.172	0.013	0.027
	(-17.29)	(1.54)	(-29.38)	(-19.69)	(27.27)	(3.76)	(9.78)
Start 1991	-0.027	0.011	-0.099	-0.025	0.139	0.004	0.020
	(-11.27)	(1.54)	(-17.05)	(-9.95)	(10.65)	(0.56)	(3.29)
Start 1992	-0.024	0.019	-0.095	-0.026	0.127	0.002	0.014
	(-10.17)	(2.86)	(-17.17)	(-11.49)	(10.62)	(0.38)	(2.70)
Start 1993	-0.023	0.025	-0.102	-0.024	0.124	0.001	0.015
	(-9.09)	(3.61)	(-18.65)	(-10.19)	(10.07)	(0.23)	(2.85)
Start 1994	-0.026	0.019	-0.115	-0.019	0.128	0.005	0.016
	(-12.71)	(3.24)	(-25.02)	(-8.13)	(11.60)	(0.94)	(3.18)
Start 1995	-0.020	0.021	-0.098	-0.020	0.096	0.013	0.020
	(-9.01)	(3.72)	(-20.56)	(-9.73)	(9.27)	(2.40)	(4.29)
Start1996	-0.018	0.023	-0.100	-0.020	0.109	0.004	0.013
	(-8.72)	(4.37)	(-22.73)	(-9.80)	(11.28)	(0.87)	(3.05)
Start 1997	-0.019	0.033	-0.095	-0.019	0.084	0.007	0.011
	(-10.11)	(6.56)	(-22.55)	(-10.19)	(9.36)	(1.43)	(3.06)
Start 1998	-0.017	0.024	-0.079	-0.015	0.068	0.008	0.014
	(-9.47)	(5.52)	(-18.69)	(-8.34)	(8.35)	(1.82)	(4.24)
Start 1999	-0.015	0.012	-0.062	-0.013	0.068	0.003	0.009
	(-8.12)	(2.96)	(-14.02)	(-6.99)	(8.50)	(0.72)	(2.76)
Start 2000	-0.013	0.014	-0.055	-0.006	0.048	0.004	0.009
	(-7.16)	(3.32)	(-11.68)	(-2.91)	(5.75)	(1.05)	(2.85)
Start 2001	-0.008	0.006	-0.036	-0.001	0.029	0.003	0.007
	(-3.63)	(1.41)	(-6.52)	(-0.33)	(3.15)	(0.59)	(1.92)
Start 2002	-0.008	0.026	-0.031	0.004	0.011	-0.010	0.001
	(-2.35)	(3.49)	(-3.72)	(0.96)	(0.79)	(-1.68)	(0.10)
Start 2003	0.005	0.006	-0.019	0.010	-0.003	-0.007	-0.004
	(1.32)	(0.91)	(-2.31)	(2.77)	(-0.19)	(-1.23)	(-0.80)

Table A3.6 (Continued): Nationality and Occupational Choice: Multinomial Logit Results.

	Security	**Craft**	**Clerical**	**Sales**	**Manage.**	**Technical**	**Professional**
Hours	-0.000	0.000	-0.001	-0.001	0.002	-0.000	-0.000
	(-13.56)	(4.16)	(-7.01)	(-21.64)	(23.27)	(-9.00)	(-2.38)
Second Job	0.007	-0.006	0.045	0.001	-0.102	0.022	0.000
	(1.47)	(-0.89)	(3.52)	(0.028)	(-7.14)	(2.53)	(0.03)
Region	0.006	0.029	-0.003	-0.002	-0.044	-0.006	0.002
	(5.07)	(14.83)	(-1.14)	(-1.74)	(-13.07)	(-2.96)	(1.13)
EDU1	-0.022	-0.022	0.032	-0.004	0.010	0.021	0.025
	(-14.55)	(-8.35)	(4.69)	(-2.30)	(1.41)	(3.44)	(3.15)
EDU2	-0.055	-0.091	0.031	-0.017	0.057	0.072	0.093
	(-32.45)	(-38.46)	(5.14)	(-10.54)	(8.06)	(11.77)	(10.69)
EDU3	-0.053	-0.025	0.059	-0.039	-0.039	0.069	0.116
	(-35.97)	(-9.03)	(8.00)	(-26.20)	(-5.24)	(9.34)	(9.92)
EDU4	-0.060	-0.108	-0.119	-0.044	-0.050	0.194	0.281
	(-40.53)	(-57.61)	(-27.52)	(-26.69)	(-5.60)	(17.19)	(16.53)
EDU5	-0.083	-0.139	-0.181	-0.051	-0.040	0.053	0.566
	(-43.63)	(-66.45)	(-56.51)	(-34.00)	(-4.17)	(7.61)	(34.91)
EDUNS	-0.053	-0.085	-0.128	-0.043	-0.143	0.071	0.450
	(-38.97	(-40.24)	(-22.35)	(-26.26)	(-12.84)	(6.13)	(19.60)
Child 5	-0.005	-0.007	-0.012	-0.001	0.030	-0.005	0.007
	(-2.96)	(-2.44)	(-2.95)	(-0.70)	(5.25)	(-1.87)	(2.82)
Child 15	0.002	0.001	0.006	-0.005	0.003	-0.000	0.003
	(0.76)	(0.13)	(1.05)	(-2.11)	(0.47)	(-0.03)	(0.89)
Child 20	0.003	0.005	0.012	0.005	-0.013	-0.004	-0.006
	(1.62)	(1.54)	(2.28)	(2.29)	(-2.07)	(-1.06)	(-2.40)
Permanent	0.029	0.003	0.127	0.026	-0.199	-0.003	-0.013
	(24.37)	(1.41)	(46.25)	(21.72)	(-54.72)	(-1.22)	(-8.29)
Mining	-0.057	-0.071	-0.191	-0.060	0.335	0.023	0.057
* Foreign	(-39.83)	(-3.66)	(-72.62)	(-36.83)	(1.75)	(0.14)	(0.58)
Manufacture	-0.055	-0.088	-0.053	-0.033	0.266	0.019	-0.002
* Foreign	(-23.02)	(-26.81)	(-0.89)	(-1.65)	(3.27)	(0.23)	(-0.06)
Electricity	-0.054	-0.095	-0.181	-0.060	0.428	-0.045	0.062
* Foreign	(-14.34)	(-33.87)	(-18.17)	(-36.83)	(3.62)	(-0.72)	(0.64)
Construction	-0.052	-0.088	-0.071	-0.048	0.329	-0.018	0.003
* Foreign	(-11.59)	(-27.62)	(-1.22)	(-3.85)	(4.05)	(-0.26)	(0.07)
Retail	-0.053	-0.092	-0.016	-0.033	0.252	0.019	-0.021
* Foreign	(-17.73)	(-33.19)	(-0.22)	(-1.67)	(2.87)	(0.21)	(-0.72)
Hotel	-0.054	-0.094	0.037	-0.017	0.166	0.046	-0.032
* Foreign	(-22.75)	(-29.89)	(0.41)	(-0.52)	(1.74)	(0.43)	(-1.19)
Transport	-0.056	-0.094	-0.062	-0.018	0.345	-0.049	-0.009
* Foreign	(-34.41)	(-38.97)	(-1.11)	(-0.60)	(4.79)	(-1.08)	(-0.25)
Finance	-0.053	-0.069	-0.094	-0.036	0.281	0.030	-0.007
* Foreign	(-16.34)	(-4.65)	(-2.14)	(-1.96)	(3.31)	(0.34)	(-0.20)
Real Estate	-0.055	-0.085	-0.034	-0.028	0.220	0.050	-0.010
* Foreign	(-26.57)	(-19.80)	(-0.51)	(-1.19)	(2.50)	(0.51)	(-0.32)
Defence	-0.056	-0.100	-0.097	0.290	-0.100	0.006	0.106
* Foreign	(-37.42)	(-46.50)	(-1.79)	(1.28)	(-0.99)	(0.07)	(1.03)
Education	-0.055	-0.096	-0.083	-0.035	0.307	0.040	-0.011
* Foreign	(-31.07)	(-33.08)	(-1.59)	(-1.16)	(3.13)	(0.42)	(-0.33)

Table A3.6 (Continued): Nationality and Occupational Choice: Multinomial Logit Results.

	Security	**Craft**	**Clerical**	**Sales**	**Manage.**	**Technical**	**Professional**
Health	-0.054	-0.092	-0.083	-0.053	0.197	0.073	0.069
* Foreign	(23.59)	(-26.82)	(-1.63)	(-5.85)	(1.97)	(0.66)	(1.01)
Other Sector	-0.054	-0.088	-0.055	-0.047	0.205	0.095	0.002
* Foreign	(-23.43)	(-24.13)	(-0.90)	(-4.40)	(2.03)	(0.80)	(0.06)
Start 1960	-0.057	-0.038	0.623	-0.060	-0.234	-0.113	-0.057
* Foreign	(-39.81)	(-0.51)	(4.68)	(-36.82)	(-2.89)	(-65.68)	(-3.33)
Start 1990	-0.023	0.002	-0.057	0.004	0.067	0.022	0.010
* Foreign	(-3.60)	(0.12)	(-2.83)	(0.32)	(2.24)	(1.32)	(0.88)
Start 1991	-0.027	0.047	-0.059	0.011	0.003	-0.018	0.055
* Foreign	(-2.35)	(0.85)	(-1.29)	(0.39)	(0.04)	(-0.58)	(1.22)
Start 1992	-0.039	-0.003	-0.110	-0.038	0.203	-0.013	0.010
* Foreign	(-5.31)	(-0.09)	(-3.94)	(-2.37)	(3.08)	(-0.49)	(0.41)
Start 1993	-0.039	0.065	-0.080	-0.009	0.110	-0.036	0.015
* Foreign	(-3.76)	(1.24)	(-1.88)	(-0.39)	(1.55)	(-1.39)	(0.60)
Start 1994	-0.013	-0.025	0.064	-0.004	-0.005	-0.006	0.022
* Foreign	(-0.84)	(-1.17)	(1.07)	(-0.19)	(-0.09)	(-0.23)	(0.95)
Start 1995	-0.031	0.018	-0.087	-0.004	0.035	0.036	0.067
* Foreign	(-3.43)	(0.59)	(-3.01)	(-0.19)	(0.67)	(1.19)	(2.24)
Start 1996	-0.030	-0.022	-0.058	0.010	0.097	0.004	0.037
* Foreign	(-3.96)	(-1.28)	(-2.10)	(0.51)	(2.25)	(0.17)	(1.71)
Start 1997	-0.027	-0.010	-0.082	0.016	0.103	-0.012	0.051
* Foreign	(-4.16)	(-0.62)	(-4.06)	(0.91)	(2.75)	(-0.74)	(2.61)
Start 1998	-0.006	0.004	-0.008	-0.002	0.043	-0.015	0.008
* Foreign	(-0.70)	(0.24)	(-0.37)	(-0.21)	(1.33)	(-1.13)	(0.69)
Start 1999	-0.008	-0.008	-0.037	0.004	0.072	-0.014	0.016
* Foreign	(-1.08)	(-0.61)	(-2.00)	(0.41)	(2.36)	(-1.12)	(1.31)
Start 2000	0.005	0.000	-0.011	0.021	-0.008	-0.005	0.012
* Foreign	(0.63)	(0.01)	(-0.54)	(1.84)	(-0.29)	(-0.37)	(1.06)
Start 2001	0.007	0.015	-0.016	0.015	-0.014	0.002	-0.004
* Foreign	(0.87)	(0.95)	(-0.84)	(1.41)	(-0.47)	(0.18)	(-0.47)
Start 2002	-0.002	-0.008	0.003	0.042	-0.002	-0.020	-0.017
* Foreign	(-0.16)	(-0.42)	(0.10)	(2.00)	(-0.04)	(-1.12)	(-1.33)
Start 2003	-0.001	0.039	0.004	0.015	-0.018	-0.032	0.012
* Foreign	(-0.10)	(1.64)	(0.13)	(1.06)	(-0.43)	(-2.11)	(0.71)
Mining	-0.049	0.380	-0.012	-0.052	-0.243	-0.064	-0.063
* Male	(-6.62)	(1.470	(-0.12)	(-7.87)	(-3.73)	(-1.61)	(-5.99)
Manufacture	-0.011	0.033	0.405	-0.024	-0.272	-0.037	-0.052
* Male	(-0.56)	(1.66)	(7.34)	(-1.76)	(-17.19)	(-1.75)	(-4.49)
Electricity	0.121	0.111	0.082	-0.056	-0.306	0.013	-0.058
* Male	(0.74)	(1.63)	(1.05)	(-19.74)	(-23.87)	(0.26)	(-6.82)
Construction	-0.001	0.344	-0.118	-0.034	-0.322	-0.028	-0.056
* Male	(-0.04)	(6.62)	(-5.62)	(-2.95)	(-31.27)	(-1.15)	(-5.85)
Retail	-0.031	0.194	0.354	-0.056	-0.310	-0.097	-0.076
* Male	(-2.44)	(4.790	(6.10)	(-11.55)	(-32.31)	(-10.80)	(-15.51)
Hotel	-0.019	0.181	0.213	-0.039	-0.282	-0.058	-0.063
* Male	(-1.10)	(2.79)	(3.06)	(-4.90)	(-25.14)	(-2.83)	(-9.67)
Transport	-0.050	0.165	0.277	-0.056	-0.332	-0.020	-0.055
* Male	(-9.18)	(3.75)	(4.55)	(-14.31)	(-52.09)	(-0.82)	(-6.49)

Table A3.6 (Continued): Nationality and Occupational Choice: Multinomial Logit Results.

	Security	**Craft**	**Clerical**	**Sales**	**Manage.**	**Technical**	**Professional**
Finance	0.021	-0.032	0.450	-0.022	-0.284	-0.039	-0.061
* Male	(0.56)	(-1.39)	(7.30)	(-1.62)	(-24.55)	(-1.82)	(-10.07)
Real Estate	0.197	0.079	0.163	-0.031	-0.294	-0.031	-0.055
* Male	(2.38)	(2.47)	(2.58)	(-2.95)	(-26.02)	(-1.40)	(-6.18)
Defence	0.070	0.184	0.181	-0.032	-0.333	-0.068	-0.070
* Male	(1.41)	(2.59)	(2.77)	(-1.81)	(-56.77)	(-4.84)	(-17.04)
Education	-0.028	0.245	0.205	-0.011	-0.307	-0.013	-0.069
* Male	(-2.07)	(3.77)	(3.02)	(-0.42)	(-34.96)	(-0.48)	(-17.65)
Health	-0.047	0.311	0.220	-0.021	-0.317	-0.101	-0.059
* Male	(-8.72)	(5.08)	(3.38)	(-1.33)	(-49.74)	(-20.71)	(-9.44)
Other Sector	-0.049	0.252	0.195	-0.050	-0.291	-0.030	-0.058
* Male	(-9.96)	(5.17)	(3.29)	(-10.62)	(-33.13)	(-1.39)	(-8.39)
Male	-0.001	-0.015	0.018	-0.005	-0.038	0.009	0.025
* Foreign	(-0.25)	(-1.47)	(1.36)	(-0.95)	(-2.56)	(1.02)	(3.50)
Dependent Variable is Occupation.							
Number of Observations = 236,601.							
Pseudo R^2 = 0.4181.							
Log pseudolikelihood = -282,473.98.							

Source: Quarterly National Household Survey 1999-2004.

Notes: **(i)** The base category is plant and machinery operatives.
(ii) The values reported are marginal effects, with T-statistics in parenthesis.
(iii) A full set of variable definitions are listed in Table A3.1 in the Appendix.

Table A3.7: Country of Birth and Occupational Choice: Multinomial Logit Results (Summary).

	Security	**Craft**	**Clerical**	**Sales**	**Manage.**	**Technical**	**Professional**
Born UK	0.002	0.003	-0.023	-0.006	0.019	0.009	-0.000
	(0.75)	(0.83)	(-4.59)	(-2.84)	(2.89)	(2.66)	(-0.03)
Born EU	0.024	0.023	0.015	0.033	-0.044	-0.016	-0.026
	(4.60)	(2.14)	(1.26)	(4.88)	(-3.36)	(-2.67)	(-8.68)
Born USA	-0.012	0.001	-0.043	0.023	0.018	0.027	-0.001
	(-1.71)	(0.08)	(-2.32)	(1.94)	(0.76)	(2.14)	(-0.09)
Born Other	0.032	0.051	-0.009	0.004	-0.107	-0.012	0.000
	(6.33)	(5.63)	(-0.89)	(1.01)	(-9.89)	(-2.33)	(0.09)
Male	0.004	0.198	-0.304	-0.037	0.046	0.019	0.028
	(4.48)	(74.76)	(-100.53)	(-29.04)	(14.38)	(11.63)	(22.84)
Dependent Variable is Occupation. Number of Observations = 236,601. Pseudo R^2 = 0.4180. Log pseudolikelihood = -282,524.72.							

Source: Quarterly National Household Survey 1999-2004.

(i) The base category is plant and machinery operatives.
(ii) The values reported are marginal effects, with T-statistics in parenthesis.
(iii) A full set of variable definitions are listed in Table A3.1 in the Appendix.
(iv) All other explanatory variables as reported in Table A3.6 were used in estimation but not reported here.

Table A3.8: Years of Residency and Occupational Choice: Multinomial Logit Results (Summary).

	Security	**Craft**	**Clerical**	**Sales**	**Manage.**	**Technical**	**Professional**
≤ 10 Years	0.024	0.027	-0.009	0.006	-0.41	-0.001	-0.011
	(7.88)	(5.33)	(-1.48)	(2.15)	(-5.41)	(-0.37)	(-5.04)
> 10 Years	0.001	0.003	-0.019	-0.002	0.007	0.008	0.002
	(0.52)	(0.63)	(-3.44)	(-0.77)	(0.99)	(2.21)	(0.92)
Not Stated	-0.015	0.008	-0.019	-0.028	-0.270	0.219	0.116
	(-0.98)	(0.13)	(-0.23)	(-0.95)	(-6.32)	(2.58)	(1.86)
Male	0.004	0.198	-0.303	-0.037	0.046	0.019	0.029
	(4.66)	(74.76)	(-100.59)	(-28.96)	(14.28)	(11.59)	(23.06)
Dependent Variable is Occupation. Number of Observations = 236,601. Pseudo R^2 = 0.4178. Log pseudolikelihood = -282,623.28.							

Source: Quarterly National Household Survey 1999-2004.

(i) The base category is plant and machinery operatives.
(ii) The values reported are marginal effects, with T-statistics in parenthesis.
(iii) A full set of variable definitions are listed in Table A3.1 in the Appendix.
(iv) All other explanatory variables as reported in Table A3.6 were used in estimation but not reported here.

Table A3.9: Nationality and Occupational Choice: Multinomial Logit Results (Summary).

	Security	**Craft**	**Clerical**	**Sales**	**Manage.**	**Technical**	**Professional**
UK	-0.002	0.042	0.004	-0.007	-0.009	-0.007	0.004
	(-0.95)	(2.18)	(0.32)	(-0.89)	(-0.90)	(-0.96)	(0.71)
EU	0.008	0.037	0.010	0.009	-0.025	-0.003	-0.11
	(1.27)	(1.06)	(0.56)	(0.67)	(-1.71)	(-0.26)	(-2.40)
USA	-0.005	0.109	-0.062	-0.004	0.025	0.104	-0.016
	(-13.85)	(1.70)	(-3.18)	(-0.18)	(0.76)	(0.43)	(-2.39)
Other Nat.	-0.000	0.076	-0.048	-0.028	-0.057	-0.027	-0.018
	(-0.09)	(3.62)	(-6.06)	(-5.72)	(-7.89)	(-5.00)	(-7.09)
Male	-0.001	0.240	-0.188	-0.003	-0.111	0.002	0.014
	(-0.97)	(52.33)	(-41.97)	(-1.39)	(-32.44)	(0.62)	(9.58)
Dependent Variable is Occupation. Number of Observations = 41,304. Pseudo R^2 = 0.1623. Log pseudolikelihood = -60,009.24.							

Source: Quarterly National Household Survey 1999-2004.

(i) The base category is plant and machinery operatives.
(ii) The values reported are marginal effects, with T-statistics in parenthesis.
(iii) A full set of variable definitions are listed in Table A3.1 in the Appendix.
(iv) All other explanatory variables as reported in Table A3.6 were used in estimation but not reported here.

Table A3.10: Country of Birth and Occupational Choice: Multinomial Logit Results (Summary).

	Security	**Craft**	**Clerical**	**Sales**	**Manage.**	**Technical**	**Professional**
Born UK	-0.002	0.009	0.002	0.002	0.006	-0.010	0.001
	(-2.46)	(0.79)	(0.22)	(0.43)	(0.82)	(-2.26)	(0.025)
Born EU	0.003	0.033	0.011	0.005	-0.014	-0.007	-0.012
	(0.82)	(1.12)	(0.73)	(0.47)	(-1.04)	(-0.80)	(-3.23)
Born USA	-0.004	0.025	-0.035	0.007	0.030	0.020	-0.002
	(-13.73)	(0.48)	(-1.55)	(0.31)	(1.03)	(0.93)	(-0.25)
Born Other	0.003	0.061	-0.030	-0.027	-0.055	-0.031	-0.019
	(1.24)	(2.86)	(-2.98)	(-4.84)	(-7.04)	(-5.63)	(-7.24)
Male	-0.001	0.240	-0.022	-0.003	0.012	0.002	0.014
	(-1.01)	(52.62)	(-4.43)	(-1.43)	(3.62)	(0.65)	(9.60)
Dependent Variable is Occupation. Number of Observations = 41,304. Pseudo R^2 = 0.1621. Log pseudolikelihood = -60,021.99.							

Source: Quarterly National Household Survey 1999-2004.

(i) The base category is plant and machinery operatives.
(ii) The values reported are marginal effects, with T-statistics in parenthesis.
(iii) A full set of variable definitions are listed in Table A3.1 in the Appendix.
(iv) All other explanatory variables as reported in Table A3.6 were used in estimation but not reported here.

Table A3.11: Years of Residency and Occupational Choice: Multinomial Logit Results (Summary).

	Security	**Craft**	**Clerical**	**Sales**	**Manage.**	**Technical**	**Professional**
≤ 10 Years	-0.000	0.039	-0.007	-0.009	-0.026	-0.015	-0.012
	(-0.09)	(2.75)	(-0.90)	(-1.83)	(-3.73)	(-3.29)	(-5.43)
> 10 Years	-0.001	0.015	-0.005	0.001	0.004	-0.010	0.001
	(-1.15)	(1.23)	(-0.65)	(0.15)	(0.50)	(-2.05)	(0.39)
Not Stated	-0.004	0.134	-0.094	-0.049	-0.109	0.023	-0.035
	(-13.83)	(0.61)	(-47.61)	(-36.95)	(-47.44)	(0.40)	(-25.01)
Male	-0.001	0.240	-0.188	-0.004	0.012	0.001	0.014
	(-0.99)	(52.60)	(-42.14)	(-1.46)	(3.62)	(0.58)	(9.60)
Dependent Variable is Occupation. Number of Observations = 41,304. Pseudo R^2 = 0.1616. Log pseudolikelihood = -60,063.17.							

Source: Quarterly National Household Survey 1999-2004.

(i) The base category is plant and machinery operatives.
(ii) The values reported are marginal effects, with T-statistics in parenthesis.
(iii) A full set of variable definitions are listed in Table A3.1 in the Appendix.
(iv) All other explanatory variables as reported in Table A3.6 were used in estimation but not reported here.

Table A3.12: Nationality and Occupational Choice: Multinomial Logit Results (Summary).

	Security	**Craft**	**Clerical**	**Sales**	**Manage.**	**Technical**	**Professional**
UK	-0.002	0.034	-0.021	-0.012	0.006	0.013	-0.000
	(-0.76)	(2.49)	(-4.09)	(-3.26)	(0.45)	(2.29)	(-0.08)
EU	0.001	0.040	0.013	0.039	-0.070	0.006	-0.021
	(0.32)	(1.55)	(1.37)	(3.85)	(-3.24)	(0.69)	(-5.75)
USA	0.016	0.038	-0.032	-0.012	-0.021	0.040	-0.008
	(0.96)	(0.79)	(-2.19)	(-0.90)	(-0.50)	(1.97)	(-0.87)
Other Nat.	0.019	0.096	-0.002	-0.002	-0.143	-0.012	-0.005
	(4.72)	(6.05)	(-0.32)	(-0.55)	(-10.99)	(-2.44)	(-1.45)
Dependent Variable is Occupation. Number of Observations = 136,459. Pseudo R^2 = 0.3834. Log pseudolikelihood = -162,197.18.							

Source: Quarterly National Household Survey 1999-2004.

(i) The base category is plant and machinery operatives.
(ii) The values reported are marginal effects, with T-statistics in parenthesis.
(iii) A full set of variable definitions are listed in Table A3.1 in the Appendix.
(iv) All other explanatory variables as reported in Table A3.6 were used in estimation but not reported here.

Table A3.13: Country of Birth and Occupational Choice: Multinomial Logit Results (Summary).

	Security	Craft	Clerical	Sales	Manage.	Technical	Professional
Born UK	-0.000	0.004	-0.016	-0.007	0.013	0.011	0.001
	(-0.23)	(0.53)	(-4.96)	(-3.06)	(1.49)	(3.15)	(0.49)
Born EU	0.000	0.026	0.022	0.026	-0.042	0.001	-0.021
	(0.07)	(1.20)	(2.39)	(3.31)	(-2.19)	(0.09)	(-6.50)
Born USA	0.008	0.007	-0.033	0.019	-0.010	0.033	0.002
	(0.90)	(0.18)	(-3.17)	(1.36)	(-0.30)	(2.18)	(0.24)
Born Other	0.015	0.083	0.007	-0.005	-0.136	-0.015	0.000
	(4.02)	(5.07)	(1.04)	(-1.30)	(-10.29)	(-2.97)	(0.07)
Dependent Variable is Occupation. Number of Observations = 136,459. Pseudo R^2 = 0.3834. Log pseudolikelihood = -162,206.14.							

Source: Quarterly National Household Survey 1999-2004.

(i) The base category is plant and machinery operatives.
(ii) The values reported are marginal effects, with T-statistics in parenthesis.
(iii) A full set of variable definitions are listed in Table A3.1 in the Appendix.
(iv) All other explanatory variables as reported in Table A3.6 were used in estimation but not reported here.

Table A3.14: Years of Residency and Occupational Choice: Multinomial Logit Results (Summary).

	Security	Craft	Clerical	Sales	Manage.	Technical	Professional
≤ 10 Years	0.009	0.051	-0.005	-0.001	-0.062	0.004	-0.006
	(4.09)	(4.98)	(-1.27)	(-0.36)	(-6.13)	(1.09)	(-2.54)
> 10 Years	0.001	0.001	-0.009	-0.003	0.002	0.008	0.001
	(0.49)	(0.09)	(-2.42)	(-1.12)	(0.24)	(2.04)	(0.50)
Not Stated	0.024	-0.034	-0.015	-0.047	-0.239	0.171	0.170
	(1.18)	(-0.29)	(-0.30)	(-33.25)	(-2.37)	(1.68)	(1.93)
Dependent Variable is Occupation. Number of Observations = 136,459. Pseudo R^2 = 0.3830. Log pseudolikelihood = -162,292.67.							

Source: Quarterly National Household Survey 1999-2004.

(i) The base category is plant and machinery operatives.
(ii) The values reported are marginal effects, with T-statistics in parenthesis.
(iii) A full set of variable definitions are listed in Table A3.1 in the Appendix.
(iv) All other explanatory variables as reported in Table A3.6 were used in estimation but not reported here.

Table A3.15: Nationality and Occupational Choice: Multinomial Logit Results (Summary).

	Security	**Craft**	**Clerical**	**Sales**	**Manage.**	**Technical**	**Professional**
UK	0.004	0.003	-0.012	-0.016	0.028	0.010	-0.015
	(0.53)	(1.04)	(-0.65)	(-4.09)	(1.87)	(1.04)	(-2.76)
EU	0.050	0.011	0.039	0.040	-0.066	-0.037	-0.032
	(4.45)	(1.92)	(1.79)	(3.64)	(-4.65)	(-4.39)	(-7.18)
USA	-0.028	0.020	-0.072	0.024	-0.054	0.025	-0.024
	(-1.87)	(3.39)	(-3.61)	(2.97)	(-4.21)	(2.45)	(-2.32)
Other Nat.	0.057	0.006	-0.038	0.048	0.033	-0.001	-0.016
	(5.25)	(0.53)	(-0.72)	(1.88)	(0.87)	(-0.06)	(-3.13)
Dependent Variable is Occupation. Number of Observations = 100,142. Pseudo R^2 = 0.4198. Log pseudolikelihood = -112,932.39.							

Source: Quarterly National Household Survey 1999-2004.

(i) The base category is plant and machinery operatives.
(ii) The values reported are marginal effects, with T-statistics in parenthesis.
(iii) A full set of variable definitions are listed in Table A3.1 in the Appendix.
(iv) All other explanatory variables as reported in Table A3.6 were used in estimation but not reported here.

Table A3.16: Country of Birth and Occupational Choice: Multinomial Logit Results (Summary).

	Security	Craft	Clerical	Sales	Manage.	Technical	Professional
Born UK	0.003	0.000	-0.022	-0.002	0.022	0.003	-0.002
	(0.73)	(0.27)	(-0.27)	(-0.82)	(2.67)	(0.51)	(-0.56)
Born EU	0.044	0.013	0.004	0.034	-0.041	-0.027	-0.025
	(4.38)	(2.50)	(0.19)	(3.57)	(-2.96)	(-3.11)	(-5.54)
Born USA	-0.034	0.000	-0.051	0.027	0.049	0.009	-0.000
	(-3.30)	(0.04)	(-1.39)	(1.67)	(1.71)	(0.54)	(-0.02)
Born Other	0.047	0.018	-0.047	0.018	-0.047	0.011	-0.014
	(4.36)	(2.95)	(-2.27)	(2.28)	(-3.45)	(1.10)	(-2.44)
Dependent Variable is Occupation. Number of Observations = 100,142. Pseudo R^2 = 0.4196. Log pseudolikelihood = -112,975.61.							

Source: Quarterly National Household Survey 1999-2004.

(i) The base category is plant and machinery operatives.
(ii) The values reported are marginal effects, with T-statistics in parenthesis.
(iii) A full set of variable definitions are listed in Table A3.1 in the Appendix.
(iv) All other explanatory variables as reported in Table A3.6 were used in estimation but not reported here.

Table A3.17: Years of Residency and Occupational Choice: Multinomial Logit Results (Summary).

	Security	Craft	Clerical	Sales	Manage.	Technical	Professional
≤ 10 Years	0.032	0.008	-0.012	0.013	-0.016	-0.005	-0.021
	(5.61)	(2.97)	(-1.01)	(3.06)	(-1.79)	(-0.84)	(-6.60)
> 10 Years	0.001	0.001	-0.027	0.000	0.013	0.007	0.005
	(0.16)	(0.80)	(-2.62)	(0.11)	(1.57)	(1.18)	(1.08)
Not Stated	-0.059	0.040	-0.034	0.028	-0.173	0.210	-0.013
	(-3.15)	(0.85)	(-0.23)	(0.36)	(-5.58)	(1.69)	(-0.36)
Dependent Variable is Occupation. Number of Observations = 100,142. Pseudo R^2 = 0.4194. Log pseudolikelihood = -113,011.71.							

Source: Quarterly National Household Survey 1999-2004.

(i) The base category is plant and machinery operatives.
(ii) The values reported are marginal effects, with T-statistics in parenthesis.
(iii) A full set of variable definitions are listed in Table A3.1 in the Appendix.
(iv) All other explanatory variables as reported in Table A3.6 were used in estimation but not reported here.

Chapter 4: Wages and Nationality in Ireland

4.1 Introduction

The prevailing wage rate in an economy is one of the key factors in determining both the competitiveness of an economy and the standard of living of the citizens within that economy. Relatively low wage levels can aid the attraction of inward investment and help sustain both the labour market and economy during recessionary times, while higher wage levels may offer the benefit of an influx of skilled labour from all over the world and higher standards of living, but often come with the burden of higher inflation. Currently, the Irish Government is faced with the prospect of implementing wage reducing policies in an attempt to stabilise an economy experiencing a severe contraction[39]. It is in this context that the importance of wage determination studies can be highlighted.

The focus of this chapter is on examining the key determinants of the hourly wage levels of workers in the Irish labour market. A standard Mincerian type analysis is carried out in conjunction with an Oaxaca style decomposition of the wage gaps between native and non-native workers. In keeping with both Chapter 3 (the occupational attainment study) and Chapter 5 (a production function study), the impact of being a foreign labour market participant in the Irish labour market on wages is examined. A panel of data comprised from the LII from 1995 to 2001 is utilised for a random effects estimation of a Mincerian wage equation. The LII data set is chosen instead of the data set used in Chapter 3, the QNHS, due to the fact that the QNHS does not contain information on wages[40]. The Mincerian wage model estimated in this chapter using the LII panel data is not a first attempt at a Mincerian wage equation in the context of the Irish labour market, but recent studies such as those by Barrett and McCarthy (2007a) and Barrett and McCarthy (2007b) employ cross sectional data on one year of data only. It should also be noted that unlike the empirical work in this study, neither of the Irish studies mentioned above appear to control for sample

[39] See Chabanet and Royall (2009) for discussion on the Irish labour market in recession.

selection bias in their estimations of earnings functions. Earnings functions that do not control for sample selection bias can produce potentially biased estimates.

In recent times, Irish wage levels have been formulated via collective bargaining, with Leddin and Walsh (1998) pointing to the 1987 *Programme for Recovery* as the first attempt by an Irish Government to establish a 'social partnership' agreement between employers, trade unions and Government[41]. The collective bargaining system that has evolved from the *Programme for Recovery* is applicable to trade union members in both the public and private sectors. In conjunction with the social partnership agreements, public service pay is regulated by the Government appointed Public Service Benchmarking Body. The regulation and setting of wage levels is further supported by industrial relations law, while the Joint Labour Committees (JLC) help in establishing the statutory minimum rates of pay and conditions of employment in sectors where typically the collective bargaining system is not in operation and where the prevailing wage levels tend to be low[42]. The minimum wage in Ireland was established as late as 2000 and the hourly rate is currently €8.65, with €6.06 being the applicable hourly rate for employees under the age of eighteen[43]. Table 4.1 below highlights the average wage levels in the manufacturing, services, financial and public sectors in Ireland between 2000 and 2006.

The most striking figure over the seven year period is that the average annual public sector pay growth (2.9%) is almost double the equivalent figures for the manufacturing (1.6%) and services (1.5%) sectors. The annual average growth in public sector pay also outstrips the growth rate of wages in the financial sector (2.1%). This is potentially evidence of the impact of the collective wage bargaining system on unionised public sector pay. The largest annual increase in public sector pay, 6.9%, occurred in 2004 and was over double the size of the growth rate in banking (3.3%)

[40] The QNHS data set is used instead of the LII data set in Chapter 3, as it contains more recent information. The LII was not carried out after 2001.
[41] Information on wage formation and industrial relations in Ireland is available at http://www.eurofound.europa.eu/eiro/index.htm.
[42] The JLC are bodies established under the Industrial Relations Act, 1946.
[43] For detailed information on the minimum wage in Ireland see http://www.entemp.ie/index.htm.

and services (2.8%) pay and over three times the magnitude of the growth in manufacturing (2.1%) pay in the same year. This inflated public sector wage growth was a direct result of the 2003 *Sustaining Progress* partnership agreement[44]. Under this agreement public sector pay was to increase by 3% in January 2004, 2% in July 2004 and a further 2% in December 2004. A recent International Monetary Fund (2009) report on the economic crisis in Ireland indicates that Ireland was the "most overheated" of the EU economies and attributes part of the inflationary pressures on the "generous" increases in public sector pay.

Table 4.1: Average Real Weekly Earnings, 2000-2006.

Year	Manufacturing	Services	Banking	Public Sector
2000	€324.07	€386.68	€454.30	€439.18
2001	€333.55	€398.11	€480.36	€462.12
2002	€337.07	€393.29	€479.35	€457.91
2003	€345.10	€397.47	€470.78	€459.22
2004	€352.40	€408.58	€486.49	€490.92
2005	€358.85	€414.93	€499.15	€512.23
2006	€356.14	€422.28	€513.43	€519.06

Source: Central Statistics Office of Ireland. Values measured in 1989 Euros.

The stated focus of this chapter of examining the key determinants of the wage levels of both native and foreign born workers in the Irish labour market, and in examining the causes of any potential pay differences between the two groups, is in line with the overall focus of the thesis in attempting to establish the role of foreign and domestic factors in Irish labour and manufacturing markets. The remainder of the chapter comprises of the following structure; in Section 4.2 the relevant literature in the field is summarised and reviewed, while Section 4.3 contains both a description of the methodology employed and some summary statistics for the key variables in the data set. Section 4.4 presents the results from the econometric analysis while conclusions drawn from the empirical analysis can be found in Section 4.5.

[44] The agreement is available at http://www.taoiseach.gov.ie/upload/SPword8.rtf.

4.2 Literature Review

This section of the chapter contains a review of some of the relevant literature in the wage determination field. Among the variables reviewed include age and experience, education, gender, race, tenure, marital status, trade union membership as well as wage studies relevant to the Irish economy. The review concludes with a brief outline of some of the Oaxaca type decomposition studies in the field.

Huang (1999) isolates three potential explanations for the empirical results which suggest that older and more experienced individuals tend to be rewarded with higher levels of remuneration. Firstly, wage increases can be viewed as a reward to workers for both the formal and informal training and work experience they have amassed over their time in employment. Employers can justify this higher reward by using their workers' human capital accumulation to explain higher profits and productivity. Secondly, companies may offer higher wages for retention purposes. Losing experienced staff is a loss of human capital investment for the employer. Finally, higher wage levels are offered to more senior and experienced employees as a reward for their higher productivity and performance levels. Lazear (1976) highlights the importance of on-the-job training by equating the opportunity cost of being unemployed with the loss of human capital accumulation via on-the-job training. An attempt is then made to construct a variable for on-the-job training by examining the differences between work experience and age. Lazear (1976) argues that such a variable is useful in the estimation of wage equations as wage growth should be related to time spent on-the-job (acquiring human capital), not just age. Lazear (1976) established that young workers in the US received one third of their total employment remuneration in the form of human capital, therefore current experience will have an impact upon future wage growth. Age is also found to be an important determinant of wages for younger workers, but this impact diminishes over time. Lazear (1976) reports that by the time a worker reaches the age of twenty five the impact of experience on wages outweighs the equivalent impact of age itself. Ben-Porath's (1967) assumption that previous work experience has a neutral impact upon wage

growth is contradicted by Lazear's (1976) finding of past work experience being inversely related to wage growth.

Hause (1980) finds that on-the-job training is a significant variable in determining the wage levels of Swedish men. Lazear (1981) suggests setting wages in such a fashion so as to equate the interests of the agent (worker) with that of the principal (employer). The argument is made that an upward sloping age-earnings profile will provide such an outcome. Lazear (1981) theorises that rewarding workers with less than their marginal product when they are young and with more than their marginal product when they are old, will decrease the workers' incentive to shirk. Lazear's (1981) age profile argument is constructed around the concept that wages grow with experience, regardless of whether productivity does also and, as such, the separation between wages, marginal product and the labour supply decision is distorted. Flabbi and Ichino (2001) using Italian data find that wages increase with age because of firm specific human capital accumulation and via the self-selection process of better workers staying longer in higher salaried posts. Koeber and Wright (2001) find in examining US data that the older a worker becomes the longer the spells of unemployment they might face, while Munasinghe and Sigman (2004) find that US workers with a history of staying in one post, earn higher wages as they get older, relative to their more mobile colleagues who switch jobs more frequently.

Returns to schooling have been a key driver of increased educational participation rates across industrialised economies in recent times, with a strong base of empirical research to support the fundamental claim of better educated workers earning higher remuneration than their counterparts with lower levels of educational attainment. Lazear (1976) reports a positive relationship between education and wages in the US, while Gabriel and Schmitz (2005) estimate the rate of return on schooling in the US labour market and find that education increases the earning power of both men and women, across both blue and white collar occupations. Becker (1967) attempts to incorporate the role of ability in the returns to schooling debate by suggesting a comparison of the marginal rates of return across workers as a function of the amount

invested to increase earnings. The worker with the higher marginal rate is deemed to be of higher ability. Hause (1972) critiques Becker's (1967) work and finds that the theory is not plausible in the context of cross-sectional data, where the marginal rates of return are only measured at one point in time. Hause (1972) contends that if workers with higher ability have the means to earn more and if they also tend to acquire more schooling, then the lack of an ability variable in wage estimation will firstly, overstate the contribution of schooling to earnings and secondly, understate the opportunity cost of foregone earnings to the higher ability individuals who attain higher levels of education. Using IQ tests taken by a sample of 2,300 white males from the US in 1943 when applying for pilot positions as a measure of ability, coupled with earnings from surveys in 1955 and 1969 respectively, Hause (1972) reports a positive relationship between ability and earnings.

Freeman (1976) reported a decline in the return on a University education in the US, while Dooley (1986) tested for and found the same phenomenon in Canadian data. A reversal in this declining trend was highlighted by Blackburn et al. (1990) and Katz and Murphy (1992) in the case of the US and likewise in the Canadian case by Blackburn and Bloom (1993). Bar-Or et al. (1995) investigate the returns to a Canadian university education, and like the earlier works did find a declining rate of return in the 1970's, but failed to find the trend reversal in the 1980's. Martins and Pereira (2004) examine the impact of education upon wage inequality in sixteen European nations, using data between 1980 and 1995. Results were categorised into four groups, with education found to have a positive and increasing contribution to within-levels of wage inequality in the case of Portugal, a positive and stable impact for Austria, Finland, France, Ireland, the Netherlands, Norway, Spain, Sweden, Switzerland and the UK, a neutral role in the cases of Denmark and Italy, while education was found to have a negative impact on within-levels of wage inequality in Germany and Greece. Finally with respect to education and training, Booth et al. (2003) report that male workers in the UK who receive work related training receive a higher wage than those workers who did not have access to this training.

The impact of gender based discrimination upon wage rates is a continuing theme in the earnings literature. Loureiro et al. (2004) explain that discrimination in the labour market context occurs, when individuals with equal skills, levels of human capital and productivity, but earn different amounts or are treated differently by their employer based on their gender, race or other personal characteristic that has no direct impact upon their respective levels of productivity. The difference in human capital accumulation between the genders is a possible explanation of the differing wage rates experienced by men and women in the labour market. Mincer and Polachek (1974) and Becker (1985) argue that as women bear the majority of child rearing duties, they do so at the expense of less labour market experience and fewer job related skills (human capital) and so generate a divergence in the human capital levels of the genders. Marini (1989) reviews the empirical work in this area and suggests that between one-third and two-fifths of the wage gap between males and females is accounted for after controlling for gender differences in work history patterns. Fuchs (1988) contends that the majority of the remaining three-fifths of the wage gap is due to unmeasured differences between men and women in their commitment to parenting. Blinder (1973) analysing US data and utilising a decomposition technique reports that 100% of the gender based wage differential could be accounted for by some form of discrimination.

There are two schools of thought with respect to the dynamics of how this divergence in human capital levels between men and women is actually generated. Goldin and Polachek (1987) suggest that women acquire less human capital than men because they remain in the home rearing children and therefore choose to invest less in human capital acquisition prior to having a family on the basis of an 'offspring interrupted' future career. This line of thinking suggests that it is the women themselves who create the divergence, while others such as Lazear and Rosen (1990) argue that the there is institutional discrimination on the behalf of the employers. Employers faced with information asymmetries with respect to employees, use gender as a predictor of future employment commitment and, on that basis, are less likely to hire women for roles that require investments in long periods of training. O'Neill (1985) suggests

including a dummy variable reflecting marital status in earnings models, as such a variable will reflect responsibilities in the home. In fact, Corcoran and Courant (1987) suggest that the key reason why females enter the legal profession in the US is that employee credentials in that sector can be 'precisely measured', thus reducing the possibility of employers discriminating on gender grounds.

An alternative theme in the gender based wage discrimination literature concentrates on occupational segregation[45]. This theory contends that women are systematically channelled by educators and employers, or self-select themselves for occupations predominately filled by females. Often these occupations will pay less, offer fewer promotional opportunities and lower the probability of human capital accumulation of the worker. Wood et al. (1993) argue that if occupational segregation of women explains lower wage levels for females, then women who enter predominately male careers should progress well in those occupations. However, Reskin and Roos (1990) find that US women who entered eleven male dominated occupations were actually segregated within those occupations and were in fact funnelled into the least desirable and progressive roles within the occupations. Wood et al. (1993) using data on University of Michigan law graduates to examine male-female pay differentials, examine the impacts of children and work history on individuals' careers. Despite controlling for childcare and work history, between one-quarter and one-third of the male-female earnings gap remains unexplained. Wood et al. (1993) also find that there are marginal differences between the genders' starting pay, but by the time they are fifteen years into their careers women are only earning 60% of what men earn at this stage. Women, it appears, tend to be segregated within the sector and end up in lower pay settings (Government and legal services) relative to the men in the legal profession.

Smith and Ward (1989) and O'Neill and Polachek (1993) all report that gender wage differentials in the US can be accounted for by differences in skill levels. Duncan (1996) finds that women in the US receive a higher earnings effect from an extra year's

[45] See Marini (1989) for a thorough discussion on the topic.

education and an extra week's work, which support Polachek's (1987) hypothesis that the gender wage gap will narrow by increasing either hours worked or educational levels. Specifically, Duncan (1996) suggests that an increase in female education in the region of 20% or a 100% increase in weeks worked by females will equate male and female earnings. Duncan (1996) also finds evidence of wage discrimination as more educated men have steeper experience-earnings profiles, but more educated women do not.

Wage studies examining the impact of race upon earnings is a strong component of the empirical research of this branch of labour economics and it is an area of concern for a 'modern Ireland', where the last ten years has seen economic migrants attracted to the Irish labour market for the first time. Themes and policies debated for the labour markets of the UK and the US in the 1970's and 1980's are now relevant in the context of a multicultural Ireland. Borjas (1987) suggests that the inflow of immigrant workers into a country is a function of the rewards that can be attained in the host country, relative to the country of origin of the immigrant worker[46]. McDonald and Worswick (1988) examine how macroeconomic conditions at the time of arrival of the immigrant into the host country impact upon subsequent earnings for immigrants in Canada. Smith and Welch (1978) in a thorough investigation of the black-white wage gap in the US find that the black wage rate grew at a faster rate than the white wage rate and attribute this result to the increased educational levels of black US workers and to the urbanisation of areas of the rural south. Government policies aimed at raising the wage of black workers were found to have a minor impact. Smith and Welch (1978) also reject the 'life-cycle hypothesis' of the black labour market, whereby black workers continually get channelled into low paying occupations. Smith and Welch (1978) are of the opinion that a 'vintage' effect is, in fact, in operation and that newer cohorts of black workers enter the labour market with higher rates of human capital than did their predecessors in previous generations. Lazear (1979) however remained unconvinced by such evidence of the narrowing of the black-white wage gap. In examining US Data, Lazear (1979) concludes that although there may be evidence of improved

[46] See Borjas (1987) for a thorough analysis of the economic factors affecting immigration.

starting wages for blacks, the overall narrowing of the racial wage gap is, in fact, an illusion, as black workers receive less on-the-job-training than do their white colleagues and so are faced with a flatter wage-experience profile. So the increase that employers have given to black workers at the start of their careers relative to previous cohorts of black workers, is in fact taken back over their working lives. Duncan (1996), in a US labour market study, reports the most pessimistic result for labour market equity, with white males earning the highest hourly wage and black females earning the least.

Chiswick (1978b) examines the impact of being a male immigrant in the US labour market. The conclusion drawn is that immigrants initially earn less than US born workers, but that the immigrant wage will rise more rapidly with experience in the labour market and that within fifteen years of US based work experience, the immigrant worker can expect to earn the equivalent wage of a US born worker. However, Chiswick (1978b) also alludes to the difficulties faced by employers in terms of the information asymmetries surrounding new immigrant workers in the labour market and suggests that, for this reason (as opposed to racial discrimination) such workers are more likely to initially end up in less productive jobs with less job-specific training. Long (1980) examines the earnings of female immigrant workers in the US and reports that immigrant earnings are 13% higher than indigenous workers, while similarly Lazear (1976) reports non-whites having higher wage growth than whites in the US. Long (1980) also reports smaller marginal effects of education and experience upon earnings for female immigrant workers relative to native US women, while immigrant earnings are found not to vary by marital status. Long (1980) suggests that the finding of foreign born earnings not increasing with experience or duration of stay in the US may be due to a small sample size and poor measurement of experience.

Trejo (1997) examines the wage gap between Mexican-American and US workers. The empirical results suggest that Mexican-American workers earn 21% less than non-Hispanic whites, which is approximately the same gap reported for the black-white wage differential. Over 75% of this deficit in wages Trejo (1997) argues is explained

by age, poor language skills, and lower educational levels, while it is claimed that the same factors account for less than one-third of the black-white wage gap. Trejo (1997) concludes that Mexican-Americans earn less due to lower levels of human capital and not because of direct discrimination. In a more recent study, Antecol and Bedard (2004) claim that black and Mexican male workers in the US earn less than white male labour market participants because of differences in education, location, age, immigration rates and occupational selection. O'Neill et al. (2006) report that the differences in cognitive skills are an important determinant of the black-white wage gap in the US and claim to be able to explain almost the entire wage gap for high earning males by utilising such analysis. It could be argued that there is less explaining to be done for high wage earners regardless of colour relative to the lower income earners, as one would expect such workers to have high levels of human capital in the first instance and are less likely to be faced with discrimination, relative to their lower income counterparts. Borjas (1987) reports that immigrants relocating to the US post 1964 have lower relative wages and slower relative wage growth, relative to those immigrants who relocated prior to 1964. The reasoning behind the slowdown in wage growth of the emigrant body is due to a change in immigration laws which focused upon family reunification as opposed to skills. Jasso and Rosenzweig (1990) highlight the sensitivity of Borjas' (1987) work to the exclusion of certain immigrant groups. Yuengert (1994) reports strong earnings growth for post 1964 immigrants to the US, an overall decrease in the immigrant quality but an increase in Mexican immigrant quality.

Chiswick (1980) concluded that immigrants who entered into the UK with a wage disadvantage were unlikely to note a decline in this disadvantage over time. Long (1980) critiques Chiswick's (1980) work and suggests that the specification employed in that empirical work may not be appropriate for groups whose labour force participation is not continuous over the life-cycle. Blackaby et al. (1994) also found in the case of the UK that the black-white wage differential had increased over time. Bell (1997) followed the work of Chiswick (1980) in examining the immigrant wage of immigrants based in the UK. Bell (1997) however uses data from 1973 to 1992 where

Chiswick (1980) examined one year of data only, 1972. Bell (1997) reports that black workers who have foreign labour market experience face a wage disadvantage relative to native workers, but that there are strong assimilation effects for the black workers and that this disadvantage diminishes with time spent in the UK. Bell (1997) also finds that both West Indian and Indian workers in the UK suffer a penalty on wage levels for both foreign labour market experience and on education obtained outside the UK. The entry wage for Indian workers is found to be higher than that of the West Indian workers. Both Chiswick and Miller (2002) in the case of the US and Dustmann and Fabbri (2003) in the case of the UK conclude that large portions of wage differentials between immigrant and native workers could be accounted for by lack of language skills acquired by immigrant workers. In conclusion on this discussion of racial wage inequality, Lindley (2009) suggests that over-education implies lower returns for immigrants and non-white natives in the UK.

Several attempts have been made to establish the relationship between the tenure of a worker and his or her wage profile. Clark and Ogawa (1992a) using Japanese data report that an increase in the age of mandatory retirement reduces the growth rate of earnings. Hashimoto and Raisian (1985) find that Japanese men have longer employment tenure than their counterparts in the US and that they also have steeper experience-earnings profiles. Growth rates in earnings that can be attributed to tenure are higher for Japanese males than US males. Both Abraham and Farber (1987) and Altonji and Shakotko (1987) theorise that estimates of tenure returns are biased due to the fact that good job matching leads to workers being employed for longer periods in a post. Bronars and Famulari (1997) find that wage growth declines as tenure increases and that more experienced workers experience slower wage growth in the US. Bronars and Famulari (1997) also report that: pay differentials may be due to unobserved skill differentials across employees; pay differentials cannot be accounted for by occupational or gender segregation; the current wages and tenure are positively correlated; and the highest skilled workers are employed by the highest paying firms, a result consistent with the findings of Abowd et al. (1999) for France. Hashimoto and Raisin (1992) counteract the findings of Clark and Ogawa (1992b) who claimed that

tenure mattered less to workers' earnings in Japan and in the US in the 1980's than prior to that decade.

Korenman and Neumark (1991) survey the literature with respect to earnings and marriage and suggest that males earn between 10% and 40% extra as a result of being married. Several hypothesis have been put forward as to why this is the case. Becker (1981) attributes the higher pay levels to higher productivity, suggesting that marriage makes men more productive. Hill (1979) suggests that employers favour married workers over single workers and this contributes to the pay differential between married and single workers, while Reed and Harford (1989) suggest that marriage premiums are the result of employers having to pay extra to married men to work under adverse conditions. Hill (1979) finds that married men in the US earn more than divorced, widowed or single men, while Greenhalgh (1980) finds similar outcomes in the case of the UK. By way of extension, Phillips and Griffiths (2004) report that divorce does not affect the earnings of females in Australia, but rather divorce is a symptom of higher wages.

Trade unions have played a key part in establishing the wage levels in the Irish economy in the last fifteen years through the wage bargaining process involving the Government, employers and trade unions. The following is a brief summary of studies examining the impact of trade unions upon wages. Ross (1948) postulated the "orbits of collective comparison" concept, where during collective bargaining workers in one union receive a certain wage increase, then the workers in other unions are entitled to, and will receive, the same increases. Rosen (1969) produced one of the first analysis with respect to wage differentials between unionised and non-unionised workers. Lazear (1979) reports that young US union workers receive higher remuneration than their non-union counterparts, but that the age-wage profiles for the unionised workers are flatter. Card et al. (2004) find that trade union membership does not reduce wage inequality among women in the US, the UK or Canada.

There are several varied works in the area of Irish wage studies, including Barrett and Trace (1998), Minns (2005), Barrett et al. (2006) and Barrett and Duffy (2008). Walsh and Whelan (1976) report that trade union membership in Ireland earned male workers a 16% premium over non-union members. Callan and Reilly (1993) also examined the impact of trade union membership on wage dispersion and concluded that union membership accounted for a 20% mark up on wage levels for members. Callan and Wren (1994) estimate that average female hourly earnings were approximately 80% of that of their male counterparts, with the gap narrowing for those under thirty five years of age. It is also reported that when the wage gap between the genders is decomposed, just under half of the gap between male and female hourly wages is due to observable differences in the characteristics of male and female workers. Barrett et al. (2002) report that the gender wage gap narrowed further, with females earning 84.5% of what men earned. Time spent out of the labour market by the females in the sample was found to account for a significant portion of the remaining differential. Barrett et al. (2002) also suggest that the increase in the flow of migrant labour into Ireland contributed to the decrease in wage inequality. Ruhs (2005) excludes EU workers in examining labour market policy for permit holders only in the Irish labour market. Barrett and McCarty (2007a) show that the wage gap between immigrants from new member states of the EU into Ireland and native Irish workers was in the order of 30% to 45%[47]. Barrett and McCarthy (2007a) also report that there is a 12% wage premium for males, that the return on a year's experience is 4%, positive returns to schooling are present, that overall immigrants faced a wage disadvantage of 18% relative to native workers and that non-English speaking workers received 31% less than comparable native workers. It should be noted that the sample size of immigrants was small (183 workers) and that the study was based upon one year of data (the 2004 Survey of Income and Living Conditions). Barrett and McCarthy (2007b) report that immigrants in the Irish economy were earning 15% less than their indigenous counterparts in 2005, with the equivalent figures for non-English speaking immigrants and immigrants from the new member states being 20% and 32% respectively. Barrett and McCarthy (2007b) also report that foreign born females experienced a 'double disadvantage',

[47] In May 2004, 10 new member states joined the EU.

whereby females were reported as earning 12% less than men, while female immigrants earned 14% less than native females. Beach and Worswick (1993) and Duleep and Dowhan (2002) highlighted similar findings in the cases of Canada and the US respectively.

Barrett and Duffy (2008) report that the lower wages experienced by immigrants from the new member states of the EU into Ireland is attributable to the lower occupational status acquired by the immigrant workers. Barrett et al. (2008) find that immigrants from new member states face the largest wage disadvantage of all immigrants in the Irish labour market, an 18% discount on what native workers could expect to earn. Barrett et al. (2008) also found that; public sector workers were found to earn 12% more than their counterparts in the private sector; unionised workers tended to earn marginally less than non-unionised workers; males earned 12% more than females; while positive returns to education were also reported. In line with earlier works by Chiswick and Miller (2002) and Dustmann and Fabbri (2003) in the cases of the US and the UK respectively, Barrett et al. (2008) found that poor spoken English was found to have a detrimental impact upon the earnings of immigrant workers. Finally in relation to Irish wage studies, Figini and Görg (1999) analyse the impact of MNC's on wage inequality and find an inverted 'U' shaped relationship between wage inequality and the presence of MNC's in the Irish economy.

The Oaxaca decomposition will be utilised as part of the empirical analysis presented in this chapter, the following is a review of some of the studies that incorporate wage decompositions[48]. Blinder (1973) found that 70% of the black-white wage differential in the US could be accounted for by discrimination using a wage decomposition technique. McNabb and Psacharopoulos (1981) find that the key source of the wage differential for black workers in the UK was the lower returns to schooling experienced by this group of workers, relative to natives. Reimers (1983) concludes that ethnicity is an important determinant when examining the wage decompositions of six ethnic groups in the US. Kee (1995) presents a similar argument for ethnic groups in the

[48] The Oaxaca decomposition technique is described in Section 4.3.3 below.

Netherlands. Neuman and Oaxaca (2005) also find that ethnicity does contribute to imbalances in wages but that the role of gender is larger when examining the wage decomposition of Israeli workers. Kidd (1993) finds that English speaking immigrant workers in Australia earn more than their native counterparts due to their higher levels of education. Blackaby et al. (1994) report that the disadvantage faced by black workers in the UK actually worsened throughout the 1980's relative to the previous decade, while Darity et al. (1995) find that colour is more important than culture in explaining male wage decompositions in the US. Interestingly, Butcher (1994) finds that black immigrant workers from the Caribbean and Jamaica have similar wage levels to those black workers who moved from their state of birth in the US. Jeon and Simmons (1998) state that immigrant West Indians face a discount on wages relative to second generation West Indians in the US. Butcher and Dinardo (2002) conclude that the structure of wages is an important determinant of the wage gap between natives and immigrants in the US. Nielsen et al. (2004) report that the wage differential between the genders in Denmark is dominated by the discriminatory component, while in contrast the key driver of wage differentials between immigrants and natives is varying levels of education.

From the evidence provided by the research in this area, it is evident that age and experience, education, gender, race, tenure and trade union membership are important explanatory variables in determining the wage levels of individuals. It is also apparent from the studies that utilise an Oaxaca style decomposition, that there still exists inequality in pay between different groups of workers in the labour force, such as immigrant and indigenous workers and male and female workers.

4.3 Methodology and Data

The econometric analysis presented in Section 4.4 of this chapter is a random effects estimation of a Mincerian wage equation. By way of extension, an Oaxaca decomposition is also presented and discussed in Section 4.4. This section of the chapter contains a brief description of the random effects estimation procedure, a discussion on Mincerian wage equations and an outline of the model to be estimated is

also included. The details of the Oaxaca decomposition procedure are explained. As the Inverse Mills Ratio is used to control for potential sample selection bias, a brief discussion on this topic is also included. Finally, key summary statistics are presented and discussed at the end of this section.

4.3.1 The Random Effects Model

Given that the LII data set used is a panel running between 1995 and 2001, the random effects model is the technique chosen to estimate the Mincerian wage equations. Gujarati and Porter (2009) suggest that the random effects model is more appropriate to use in instances where the coefficients on time invariant variables such as gender and nationality need to be established, hence a fixed effects estimator would not be appropriate. Baltagi (2008) states that the random effects model should be selected for panel data sets that are comprised of *N* individuals randomly chosen from a large population and by way of example highlights the suitability of household panel data studies[49]. A brief explanation of the random effects model is set out below[50].

Equation (4.1) below is a standard wage equation where W_{it} measures the natural log of hourly wages for individual 'i' in time period 't', X_{it} is a vector containing explanatory variables for individual 'i' in time period 't' and where the error term consists of two components ($\alpha_i + \mu_{it}$). The error term has an individual specific element (α_i) which does not vary with time and a combined time series and cross-section error component (μ_{it}).

$$W_{it} = \beta_0 + \beta_1 X_{it} + \alpha_i + \mu_{it}. \qquad (4.1)$$

The four assumptions outlined below are expected to hold for the random effects model:

[49] For a comparison of the fixed effects and random effects models see Baltagi (2008) and Cameron and Trivedi (2005).
[50] The description of the random effects model is drawn mainly from Gujarati and Porter (2009) and Verbeek (2008).

$$\alpha_i \sim N(0, \sigma_\alpha^2). \tag{4.2}$$

$$\mu_{it} \sim N(0, \sigma_\mu^2). \tag{4.3}$$

$$E(\alpha_i \mu_{it}) = 0; E(\alpha_i \alpha_j) = 0; (i \neq j). \tag{4.4}$$

$$E(\mu_{it} \mu_{is}) = E(\mu_{ij} \mu_{ij}) = E(\mu_{it} \mu_{js}) = 0; (i \neq j; t \neq s). \tag{4.5}$$

These assumptions state that the individual error components are uncorrelated with each other and that there will be no autocorrelation across both the cross-section and time series elements. Greene (2003) establishes that the coefficients from random effects estimator $(\hat{\beta}_{RE})$ can be estimated via equation (4.6) below:

$$\hat{\beta}_{RE} = \left(\sum_{i=1}^{N} X_i' \Omega^{-1} X_i \right)^{-1} \left(\sum_{i=1}^{N} X_i' \Omega^{-1} W_i \right). \tag{4.6}$$

where Ω is the disturbance covariance matrix. Verbeek (2008) suggests that the random effects estimator is determined simply as a weighted average of the equivalent within and between estimators.

4.3.2 The Mincerian Wage Equation

Mincer (1974) established an earnings regression, the specification of which is still widely applied in econometric studies on earnings today and the results of the model presented in Section 4.4 are based upon such a Mincerian style model. Teixeira (2007) outlines the significance of Mincer's (1974) work and the wider role he played in modern economics. Heckman et al. (2006) suggest that Mincer's (1974) model builds upon the assumptions around the human capital investment model as developed by Ben-Porath (1967) and derives the Mincer equation that is set out below[51].

Let P_t represent potential earnings at age 't' and assume the cost of training (C_t) is a fraction (K_t) of potential earnings:

[51] The derivation of the Mincer equation is drawn mainly from Heckman et al. (2006).

$$C_t = K_t P_t. \tag{4.7}$$

Assuming that ρ_t is the average return on training investments made at age 't', potential earnings at age 't' can be written as:

$$P_t \equiv P_{t-1}(1 + K_{t-1}\rho_{t-1}) \equiv \prod_{j=0}^{t-1}(1 + \rho_j K_j)P_0. \tag{4.8}$$

Schooling is defined as the number of years spent in full time schooling (S) and it is assumed that the return on schooling will yield a return, ρ_S. If the assumption is made that the rate of return to post-school investment is constant over age and is set equal to ρ_0, then equation (4.9) below will hold:

$$\ln P_t \approx \ln P_0 + S\ln(1+\rho_S) + \sum_{j=S}^{t-1}\ln(1+\rho_0 K_j). \tag{4.9}$$

The assumption is made that the rate of post-school investment is both linear and declining:

$$K_{S+X} = K(1 - \frac{X}{T}). \tag{4.10}$$

The amount of work experience gained at age 't' (X) is defined as t-S. Mincer (1974) also assumed that the length of an individual's working life is independent of years of schooling. This allows the relationship between potential earnings, schooling and experience to be defined in the following way:

$$\ln P_{X+S} \approx \ln P_0 + S\rho_S + \left(\rho_0 K + \frac{\rho_0 K}{2T}\right)X - \frac{\rho_0 K}{2T}X^2. \tag{4.11}$$

Real earnings are taken to be potential earnings less investment costs, which allows for the Mincer equation to be expressed as follows:

$$\ln Y(S,X) = (\ln P_0 - K) + \rho_S S + \left(\rho_0 K + \frac{\rho_0 K}{2T} + \frac{K}{T}\right)X - \frac{\rho_0 K}{2T}X^2. \quad (4.12)$$

where Y(S, X) represents the earnings at schooling level S and experience level X. The following section outlines the Mincerian wage equation that is used on this study as well as the workings of the Oaxaca decomposition.

4.3.3 The Wage Equation and the Oaxaca Decomposition

Equation (4.13) below, a Mincerian wage model, is estimated using a random effects model. The Irish data that is used in the estimation procedure is drawn from the LII panel of data, running from 1995 to 2001.

$$W_{it} = \beta_0 + \beta_1 S_{it} + \beta_2 X_{it} + \beta_3 X_{it}^2 + \beta_4 Z_{it} + \alpha_i + \mu_{it}. \quad (4.13)$$

In this model, W_{it} measures the natural log of hourly wages for individual 'i' in time period 't', S_{it} is the level of schooling acquired by individual 'i' in time period 't', X_{it} is the level of experience gained by individual 'i' in time period 't', while Z_{it} is a vector containing other explanatory variables for individual 'i' in time period 't' including gender, nationality/country of birth, location and sector that the individual is employed in. Two separate models are included in the analysis and vary only in the measure included to control for nationality. Model 1 includes country of birth while model 2 utilises citizenship. The inclusion of citizenship in model 2 also allows for an examination of the impact (if any) of non-Irish workers taking Irish citizenship upon their earnings. Three different samples of the data are used: all workers, male workers only and female workers only[52]. A full description of both the independent variables

[52] Workers over the retirement age of 65 are excluded as are self-employed individuals due to the inherent unreliability of self-employed earnings data. Approximately 1% of the sample the estimates are based upon are recorded as being self-employed. See Hamilton (2000) for a discussion on self-employed earnings data.

and the dependent variables used are included in Table A4.1 in the Appendix at the end of the chapter. The model is also used to generate Oaxaca style wage decomposition values and the following is a brief description of the workings of a pooled Oaxaca decomposition. Taking equation (4.1) and estimating separately for two groups, A and B, the Oaxaca (1973) wage decomposition can be represented by equation (4.14) below:

$$\overline{W_A} - \overline{W_B} = (\overline{X_A} - \overline{X_B})\beta^* + \{\overline{X_A}(\beta_{1A} - \beta^*) + \overline{X_B}(\beta^* - \beta_{1B})\}. \quad (4.14)$$

Equation (4.14) generates the log wage differential between group A and group B, where $\overline{X}$ is a vector of explanatory variables, β_1 is a vector of wage regression coefficients and β^* is the unobserved non-discriminatory wage structure. The bar notation suggests that the wage decomposition is evaluated for workers with the characteristics of the average worker in the samples. The wage differential is decomposed into three parts, with the first part measuring the wage differential between the two groups that is due to differences in personal characteristics, the second part of the decomposition represents wage discrimination in terms of the overvaluation of the characteristics of group A, while the third part also represents discrimination but in terms of the undervaluation of group B. In keeping with the focus of this chapter, the Oaxaca decomposition is carried out and analysed in Section 4.4.4 for all workers in the sample, where estimates are decomposed according to nationality. The following section presents a discussion on sample selection bias and the inverse Mills ratio.

4.3.4 Sample Selection Bias and the Inverse Mills Ratio

Cameron and Trivedi (2005) summarise the work of Manski (1995) in describing sample selection bias. Manski (1995) suggests that sample selection bias is in effect an identification issue and states that it is the problem of identifying conditional probability distributions from a random sample of data when the realisations of the conditioning variables are always observed, but that some of the realisations of the outcomes are in fact censored. Cameron and Trivedi (2005) assume that Y is an

outcome to be predicted and that the appropriate conditioning variables are defined as X. It is also assumed that D is a censoring indicator which will take the value of 1 if the outcome for Y is observed and 0 if the outcome for Y is unobserved. Cameron and Trivedi (2005) then suggest that the variables (D, X) can always be observed, but Y can only be observed when D takes on the value of 1. This is defined by Manski (1995) as being a 'censored sampling process' and such a process cannot identify equation (4.15) below, where P is the probability:

$$P[Y|X] = (P[Y|X, D = 1])(P[D = 1|X]) + (P[Y|X, D = 0])(P[D = 0|X]). \quad (4.15)$$

One potential method for controlling for this problem is known as the inverse Mills ratio. The inverse Mills ratio is the ratio of the probability density function over the cumulative distribution function of a distribution. As the dependent variable in the Mincerian wage model is censored (i.e. only includes outcomes for the employed in the sample), then as Tobin (1958) demonstrates, if the exclusion of the unemployed from the estimation is not controlled for the resulting estimates will be potentially biased. Heckman (1979) suggests generating the inverse Mills ratio from a probit model that predicts employment and to incorporate the inverse Mills ratio as an explanatory variable in the Mincerian wage equation. Greene (2003) defines the inverse Mills ratio by assuming that a is a constant, Φ is the standard normal cumulative distribution function and that:

$$X \sim N(\mu, \sigma^2). \quad (4.16)$$

It is further assumed that:

$$E[X|Truncation] = \mu + \sigma\lambda(\alpha) \text{ and } Variance[X|Truncation] = \sigma^2[1 - \delta(\alpha)]. \quad (4.17)$$

where $\sigma = (a - \mu)/\sigma$ and where $\delta(\alpha) = \lambda(\sigma)[\lambda(\sigma) - \sigma]$. It is assumed that $\theta(\alpha)$ is the standard normal density function. Greene (2003) shows that the inverse Mills ratio is defined as:

$\lambda(\alpha) = \theta(\alpha)/[1 - \Phi(\alpha)]$ if truncation is $X > a$. (4.18)

$\lambda(\alpha) = -\theta(\alpha)/\Phi(\alpha)$ if truncation is $X < a$. (4.19)

The final subsection below presents a brief summary of some of the key descriptive statistics from the data used.

4.3.5 Data Description

The LII surveys and data set were collected by the Economics and Social Research Institute (ERSI), but the ISSDA provided the data[53]. The following description of the LII is provided by the ERSI[54];

> *"The Living in Ireland Surveys form the Irish component of the European Community Household Panel (ECHP): an EU-wide project, co-ordinated by Eurostat, to conduct harmonised surveys dealing with the social situations, financial circumstances and living standards of European individuals and households. The ECHP provides harmonised cross-sectional surveys for each year in which the survey is conducted."*

Although the LII data set was not collected after 2001, it is used instead of the alternative data set that is utilised in Chapter 3, the QNHS, as the QNHS does unfortunately not contain wage data. There are seven years (1995-2001) used in the Mincerian wage model analysed, with 18,349 observations in total. Table 4.2 below contains the yearly breakdown of the number of observations included in the Mincerian wage study[55]. The number of observations is also split by gender and by country of birth. The number of observations included in the sample fell year on year until the sample size increased in 2000 and although it fell again in 2001, it was still a larger cohort than four of the previous six years[56].

[53] For information on the ERSI and the ISSDA see http://www.esri.ie/ and http://www.ucd.ie/issda/.
[54] Source: http://issda.ucd.ie/documentation/esri/lii-overview.pdf, page 1.
[55] Persons included in the sample were employed, were under the age of 66, were resident in Ireland and were not engaged in self-employment.
[56] The ERSI attribute the fall in sample size to attrition and increased the sample size by 1,500 new households in 2000 to counteract this.

Table 4.2: LII, Number of Individuals by Gender and Country of Birth, 1995-2001.

Year	All Workers	Males	Females	Born Ireland	Born Abroad
1995	2,868	1,747	1,121	2,709	159
1996	2,531	1,513	1,018	2,405	126
1997	2,490	1,476	1,014	2,360	130
1998	2,407	1,399	1,008	2,284	123
1999	2,162	1,260	902	2,060	102
2000	3,236	1,861	1,375	3,050	186
2001	2,655	1,479	1,176	2,495	160
Total	18,349	10,735	7,614	17,363	986

Source: The Living in Ireland Survey, 1995-2001. For a percentage breakdown of these figures see Table A4.2 in the Appendix.

Of the entire sample, 59% (10,735 male workers) are male and 41% (7,614 female workers) are female. Interestingly, female representation in the sample has grown from 39% in 1995 to 44% by 2001, while the number of individuals not born in Ireland marginally increased their representation in the sample from 5.5% in 1995, to 6% in 2001. It would be expected that the non-Irish born figure will have grown steadily throughout the last eight years, but in particular since the EU accession treaty of 2004, when Ireland offered immediate entry to economic migrants from the accession states.

Table 4.3 below presents the average real hourly wage rates for the sample, by all workers, male workers, female workers, Irish workers and foreign workers. The real hourly wage for each individual was constructed by dividing the individual's gross pay per week by the usual number of hours worked by the individual. This value was then deflated using the Consumer price index, taking 1989 as the base year. The real hourly wage rate of foreign workers in the sample grew on average by 3.34% per annum, giving a total increase over the seven year period of just over 21%. The equivalent figure for the Irish workers in the sample is an average growth in real hourly wages of 2.13% per annum, with total growth in wages of 13.38%, by the end of the seventh year. This growth in wage levels of foreign workers coupled with the higher average

real hourly wage relative to Irish workers (€8.09 versus €8.00), is possibly the result of foreign firms located in Ireland hiring or relocating skilled foreign labour.

Table 4.3: LII, Average Hourly Wage by Gender and Country of Birth, 1995-2001.

Year	All Workers	Males	Females	Born Ireland	Born Abroad
1995	€7.56	€8.06	€6.78	€7.55	€7.71
1996	€7.75	€8.31	€6.93	€7.55	€7.76
1997	€7.84	€8.37	€7.06	€7.85	€7.71
1998	€7.85	€8.35	€7.16	€7.86	€7.77
1999	€8.12	€8.67	€7.34	€8.13	€7.77
2000	€8.31	€8.90	€7.51	€8.31	€8.24
2001	€8.61	€9.25	€7.80	€8.56	€9.33
Average	€8.01	€8.56	€7.24	€8.00	€8.09

Source: The Living in Ireland Survey, 1995-2001. Measured in 1989 euros.

The differential between male and female hourly real pay has varied between 14% and 17% over the seven year period, with the largest differential (16.61%) occurring in 1996[57]. The differential diminished year on year until widening again in the final two years of the sample. The potential causes of such dispersion are well documented in the earnings literature and have been discussed in Section 4.2 and will be further explored in Section 4.4. The average differential between foreign and Irish workers is quite small, with foreign born workers receiving on average, an extra 0.81% euro per hour, over the seven year period. However, there is quite a variation year on year inherent within these figures, with foreign workers earning an extra 9% per hour relative to Irish born workers in 2001 and Irish born workers receiving an extra 4.43% in hourly pay relative to foreign born workers in 1999.

Table 4.4 below presents the average real hourly wage rates by region and by year, within the seven year sample.

[57] Table A4.3 in the Appendix contains the percentage difference in real hourly pay between the genders and between Irish born and foreign born workers.

Table 4.4: Real Hourly Wage Rate by Region from 1995 to 2001.

Year	Dublin	Border	Mid East	Midlands	Mid West	South East	South West	West
1995	€8.35	€6.89	€7.66	€7.40	€6.97	€6.91	€7.24	€7.93
1996	€8.45	€7.16	€8.08	€7.47	€6.82	€7.14	€7.58	€8.14
1997	€8.62	€7.46	€7.72	€7.34	€7.12	€7.07	€7.73	€8.21
1998	€8.68	€7.36	€7.83	€7.50	€7.46	€7.16	€7.60	€8.07
1999	€8.94	€7.82	€8.59	€8.09	€7.37	€6.86	€7.74	€8.40
2000	€9.20	€7.57	€8.82	€7.69	€8.67	€7.43	€7.87	€7.98
2001	€9.37	€8.39	€9.12	€7.81	€8.92	€7.62	€7.67	€8.46
Average	€8.81	€7.52	€8.30	€7.62	€7.65	€7.20	€7.62	€8.15

Source: The Living in Ireland Survey, 1995-2001. Measured in 1989 euros.

As expected, the highest hourly wage is earned in the Dublin region, which over the seven year sample is 18% higher than what is earned per hour on average in the south eastern region and 14% more than what workers in the border region earn per hour. The mid eastern region, which includes counties such as Kildare, Meath and Wicklow which form a ring around Dublin County geographically, as expected has the second highest earnings per hour after Dublin on average over the duration of the panel, with an average hourly wage differential (relative to Dublin) over the seven year period of just under 6%. Employment, infrastructure and investment in Ireland is regionally unbalanced within Ireland, with Dublin and the mid eastern counties benefiting most. Attempts through Government policy, such as the 2002 National Spatial strategy, to redress this imbalance is evidence of the concern this problem is causing nationally.

The mid western region experienced the highest per annum average growth rate in real hourly pay over the seven years. This resulted in the hourly pay differential with Dublin being just under 5% in 2001. The growth in pay levels may be the result of multinational companies such as Dell locating in the region (opened in 1991), and the ongoing impacts of the access to research and development through the University of Limerick and Shannon International Airport being located in the region. However, in

2008 Shannon International Airport lost its connecting services with London and in 2009 Dell announced their withdrawal from the region. Workers in the border region earned on average, just under 15% less per hour, than workers in Dublin over the seven years sampled. It is likely to be the case that this differential will have diminished in the current decade, with cross border initiatives with Northern Ireland via the 1998 Good Friday Agreement generating employment in the region.

The western region, despite the distance from Dublin and the mid eastern region, performs well in terms of real hourly pay, with on average workers in the western region earning 7.5% less per hour than those workers in the Dublin region. Only workers in the mid eastern region and Dublin earn more per hour on average over the seven years sampled. The driver of the relatively high wage rate could possibly be viewed as being the location of Galway City within the region and the associated industries, the National University of Ireland, Galway and the close proximity of tourist destinations such as Connemara. Overall, the differential in hourly pay between the regions is skewed in favour of workers in the Dublin region and to a lesser extent the mid eastern region, with the south east, and border regions faring worst, relative to Dublin.

Table A4.4 in the Appendix contains information on the summary statistics (mean, standard deviation, the maximum and the minimum) for the variables used in the Mincerian wage equation to be estimated in Section 4.4, for the 18,349 observations in the sample. Table A4.1 in the Appendix at the end of this chapter contains a complete list of the definitions of the variables used in the wage study. As highlighted earlier in Table 4.3, the average hourly wage for all workers sampled is €8.01 and 59% of those individuals sampled are male (see Table 4.2 above). On average, workers have acquired 10.48 years experience[58], while half of the respondents are married. As was the case in Chapter 3, there is a differential between workers born in Ireland (0.95) and those workers holding Irish citizenship (0.98). This is possibly evidence of foreign

[58] Experience is defined as being the number of years since the respondent entered full time employment.

nationals taking on Irish citizenship and the impact of this change in citizenship for immigrant workers upon their wage level is examined in model 2 in Section 4.4.

The most populated occupation in the sample is the professional category, with the army (excluding 'other occupations') having the fewest workers represented in the sample. The majority of workers are engaged in employment in the manufacturing sector with the next most populated sector being retail. The sectors which contain the smallest samples are the mining and electrical sectors respectively. This mirrors the profile of workers analysed in the occupational attainment model in Chapter 3, where the manufacturing and retail sectors were the most populated and the mining and electrical sectors contained the fewest respondents. Almost one in seven workers sampled are employed in the private sector, while less than half of the workers in the sample contribute to a pension scheme, although the 2003 Government Personal Retirement Savings Account (PRSA) initiative may well have increased the uptake of pension contributions[59].

Approximately the same proportion of workers hold a third level diploma as have acquired a degree (0.06), while a smaller proportion (0.03) have gone on to study beyond degree level (the highest educational attainment level recorded in the survey). Excluding the 'other education' category, the leaving certificate provides the most populated educational attainment category (0.20), with the lowest educational attainment level listed, primary lower, being the least populated category (0.02). As expected given the infrastructure and employment opportunities available there, the majority of people are located in the Dublin Region with the midlands providing the least amount of workers in the sample. The average amount of unearned income respondents received was €13.70 per week, while the average respondent was married for just over 9 years[60].

[59] For information on Irish pension schemes and legislation see http://www.pensionsboard.ie/.
[60] See Table A4.1 for a definition of unearned income.

It is clear from the summary statistics that the majority of workers are employed in the manufacturing and retail sectors, while the most populated occupation was the professional category. The vast majority of workers sampled are natives and the minority of workers have gone on to acquire degree level education. The following section presents a Mincerian wage analysis of the data described in this section.

4.4 Results

In this section the results for the models specified in Section 4.3.3 are presented and analysed. A random effects estimation technique is utilised with two different models, with the models varying only in the measure of nationality included as an explanatory variable. Model 1 contains country of birth as the nationality control, while model 2 includes citizenship rather than country of birth as the nationality variable. In keeping with the overall theme of the thesis of analysing the impact of foreign labour and capital on the Irish economy, in both models examined nationality is a key explanatory variable. The variation of nationality variables used within the models also allows for an analysis of the impact of non-native workers taking out Irish citizenship upon their wage levels. Exploring nationality as a determinant of wage levels in the Irish labour market also allows for a contribution to be made to the debate on the impact of being an immigrant upon wage levels in a foreign labour market. Analysis will also be made in relation to the human capital/earnings debate, while in the context of Ireland, regional impacts upon earnings are also of interest and are discussed. A topic of contemporary concern in the Irish economy, i.e. public versus private sector pay, is also highlighted in this section. All models presented also control for the years sampling occurred and both the occupations and sectors that the employees are engaged in are controlled for[61].

Given that the unemployed are also included in the LII (approximately 17% of the sample the estimates are based upon are recorded as being unemployed), all models presented also control for possible selection bias by incorporating an inverse Mills ratio

[61] The estimated coefficients on education are marginally higher when the occupational controls are removed.

as an explanatory variable[62]. The inverse Mills ratio is the ratio of the probability density function over the cumulative distribution function of a distribution. As the dependent variable in the Mincerian wage model is censored (i.e. only includes outcomes for the employed in the sample), then as Tobin (1958) demonstrates, if the exclusion of the unemployed from the estimation is not controlled for the resulting estimates will be potentially biased. Heckman (1979) suggests generating the inverse Mills ratio from a probit model that predicts employment and to incorporate the inverse Mills ratio as an explanatory variable in the Mincerian wage equation. It should be noted that the recent Irish studies by Barrett et al. (2008), Barrett and McCarthy (2007a) and Barrett and McCarthy (2007b) do not appear to control for possible sample selection bias. Tables reporting the main estimates (coefficients and T Statistics) and the marginal effects for the probit model estimated to control for possible sample selection bias are presented in the Appendix at the end of this Chapter. A full description of the variables used is contained in Table A4.1 in the Appendix to this chapter.

Results from an Oaxaca style decomposition as discussed in Section 4.3.3 are presented and analysed also. This analysis will allow for commentary to be made regarding potential wage discrimination based upon nationality. In keeping with this theme and also in keeping with the work presented in Chapter 3, random effects estimations are also carried out separately for each gender.

4.4.1 Random Effects Estimates for All Workers

There are 18,349 observations in this sample and the key findings for model 1 are presented in Table A4.5 in the Appendix. Table A4.6 in the Appendix presents the estimates from the probit model predicting employment from which the inverse Mills ratio is generated. The duration of the individual's marriage in years (Marriage Length) is the instrumental variable chosen as it was found to be an insignificant determinant of earnings (the dependent variable in the Mincerian wage equation), but

[62] See Greene (2003) for a proof of and Hersch (1991) for further discussion and use of the inverse Mills ratio.

did help predict whether or an individual was likely to be employed (the dependent variables in the probit model) or not, in all models estimated[63]. The results discussion is focused upon the outcomes from the wage equations.

Gender as expected was found to be a significant determinant of hourly pay, with males earning an extra 15% more per hour relative to their female counterparts. This finding is much in line with earlier earnings studies in Ireland with Callan and Wren (1994) reporting a 20% differential and Barrett et al. (2002) estimating the pay differential between the genders to be 14.5%. The more recent studies of Barrett and McCarthy (2007a) and Barrett and McCarthy (2007b) both find a 12% wage premium for males, while Barrett et al. (2008) report a 14% premium for males. However, it should be noted that Barrett and McCarthy (2007a), Barrett and McCarthy (2007b) and Barrett et al. (2008) all use only one year of data in their estimations. There is evidence of positive returns to human capital, with an additional year of experience resulting in an extra 2% of pay per hour, a result identical to that reported by Barrett et al. (2008). Both Barrett and McCarthy (2007a) and Barrett and McCarthy (2007b) find the premium for an extra year of experience to be in the region of 4%. The coefficient on the square of experience has the expected negative sign and is found to be significant. Such a finding indicates that workers' pay will in fact increase at a decreasing rate[64].

As Korenman and Neumark (1991) suggested, the wage premium for a married worker is within the 10% to 40% range, with married workers receiving an extra 16% per hour more than workers who have never been married. Those workers who are divorced, separated or widowed earn 8% more than workers who have never been married. This finding of married workers earning more than divorced, separated or widowed workers, who in turn earn more than workers who have never married is much in line with the findings reported by Hill (1979) in the case of men in the US. It could potentially be argued that being a married worker signals stability to the employer and employers

[63] The P-value for Marriage Length when included in the Mincerian wage equation for model 1 is 0.145.
[64] Cubic and quartic measures of experience were found to be only marginally different from zero.

offer a premium for workers with such qualities. Alternatively, the wage premium earned by married workers may be the result of married workers needing higher earnings to support a family and so their productivity levels reflect this, which is in turn rewarded. Finally with respect to the impact of marriage and divorce upon earnings, it should also be noted that there is the potential for reverse causality i.e. workers with higher pay levels are potentially more likely to be married than those workers earning relatively less.

With respect to occupations and relative to unskilled workers, professional workers earn the highest wage premium of all the occupations, with an extra 33% per hour associated with this category of workers. The next most lucrative occupations are management and associate professional which yield an extra 25% and 19% respectively per hour, relative to those workers occupying unskilled roles. The effects of each occupational category are not unexpected as the 'higher skilled' occupations or occupations that require higher levels of educational attainment or training, are the occupations that reward the workers with the highest pay. By way of comparison, Barrett and McCarthy (2007a), Barrett and McCarthy (2007b) and Barrett at al. (2008) all control for the occupational category of the worker, but only Barrett and McCarthy (2007b) present the estimates for the occupational categories in their study. Although the occupational categories utilised by Barrett and McCarthy (2007b) vary with the occupational categories included in this chapter, the findings are similar with professional workers earning the highest wage premium (37%). Managers and administrators (21%) and associate professionals and technical workers (18%) are next in line in terms of higher hourly pay. It should be noted that the wage premiums earned by each of the occupational categories in the Barrett and McCarthy (2007b) study are expressed relative to craft workers.

Relative to workers in the agricultural sector, workers in the education sector earn an extra 40% per hour and are employed in the highest paying sector. Both the finance and public sectors pay an extra 29% per hour relative to the agricultural sector, while the premium earned by workers in the construction and manufacturing sectors is 30%.

Hourly pay in all sectors controlled for exceed the pay that is earned in the agricultural sector, with workers in the hotel and restaurant sector, who earn an extra 19%, being the closest to agricultural sector in terms of hourly pay. Barrett et al. (2008) control for the sector the respondents work in, but do not report the estimated coefficients, while neither Barrett and McCarthy (2007a) nor Barrett and McCarthy (2007b) appear to control for the sector that the worker is employed in. The question of private versus public sector pay is currently being very publicly debated in Ireland and the results from this Mincerian wage estimation suggest that workers in the private sector earn 11% less than similar workers employed by the Government. This result of public sector workers receiving a wage premium relative to their private sector counterparts corresponds with the Barrett et al. (2008) finding that public sector workers earned 12% more than similar workers in the private sector. Neither Barrett and McCarthy (2007a) nor Barrett and McCarthy (2007b) include an explanatory variable to measure the impact of being a public or private sector worker. Contributing to a pension scheme appears to have a positive and significant impact upon earnings, with those workers who do make contributions to a pension scheme earning 18% more than those workers who do not[65]. It could possibly be argued that better paid occupations tend to offer pension remuneration as part of the terms of employment in order to attract high quality workers and therefore it is not unexpected to find that higher paid workers appear to be associated with pension entitlements. None of the three recent Irish wage determination studies referred to in this analysis examine the impact of workers contributing to a pension scheme on earnings.

The impact of education upon earnings is well documented in the existing literature and the positive links associated between education and earnings as reported by Lazear (1976) in the case of the US and by Barrett and McCarthy (2007a) in the case of Ireland are also apparent in this study. The returns to education presented in Table A4.5 are as expected, with higher levels of educational attainment rewarded with higher levels of pay. Those workers who have not taken education beyond their

[65] The model was also estimated without pensions as an explanatory variable and results were much in line with those analysed in this section.

Leaving Certificate can expect to earn 5% more per hour, relative to workers who have not taken Junior Certificate examinations. Barrett et al. (2008) attribute an extra 8% per hour to workers holding a Leaving Certificate. While both Barrett and McCarthy (2007a) and Barrett and McCarthy (2007b) do include a dummy variable to account for those workers who hold this qualification, they only include one more educational level control, degree level education. This makes direct comparison with the results reported here difficult and in fact the coefficients reported for the Leaving Certificate are six times higher in the case of Barrett and McCarthy (2007a) and four times higher in the case of Barrett and McCarthy (2007b), than the effect recorded in this study. The next level of education attainment available to students who hold a Leaving Certificate is either a diploma or a Post-Leaving Certificate course (PLC). The level of returns on these qualifications are similar and both are higher than the return from holding a Leaving Certificate only, with holders of a diploma expecting to earn 8% more per hour and holders of a PLC earning an extra 9% more, than those workers who have not achieved a Junior Certificate. As none of the three Irish studies that the results presented here have been compared against include variables to measure the impact of these two particular educational awards, unfortunately no comparison can be made in this instance. As expected, holders of degrees and higher degrees (the highest levels of education controlled for) fare best in terms of pay, relative to workers with lower educational attainment levels. A degree earns a worker a premium of 11% per hour, while those workers with higher degrees earn an extra 14% more per hour, relative to those workers without a Junior Certificate. Again, the educational categories are not the same as those constructed in Barrett and McCarthy (2007a), Barrett and McCarthy (2007b) and Barrett et al. (2008), but all three studies report the highest level of education in their respective studies as having the highest coefficient of all the educational categories included. Neither the Junior Certificate nor other levels of education were found to be significant factors in determining the wage levels of the individuals sampled.

Given Table 4.4 in Section 4.3.4, it is not surprising to find that workers living in regions other than Dublin earn less than a similar worker in the Capital. Workers in the

south eastern and border regions fare worst, earning 13% less than their counterparts in Dublin, with the workers based in the midlands and the south west being the next worst off, with a wage discount of 11% relative to workers in Dublin. Unsurprisingly given its proximity to Dublin and the associated industrial and transport links, the eastern region is second only to Dublin in terms of hourly way. A worker in the east earns just 3% less than an equivalent worker in Dublin. This finding is further evidence of the regional disparity that Ireland is experiencing and further policy initiatives may be necessary to redress the economic imbalance for future generations. Unfortunately Barrett and McCarthy (2007a), Barrett and McCarthy (2007b) and Barrett et al. (2008) do not control for the region the workers sampled are based in, so no comparison can be made with an Irish study, although studies based upon other regions do report urban/rural disparity in wages, with Smith and Welch (1989) reporting higher wage rates for US employees based in cities, and Vera-Toscano et al. (2004) highlighting a rural-urban wage differential using Canadian data. The amount of unearned income of the worker was found to have a marginally positive impact upon earnings, while the inverse Mills ratio was insignificant indicating that selection issues are not apparent.

The main focus of this chapter is the impact of being a foreign national employed in the Irish labour market upon hourly wages. Unfortunately, a detailed recording of the country of birth of the worker is not provided in the LII data set and no reference is made to the primary language spoken by the respondent. This makes comparison with earlier Irish wage studies redundant, where Barrett and McCarthy (2007a), Barrett and McCarthy (2007b) and Barrett et al. (2008) all provide estimates for immigrants from English speaking and non-English speaking backgrounds. The estimates from model 1 suggest that foreign born workers fare better than their Irish counterparts, with indigenous workers earning 5% less per hour than a comparable immigrant worker. This finding of immigrant workers actually earning a wage premium relative to native workers is consistent with the work of Bell (1997), who reports that white immigrants entering the UK earned 30% more than comparable native workers. The positive effect of being born outside of Ireland may possibly be explained by foreign firms with plants located in Ireland relocating skilled workers from another foreign based subsidiary to

Ireland and offering the workers a premium to do so. It is not unusual for firms to behave in such a way in order to establish new plants and to train indigenous workers with the relevant skills and technology[66].

The estimated coefficients on the key variables (Currently Irish and Nation Switch) for model 2 are presented in Table A4.7 in the Appendix to this chapter. Being an Irish citizen (relative to being a foreign citizen) was found to have no impact upon hourly wage. This finding may simply be due to the fact that the vast majority of workers in the sample (98%) hold Irish citizenship. However, a benefit does accrue to immigrant workers who take on Irish citizenship, with such a worker earning 6% more than a similar foreign born worker who does not hold Irish citizenship[67]. To the best knowledge of the author, such a finding is the first in the context of an Irish wage study and potentially raises questions relating to the causation of the wage premium. Perhaps some of the workers included in the category of 'citizenship switchers' are simply children of Irish parents who were born abroad, but returned to Ireland and so were educated in Ireland. In this case, the human capital characteristics of the workers are similar to an Irish born worker and so the premium is really earned by an 'Irish' worker, relative to a non-Irish worker. Alternatively, it may possibly be the case that employers are more willing to offer better terms of employment to foreign born workers holding Irish citizenship, as the view might be held that these workers are more likely to stay in Ireland and thus in the role they occupy, than a similar foreign born worker who does not hold Irish citizenship and who requires visa permits.

4.4.2 Random Effects Estimates for Male Workers Only

Given the continuing debate and research devoted to examining the differences between male and female earnings, both model 1 and model 2 were estimated using sub samples of the data containing male and female workers only. The results for the key variables for the male workers in the sample for both model 1 and model 2 are presented in Table A4.8 in the Appendix at the end of this chapter. With respect to the

[66] An interaction term comprised of Born in Ireland and Gender was found to be insignificant.

findings of model 1, male workers who were born in a country other than Ireland receive a wage premium of 8% relative to men born in Ireland. Although this wage advantage accrues to the same group of workers (workers not born in Ireland) as was reported for all workers for model 1, it is higher than was the case reported for all workers (see Table A4.5). This may also indicate that the differential between females born in Ireland and those born outside of Ireland will be smaller than is the case of the males sampled. The same argument as was put forward in the case of all workers is valid here, with the differential in pay between Irish born and foreign born men perhaps being attributable to foreign firms located in Ireland employing skilled foreign born workers who are already engaged in a similar activity for their employer but in a different location, relocating those workers to their Irish based operations. Again it should be reiterated that if country of birth was available in greater detail than what is available in the LII data, then firmer implications could possibly be drawn from the variable and potential wage premiums by nationality could be established.

The results for the citizenship estimations for male workers only (model 2) are very much in line with the results reported for model 2 for all workers sampled (see Table A4.7). Being an Irish citizen (relative to holding citizenship other than Irish) was found to be insignificant in determining the hourly wage of male workers. However, male workers that switch their citizenship to Irish do benefit from a 8% wage premium, relative to similar workers who were also born abroad, but do not currently hold Irish citizenship. The arguments postulated for foreign born workers switching to Irish citizenship earning a wage premium as outlined in the case of all workers are equally viable here. It was earlier argued that the source of this wage premium could possibly be the result of foreign born workers with Irish parents returning home and taking out Irish citizenship or that Irish citizenship possibly operates as a signal to employers of the stability of a foreign born worker in terms of tenure in a post.

[67] To take up Irish citizenship you need to have been resident in Ireland for at least four years. For more details on Irish citizenship see http://www.inis.gov.ie/en/INIS/Pages/WP07000113.

4.4.3 Random Effects Estimates for Female Workers Only

The 'nationality' results for the female workers sampled for both model 1 and model 2 are presented in Table A4.9 in the Appendix to this chapter. Unlike the cases of all workers and male workers only, country of birth is found to have no impact upon the hourly earnings of females in the Irish labour market. This may be an indication of the absence of discrimination against foreign born females in the Irish labour market, but it could also possibly be the result of the sample size of foreign born women. Of the 7,614 females included in this estimation, only 475 were born in a country other than Ireland. The insignificant effect of country of birth from model 1 (for females only) coupled with an insignificant coefficient on citizenship from model 2, provides no evidence to support the 'double disadvantage' finding as highlighted by Barrett and McCarthy (2007b) in the case of Ireland and by both Beach and Worswick (1993) and Duleep and Dowhan (2002) in the cases of Canada and the US, respectively. Overall, nationality is found to be an insignificant factor in determining the hourly wages of females working in the Irish labour market. This is in contrast with the findings for the other samples of all workers and male workers only, where country of birth was found to favour foreign born workers in terms of a wage premium, relative to similar indigenous workers in the sample.

As was the case for the other two samples examined, a wage benefit accrues to female workers who were not born in Ireland but who currently hold Irish citizenship. Relative to similar foreign born female workers in the sample who hold citizenship other than Irish, the foreign females who have switched their citizenship to Irish earn an extra 5% per hour. This premium is less than is earned by foreign born males who have switched their citizenship to Irish who can expect to receive an extra 8% per hour more than an equivalent foreign born male worker without Irish citizenship. This differential raises questions with respect to why female immigrants do not earn the same premium as their male counterparts for taking out Irish citizenship, however in light of the consistent trend in the empirical findings in the field of males earning more than females, this finding is perhaps not surprising. This finding of a differential between the premium earned by foreign born males and females who hold Irish

citizenship, coupled with the overall result of foreign born workers earning a wage premium for taking out Irish citizenship are two of the key findings from this study and appear to make an interesting contribution in the context of the Irish literature to date on wage determination and nationality.

4.4.4 Estimates for the Oaxaca Decompositions

Table A4.10 in the Appendix contains results for the Oaxaca decomposition carried out for all workers in the sample, where estimates are decomposed according to nationality. The decomposition was carried out for both models and results are presented for model 1 (Country of Birth is the nationality variable) and model 2 (Currently Irish is the nationality variable). When country of birth is used to represent nationality in the model, the difference in the average group characteristics between foreign born and Irish born workers is relatively small, with the difference due to endowments reported as being 1.1% (in favour of indigenous workers), with the equivalent measure for model 2 being 4.6%, but in favour of the foreign born workers. Overall, the differential between the two groups is relatively small and in both models favours the foreign born workers, with the raw differential between the groups being 3.9% in the case of model 1 and 8.3% in the case of model 2. However, in both cases when the decomposition is analysed, the majority of this differential is as a result of discrimination, with 129.1% of the raw differential due to discrimination in model 1 and the equivalent value in the case of model 2 being 44.9%.

The results from the Oaxaca decompositions potentially suggest that Irish workers earn a premium for those characteristics that are controlled for within the model (e.g. education and experience), but that foreign born workers earn a premium for other qualities or characteristics that are unobserved by the model. It could argued that foreign born workers display greater work ethic, effort and attitude towards their work than indigenous workers and that it is on this basis that they are rewarded by their employers with relatively higher levels of pay than indigenous workers. The result of this decomposition for the Irish labour market vary with the findings of Blinder (1973) and Darity et al. (1995) who both report wage discrimination in the US, but do not find

that it is the indigenous workers who experience it. In contrast, Long (1980) in the case of the US, Beach and Worswick (1993) and Shamsuddin (1998), both in the case of Canada, all report foreign born workers receiving wage premiums relative to indigenous workers. In conclusion to the discuss on the Oaxaca decomposition, the finding raises questions as to how Irish employers value the qualities of foreign workers relative to natives and could possibly point to Irish employers preferring the work ethic, effort and attitude of foreign born workers relative to that provided by indigenous workers.

4.5 Conclusion

Earnings studies are currently very topical in the Irish economy as both the private and public sectors attempt to deflate the prevailing wage levels. Successive Government budgets have included measures to halt growing wage bills, while the recently published report on public service expenditure reiterates the need to maintain lower wage costs in attempt to create a low cost economy[68]. The topic of public sector versus private sector pay is examined within this chapter through the Mincerian wage equation, but the primary focus is upon the differential between immigrant and native wage levels. The theories of wage determination are long established, with human capital (as measured by experience and education), gender, race, tenure and marital status identified as being the key determinants in Section 4.2, the literature review. The Mincerian wage equation and the Oaxaca style decomposition technique were identified as being the appropriate analytical tools to utilise in an earnings study of this type.

The Mincerian wage analysis presented in this chapter attempts to build upon previous Irish based wage studies such as Barrett and McCarthy (2007a), Barrett and McCarthy (2007b) and Barrett et al. (2008). This particular wage study examines the LII panel data over a seven year period, whilst the earlier Irish studies mentioned above all use only year of data in their estimations. In all, 18,349 observations from the LII data set

[68]The Report of the Special Group on Public Service Numbers and Expenditure Programmes is available at http://www.finance.irlgov.ie/documents/pressreleases/2009/bl100vol1.pdf.

are used between 1995 and 2001, with 986 of these workers being born in a country other than Ireland. Two separate models are analysed, with the models differing only in the measure included to represent nationality. Model 1 contains country of birth as an independent variable, while model 2 utilises citizenship as the nationality variable. By including citizenship as an independent variable it also allows for an examination of any potential impacts of foreign born workers taking out Irish citizenship. Both models are then estimated for samples including all workers, male workers only and female workers only. The econometric analysis concludes with a discussion on the key findings from the Oaxaca decompositions that were conducted with a view to examining the potential sources of wage differentials between foreign born and indigenous workers.

In general, the results for the key determinants of earnings in Ireland were much in line with the patterns established by prior research. Gender was found to be a significant determinant of the hourly pay of workers sampled, with men earning a 15% premium relative to the women included in the estimates. This finding of a wage premium for males is consistent with earlier Irish studies with Callan and Wren (1994), Barrett et al. (2002), Barrett and McCarthy (2007a), Barrett and McCarthy (2007b) and Barrett et al. (2008) all reporting wage discounts for females in the region of 12% to 20%. This imbalance in earnings between the genders raises the question of true equality in the labour market and further longer term studies in the field would be useful to establish the long term and current trends. As anticipated, more experienced workers earn marginally higher rates of pay than relatively less experienced workers, with an additional year of experience translating into an extra 2% per hour. Again this result is consistent with earlier Irish wage studies, with Barrett and McCarthy (2007a), Barrett and McCarthy (2007b) and Barrett et al. (2008) finding that one year extra of experience generates a wage premium of between 2% and 4% for the worker.

Marital status was found to have an impact upon Irish earnings, with married workers earning an extra 16% relative to a worker who has never been married. This wage advantage for the married worker is consistent with the review provided by Korenman

and Neumark (1991) who suggest that married workers earn a premium of between 10% and 40%. Workers who have never been married also earn less per hour than workers who are divorced, separated or widowed (earn 8% premium relative to those workers who never married), and this ordering of wage premiums by marital status (i.e. married workers earning more than divorced, separated and widowed workers who in turn earn more than workers who have yet to be married) is consistent with the finding of Hill (1979) who examined the case for males in the US. Occupations that tend to require higher levels of skill or human capital accumulation do offer workers more earnings, relative to unskilled occupations. Relative to unskilled workers, professional workers earn a 33% wage premium while management and associate professional occupations earn workers an extra 25% and 19% respectively. Barrett and McCarthy (2007b) also report that the three highest earning occupational categories in the Irish labour market are the professional, management and associate professional occupations respectively. Further and more detailed analysis on occupations in Ireland was examined in Chapter 3 of the thesis. With respect to the sectors workers are employed in, the educational sector was found to pay the highest, with workers in this sector earning an extra 40% per hour relative to workers in the agricultural sector. In fact, all sectors controlled for returned higher earnings than for workers in the agricultural sector, with the closest sector in terms of pay (19% more than agricultural workers) being the hotel and restaurant sector. Such a finding highlights the battle that the agricultural sector faces to survive in a globalised world economy and furthermore the future of the sector is uncertain without future EU support.

Private sector versus public sector pay is currently a highly topical and emotive debate in recessionary Ireland, where Government and private sector firms highlight the pay levels of the Civil Service in an attempt to realign wage levels. It was found that public sector workers do indeed earn a wage premium relative to similar workers in the private sector, with the differential being 11%. This finding of private sector workers receiving a wage discount relative to public sector workers is in line with the work of Barrett et al. (2008), who report a differential of 12% between the public and private sectors. Workers who contribute to a pension scheme were found to earn an extra 18%

relative to similar workers who do not hold pension entitlements. The Irish Government has made attempts to increase the uptake of pension schemes among workers with the 2003 PRSA scheme mentioned in Section 4.2 targeted at non-pension holders.

Education was found to have a positive impact upon earnings with the returns to education rising with the educational attainment level of the individual. The highest levels of educational attainment (degree and higher degree) earn workers the highest wage premiums, with hourly pay being above that of workers who do not hold these levels of educational attainment by 11% and 14% respectively. The finding of returns to education is consistent with the earlier Irish studies of Barrett and McCarthy (2007a), Barrett and McCarthy (2007b) and Barrett et al. (2008) and with Lazear (1976) in the case of the US. The reintroduction of fees for third level students is being debated in Irish politics and this, in conjunction with expenditure cuts at second and primary levels of education, which will potentially lead to increases in the teacher-pupil ratio, are worrying changes in the Irish education system[69]. The 'Celtic Tiger' economy was developed with the aid of a well educated workforce and more investment is arguably needed within education, not less. The regionally disparity experienced by workers across Ireland in terms of earnings is evident from these results. No region in the Irish labour market provides workers with the same level of earnings as similar workers based in the Dublin region. Workers in the eastern region earn just 3% less than their counterparts in Dublin, while workers in the south eastern and border regions are faced with a 13% wage discount relative to Dublin base workers. Further policy issues need to be addressed to attempt to realign industry, employment and earnings in the Irish economy.

With respect to the key question addressed in this chapter, the impact of nationality upon earnings, Irish born workers tend to earn 5% less than similar workers born elsewhere, a finding much in line with those reported by Bell (1997) for white immigrants in the UK. Potentially this is evidence of foreign firms transferring skilled

[69] See FitzGerald (2009) for further information on the impacts of third level fees.

foreign born labour from other plants in different jurisdictions in an attempt to manage Irish operations and to transfer skills to indigenous workers in the Irish plants. Interestingly the citizenship of the worker was found to have no impact upon the earnings of that worker, but individuals who were born out of Ireland and who took up Irish citizenship did earn a wage premium of the order of 6%, relative to a similar foreign born worker who does not hold Irish citizenship.

The nationality results for male workers only were much in line with the results outlined above for all workers, with foreign born males earning a wage premium (8%) relative to native workers, citizenship being insignificant and foreign born workers benefiting from a switch to Irish citizenship (8% premium). The nationality results for the estimates for females only do vary however with those results for all workers and male workers only, with both country of birth and citizenship found to be insignificant determinants of hourly female pay. Country of birth being insignificant may potentially indicate that foreign females do not face a disadvantage relative to native females and this finding does not support the 'double disadvantage' finding of Barrett and McCarthy (2007b). A wage benefit does accrue to foreign born females who switch to Irish citizenship, with such workers receiving an extra 5% more per hour than a similar foreign born female without Irish citizenship. However, the premium earned from switching nationality is smaller than what was found for males, which raises the question as to why this differential should exist. In conclusion to this summary of the results, it was found from the Oaxaca decomposition that although there is a relatively small differential between Irish and non-Irish workers, that there was discrimination in terms of earnings and that it was in favour of foreign born workers.

It must be noted that there are some shortcomings in the empirical analysis outlined in this chapter, particularly with respect to the omission of some key explanatory variables. Trade union membership was highlighted in Section 4.3 as being a determinant in wage formation, while recent Irish studies such as Barrett and McCarthy (2007a), Barrett and McCarthy (2007b) and Barrett et al. (2008) all have the ability to control for English-speaking and non-English speaking workers. Further breakdowns

in the data in terms of nationality and citizenship would allow for more detailed comments to be made on the impacts of nationality and citizenship upon hourly wages in Ireland, while ideally more up to date data would allow for a more current view to be formed in an ever changing labour market. However, the LII does not contain this information and the data was not gathered after 2001.

Overall, the results are much in line with what would be expected from a Mincerian wage study; education, experience and gender are all important determinants of earnings in Ireland, while more skilled occupations attract higher levels of pay. Public sector workers were found to earn more than their private sector counterparts, while married workers earned more than those workers who never married or who are currently divorced, separated or widowed. Pension holders earn more than non-pension holders and workers from all other regions earn less than workers based in Dublin. Workers born outside of Ireland were found to hold a wage advantage over Irish born workers (except in the case of the sample examining females only), while citizenship was found to be insignificant. Foreign born workers who take out Irish citizenship benefit from doing so, with male workers gaining more than female workers from switching.

Appendix to Chapter 4: Results and Variable Definitions

Table A41: Variable List and Definitions.

Variable Name	Variable Description	Variable Values
Real Wage	Rate of pay per hour of the respondent	Measured in 1989 euros.
Log Wage	Dependent variable	Natural log of hourly wage of the respondent, with hourly wage measured in 1989 euros.
1995	Dummy variable for year of survey	1 = 1995. 0 = Otherwise.
1996	Dummy variable for year of survey	1 = 1996. 0 = Otherwise.
1997	Dummy variable for year of survey	1 = 1997. 0 = Otherwise.
1998	Dummy variable for year of survey	1 = 1998. 0 = Otherwise.
1999	Dummy variable for year of survey	1 = 1999. 0 = Otherwise.
2000	Dummy variable for year of survey	1 = 2000. 0 = Otherwise.

Table A4.1 (continued): Variable List and Definitions.

Variable Name	Variable Description	Variable Values
2001	Dummy variable for year of survey	1 = 2001. 0 = Otherwise.
Male	Sex of Respondent	1 = Male. 0 = Female.
Experience	Number of years since the respondent commenced his/her first regular job	Measured in years.
Experience^2	Experience squared	Measured in years.
Married	Respondent's marital status	1 = Married. 0 = Otherwise.
Divorced	Respondent's marital status	1 = Separated, divorced or widowed. 0 = Otherwise.
Never Married	Respondent's marital status	1 = Never married. 0 = Otherwise.
Born Ireland	Respondent's country of birth	1 = Ireland. 0 = Otherwise.
Currently Irish	Respondent's citizenship	1 = Irish citizen. 0 = Otherwise.

Table A4.1 (continued): Variable List and Definitions.

Variable Name	Variable Description	Variable Values		
Nation Switch	Respondent's citizenship	1	=	Not born in Ireland but an Irish citizen.
		0	=	Otherwise.
Foreigner	Respondent's citizenship	1	=	Not born in Ireland and not an Irish citizen.
		0	=	Otherwise.
Army	Respondent's occupation or previous occupation if currently unemployed	1	=	Member of the armed forces.
		0	=	Otherwise.
Manager	Respondent's occupation or previous occupation if currently unemployed	1	=	Managers/senior officials and legislators.
		0	=	Otherwise.
Professional	Respondent's occupation or previous occupation if currently unemployed	1	=	Professional.
		0	=	Otherwise.
Associate Professional	Respondent's occupation or previous occupation if currently unemployed	1	=	Technicians and associate professional.
		0	=	Otherwise.
Clerk	Respondent's occupation or previous occupation if currently unemployed	1	=	Clerks.
		0	=	Otherwise.

Table A4.1 (continued): Variable List and Definitions.

Variable Name	Variable Description	Variable Values		
Retail	Respondent's occupation or previous occupation if currently unemployed	1	=	Service, shops and sales workers.
		0	=	Otherwise.
Agriculture	Respondent's occupation or previous occupation if currently unemployed	1	=	Skilled agricultural and fisheries workers.
		0	=	Otherwise.
Trade	Respondent's occupation or previous occupation if currently unemployed	1	=	Skilled craft and trade workers.
		0	=	Otherwise.
Plant	Respondent's occupation or previous occupation if currently unemployed	1	=	Plant/machine workers.
		0	=	Otherwise.
Unskilled	Respondent's occupation or previous occupation if currently unemployed	1	=	Elementary workers.
		0	=	Otherwise.
Other Occupation	Respondent's occupation or previous occupation if currently unemployed	1	=	Other occupations.
		0	=	Otherwise.
Agricultural	NACE sector of respondent's employer or previous employer if currently unemployed	1	=	Agriculture, forestry and fishing.
		0	=	Otherwise.

Table A4.1 (continued): Variable List and Definitions.

Variable Name	Variable Description	Variable Values		
Mining	NACE sector of respondent's employer or previous employer if currently unemployed	1	=	Mining and quarrying.
		0	=	Otherwise.
Manufacture	NACE sector of respondent's employer or previous employer if currently unemployed	1	=	Manufacturing.
		0	=	Otherwise.
Electricity	NACE sector of respondent's employer or previous employer if currently unemployed	1	=	Electricity, gas and water supply.
		0	=	Otherwise.
Construction	NACE sector of respondent's employer or previous employer if currently unemployed	1	=	Construction.
		0	=	Otherwise.
Retail Sector	NACE sector of respondent's employer or previous employer if currently unemployed	1	=	Wholesale and retail.
		0	=	Otherwise.
Hotel	NACE sector of respondent's employer or previous employer if currently unemployed	1	=	Hotels and restaurants.
		0	=	Otherwise.
Transport	NACE sector of respondent's employer or previous employer if currently unemployed	1	=	Transport, Storage and communication.
		0	=	Otherwise.

Table A4.1 (continued): Variable List and Definitions.

Variable Name	Variable Description	Variable Values		
Finance	NACE sector of respondent's employer or previous employer if currently unemployed	1	=	Financial intermediation.
		0	=	Otherwise.
Property	NACE sector of respondent's employer or previous employer if currently unemployed	1	=	Real estate, renting and property business activities.
		0	=	Otherwise.
Public	NACE sector of respondent's employer or previous employer if currently unemployed	1	=	Public administration, defence, social security.
		0	=	Otherwise.
Education	NACE sector of respondent's employer or previous employer if currently unemployed	1	=	Education.
		0	=	Otherwise.
Health	NACE sector of respondent's employer or previous employer if currently unemployed	1	=	Health.
		0	=	Otherwise.
Othersector	NACE sector of respondent's employer or previous employer if currently unemployed	1	=	Other sector.
		0	=	Otherwise.
Private Sector	Respondent's post in the private sector or previous post if currently unemployed	1	=	Private sector.
		0	=	Otherwise.

Table A4.1 (continued): Variable List and Definitions.

Variable Name	Variable Description	Variable Values		
Pension	Does the respondent contribute to a personal or private pension scheme or did they in their previous post if currently unemployed	1	=	Yes.
		0	=	No.
Primary Lower	Respondent's highest educational attainment	1	=	No education beyond primary level.
		0	=	Otherwise.
Primary Upper	Respondent's highest educational attainment	1	=	Primary certificate.
		0	=	Otherwise.
Second Level	Respondent's highest educational attainment	1	=	Second level with no exams taken.
		0	=	Otherwise.
Group Cert	Respondent's highest educational attainment	1	=	Group certificate.
		0	=	Otherwise.
Junior Cert	Respondent's highest educational attainment	1	=	Junior certificate.
		0	=	Otherwise.
Leaving Cert	Respondent's highest educational attainment	1	=	Leaving certificate.
		0	=	Otherwise.
PLC	Respondent's highest educational attainment	1	=	Post leaving certificate.
		0	=	Otherwise.

Table A4.1 (continued): Variable List and Definitions.

Variable Name	Variable Description	Variable Values		
Diploma	Respondent's highest educational attainment	1 0	= =	Third level diploma. Otherwise.
Degree	Respondent's highest educational attainment	1 0	= =	Primary degree. Otherwise.
Higher Degree	Respondent's highest educational attainment	1 0	= =	Higher degree. Otherwise.
Other Education	Respondent's highest educational attainment	1 0	= =	Other education attainment. Otherwise.
Border	Location of respondent's residence	1 0	= =	Border Region. Otherwise.
Dublin	Location of respondent's residence	1 0	= =	Dublin Region. Otherwise.
Mid East	Location of respondent's residence	1 0	= =	Mid-East Region. Otherwise.
Midlands	Location of respondent's residence	1 0	= =	Midland Region. Otherwise.
Mid West	Location of respondent's residence	1 0	= =	Mid-West Region. Otherwise.

Table A4.1 (continued): Variable List and Definitions.

Variable Name	Variable Description	Variable Values
South East	Location of respondent's residence	1 = South-East Region. 0 = Otherwise.
South West	Location of respondent's residence	1 = South-West Region. 0 = Otherwise.
West	Location of respondent's residence	1 = West Region. 0 = Otherwise.
Social Benefit	Net weekly social welfare payments	Measured in 1989 euros.
Child Benefit	Net weekly child benefit payments	Measured in 1989 euros.
Dividends	Net weekly income from Dividends, interest and renting of assets	Measured in 1989 euros.
Pension Payment	Net weekly income from all non-social welfare pensions	Measured in 1989 euros.
Cash Windfall	Lump sum payments received by respondents	Measured in 1989 euros.
Unearned Income	The natural log of total unearned income reported by the respondent	Social Benefit + Child Benefit + Dividends + Pension Payment + (Cash Windfall/52).
Employed	Respondent in employment	1 = Employed. 0 = Otherwise.
Marriage Length	Duration of respondent's marriage	Measured in years.

Table A4.2: Percentage of Individuals by Gender and Country of Birth: 1995-2001.

Year	Males	Females	Born in Ireland	Born Abroad
1995	61%	39%	94%	6%
1996	60%	40%	95%	5%
1997	59%	41%	95%	5%
1998	58%	42%	95%	5%
1999	58%	42%	95%	5%
2000	58%	42%	94%	6%
2001	56%	44%	94%	6%
Total	59%	41%	95%	5%

Source: The Living in Ireland Survey, 1995-2001.

Table A4.3: Differences in Hourly Wage by Gender and Country of Birth, 1995-2001.

Year	Gender	Country of Birth
1995	16%	-2%
1996	17%	-3%
1997	16%	2%
1998	14%	1%
1999	15%	4%
2000	16%	1%
2001	16%	-9%

Source: The Living in Ireland Survey, 1995-2001.

Notes: (i) Gender is measured as a percentage of real male hourly wage.
(ii) Country of Birth is measured as a percentage of the real hourly pay of Irish born workers.

Table A4.4: LII 1995–2001: Summary Statistics.

Variable	Mean	Standard Deviation	Max	Min
Real Wage	€8.01	€5.09	€63.63	€0.45
Log Wage	1.91	0.58	4.15	-0.81
1995	0.16	0.36	1	0
1996	0.14	0.35	1	0
1997	0.14	0.34	1	0
1998	0.13	0.34	1	0
1999	0.12	0.32	1	0
2000	0.18	0.38	1	0
2001	0.15	0.35	1	0
Male	0.59	0.49	1	0
Experience	10.48	9.83	52	0
Experience^2	206.59	336.71	2704	0
Married	0.50	0.50	1	0
Divorced	0.03	0.16	1	0
Never Married	0.47	0.50	1	0
Born Ireland	0.95	0.23	1	0
Currently Irish	0.98	0.13	1	0
Nation Switch	0.04	0.20	1	0
Foreigner	0.01	0.12	1	0
Unearned Income	€13.70	€68.97	€2073.67	0
Marriage Length	9.17	11.29	46	0
Occupations				
Army	0.01	0.10	1	0
Manager	0.07	0.25	1	0
Professional	0.16	0.37	1	0
Associate Professional	0.11	0.31	1	0
Clerk	0.14	0.35	1	0
Retail	0.15	0.36	1	0

Table A4.4 (Continued): LII 1995–2001: Summary Statistics.

Variable	Mean	Standard Deviation	Max	Min
Agriculture	0.02	0.13	1	0
Trade	0.12	0.32	1	0
Plant	0.13	0.33	1	0
Unskilled	0.11	0.31	1	0
Other Occupation	0.00	0.02	1	0
Sectors				
Agricultural	0.03	0.18	1	0
Mining	0.01	0.07	1	0
Manufacture	0.21	0.41	1	0
Electricity	0.01	0.11	1	0
Construction	0.08	0.27	1	0
Retail Sector	0.12	0.32	1	0
Hotel	0.04	0.21	1	0
Transport	0.07	0.25	1	0
Finance	0.04	0.20	1	0
Property	0.06	0.24	1	0
Public	0.09	0.29	1	0
Education	0.09	0.28	1	0
Health	0.09	0.29	1	0
Other Sector	0.06	0.23	1	0
Private Sector	0.69	0.46	1	0
Pension	0.47	0.50	1	0
Educational Attainment				
Primary Lower	0.02	0.13	1	0
Primary Upper	0.03	0.17	1	0
Second Level	0.03	0.17	1	0
Group Cert	0.04	0.19	1	0
Junior Cert	0.10	0.30	1	0

Table A4.4 (Continued): LII 1995–2001: Summary Statistics.

Variable	Mean	Standard Deviation	Max	Min
Leaving Cert	0.20	0.40	1	0
PLC	0.03	0.16	1	0
Diploma	0.06	0.25	1	0
Degree	0.06	0.24	1	0
Higher Degree	0.03	0.17	1	0
Other Education	0.41	0.49	1	0
Regions				
Border	0.10	0.31	1	0
Dublin	0.27	0.44	1	0
Mid East	0.12	0.32	1	0
Midlands	0.07	0.26	1	0
Mid West	0.10	0.29	1	0
South East	0.11	0.31	1	0
South West	0.14	0.35	1	0
West	0.09	0.28	1	0

Source: The Living in Ireland Survey, 1995-2001.

Table A4.5: Country of Birth and Earnings: Random Effects Results.

Variable	Coefficient
1995	-0.20 (-11.69)
1996	-0.17 (-10.11)
1997	-0.13 (-7.60)
1998	-0.12 (-14.27)
1999	-0.07 (-8.27)
2000	-0.01 (-1.74)
Male	0.15 (14.23)
Experience	0.02 (26.52)
Experience^2	-0.00 (-26.86)
Married	0.16 (19.05)
Divorced	0.08 (3.17)
Born Ireland	-0.05 (-2.85)
Unearned Income	0.01 (5.02)
Inverse Mills Ratio	-0.00 (-0.01)
Occupations	
Army	0.01 (0.17)
Manager	0.25 (16.18)
Professional	0.33 (24.43)
Associate Professional	0.19 (13.51)
Clerk	0.13 (9.11)
Retail	0.01 (0.88)
Agriculture	0.11 (4.32)

Table A4.5 (Continued): Country of Birth and Earnings: Random Effects Results.

Variable	Coefficient
Trade	0.04 (2.66)
Plant	0.06 (4.76)
Sectors	
Mining	0.27 (6.30)
Manufacture	0.30 (14.07)
Electricity	0.28 (7.79)
Construction	0.29 (12.57)
Retail Sector	0.23 (10.04)
Hotel	0.19 (7.24)
Transport	0.29 (11.99)
Finance	0.30 (10.98)
Property	0.26 (11.36)
Public	0.29 (11.97)
Education	0.40 (15.82)
Health	0.27 (10.82)
Other Sector	0.22 (8.92)
Private Sector	-0.11 (-9.38)
Pension	0.18 (24.75)
Educational Attainment	
Junior Cert	0.01 (1.12)
Leaving Cert	0.05 (5.24)
PLC	0.09 (5.17)
Diploma	0.08 (6.22)

Table A4.5 (Continued): Country of Birth and Earnings: Random Effects Results.

Variable	Coefficient
Degree	0.11 (7.94)
Higher Degree	0.14 (8.04)
Other Education	0.03 (1.73)
Regions	
Border	-0.13 (-8.00)
Mid East	-0.03 (-2.12)
Midlands	-0.11 (-6.07)
Mid West	-0.09 (-5.30)
South East	-0.13 (-8.02)
South West	-0.11 (-7.28)
West	-0.08 (-4.61)
Dependent variable is the natural log of hourly wage (Log Wage). Number of observations = 18,349. $R^2 = 0.57$. Average, maximum and minimum number of years in panel is 2.8, 7 and 1.	

Source: The Living in Ireland Survey, 1995-2001.

Notes: **(i)** The values in parenthesis are T-statistics.
(ii) A full set of variable definitions are listed in Table A4.1 in the Appendix.

Table A4.6: Employment Model for All Workers: Probit Results.

Variable	Marginal Effects
1995	-0.13 (-0.71)
1996	-0.16 (-0.90)
1997	-0.26 (-1.43)
1998	0.01 (0.09)
1999	-0.01 (-0.07)
2000	0.10 (1.01)
Male	0.45 (6.12)
Experience	0.02 (3.03)
Experience^2	-0.00 (-2.61)
Married	-0.01 (-0.08)
Divorced	0.78 (4.21)
Born Ireland	0.11 (0.87)
Unearned Income	-0.32 (-16.13)
Marriage Length	0.01 (1.71)
Occupations	
Army	1.34 (2.56)
Manager	1.64 (9.42)
Professional	1.94 (12.58)
Associate Professional	1.86 (12.05)
Clerk	2.21 (14.70)
Retail	1.88 (14.30)
Agriculture	1.98 (5.61)

Table A4.6 (Continued): Employment Model for All Workers: Probit Results.

Variable	Marginal Effects
Trade	0.97 (6.80)
Plant	0.84 (6.70)
Sectors	
Mining	-0.48 (-0.94)
Manufacture	-0.78 (-2.87)
Electricity	0.66 (1.31)
Construction	-0.32 (-1.12)
Retail Sector	-1.13 (-3.95)
Hotel	-0.86 (-2.77)
Transport	-0.26 (-0.87)
Finance	-0.98 (-2.92)
Property	-0.78 (-2.59)
Public	0.83 (2.67)
Education	0.61 (2.03)
Health	0.37 (1.26)
Other Sector	-2.54 (-9.26)
Private Sector	2.22 (20.30)
Pension	0.24 (2.71)
Educational Attainment	
Junior Cert	-0.51 (-4.13)
Leaving Cert	-0.69 (-6.00)
PLC	-0.92 (-4.62)
Diploma	-0.78 (-5.02)

Table A4.6 (Continued): Employment Model for All Workers: Probit Results.

Variable	Marginal Effects
Degree	-0.68 (-3.91)
Higher Degree	-0.31 (-1.35)
Other Education	-0.39 (-2.14)
Regions	
Border	-0.11 (-0.95)
Mid East	-0.30 (-2.67)
Midlands	-0.08 (-0.62)
Mid West	-0.19 (-1.68)
South East	-0.15 (-1.29)
South West	-0.14 (-1.37)
West	-0.38 (-3.22)
Dependent variable is Employment. Number of observations = 22,051. Log likelihood = -2015.17. Pseudo R^2 = 0.17. Average, maximum and minimum number of years in panel is 2.9, 7 and 1.	

Source: The Living in Ireland Survey, 1995-2001.

Notes: **(i)** The values in parenthesis are T-statistics.
(ii) A full set of variable definitions are listed in Table A4.1 in the Appendix.

Table A4.7: Citizenship and Earnings: Random Effects Results.

Variable	Coefficient
Currently Irish	-0.01 (-0.35)
Nation Switch	0.06 (3.07)
Dependent variable is the natural log of hourly wage (Log Wage). Number of observations = 18,349. $R^2 = 0.57$. Average, maximum and minimum number of years in panel is 2.8, 7 and 1.	

Source: The Living in Ireland Survey, 1995-2001.

Notes: **(i)** The values in parenthesis are T-statistics.
(ii) A full set of variable definitions are listed in Table A4.1 in the Appendix.
(iii) All other explanatory variables as reported in Table A4.5 were used in the estimation but not reported here.

Table A4.8: Male Earnings: Random Effects Results for Model 1 and Model 2.

	Model 1	Model 2
Born Ireland	-0.08 (-3.09)	-
Currently Irish	-	-0.04 (-1.24)
Nation Switch	-	0.08 (2.77)
Dependent variable is the natural log of hourly wage (Log Wage). Number of observations = 10,735. $R^2 = 0.55$. Average, maximum and minimum number of years in panel is 2.9, 7 and 1.		

Source: The Living in Ireland Survey, 1995-2001.

Notes: **(i)** The values in parenthesis are T-statistics.
(ii) A full set of variable definitions are listed in Table A4.1 in the Appendix.
(iii) All other explanatory variables as reported in Table A4.5 were used in the estimation but not reported here.

Table A4.9: Female Earnings: Random Effects Results for Model 1 and Model 2.

	Model 1	**Model 2**
Born Ireland	-0.03 (-1.25)	-
Currently Irish	-	0.02 (0.67)
Nation Switch	-	0.05 (1.96)
Dependent variable is the natural log of hourly wage (Log Wage). Number of observations = 7,614. $R^2 = 0.59$. Average, maximum and minimum number of years in panel is 2.7, 7 and 1.		

Source: The Living in Ireland Survey, 1995-2001.

Notes: **(i)** The values in parenthesis are T-statistics.
(ii) A full set of variable definitions are listed in Table A4.1 in the Appendix.
(iii) All other explanatory variables as reported in Table A4.5 were used in the estimation but not reported here.

Table A4.10: Oaxaca Decomposition for All Workers.

Differential	Born Ireland	Currently Irish
Due to Endowments (E)	1.1%	-4.6%
Due to Coefficients (C)	32.0%	-2.7%
Shift Coefficient (U)	-37.1%	-1.1%
Raw Differential (R) = E + C +U	-3.9%	-8.3%
Adjusted Differential (D) = C + U	-5.1%	-3.7%
Percentage Endowments (E/R)	-29.1%	55.1%
Percentage Discrimination (D/R)	129.1%	44.9%

Source: The Living in Ireland Survey, 1995-2001.

Notes:

E = The endowments component of the decomposition, and is the sum of (the coefficient vector of the regressors of the high-wage group) times (the difference in group means between the high-wage and low-wage groups for the vector of regressors).

C = The coefficients component of the decomposition, and is the sum of the (group means of the low-wage group for the vector of regressors) times (the difference between the regression coefficients of the high-wage group and the low-wage group).

U = The unexplained portion of the differential, and is the difference in constants between the high-wage wage and the low-wage group.

C + U = The portion of the differential due to discrimination.

E + C + U = The raw or total differential.

Chapter 5: The Irish Manufacturing Sector: A Production Function Analysis

5.1 Introduction

This chapter of the thesis is concerned with exploring the relative performances of indigenous firms and foreign MNC's located in the manufacturing sector of the Irish economy between 1991 and 2000, as measured using a Cobb-Douglas production function[70]. Over the last decade, a large influx of foreign MNC's into the Irish economy has coincided with an unusually strong and persistent economic performance, with the official CSO figures showing GDP growing by over 8% per annum on average between 1994 and 2000. According to Enterprise Ireland (2007), Ireland is the fourth most attractive location for US manufacturing investment and plays host to almost five hundred US firms, who on a per capita basis provide double the FDI investment into Ireland than is invested in the UK by US firms. The aim of the production function analysis presented in this chapter is to compare the efficiency of Irish firms with that of multi-located foreign firms operating within the Irish economy; i.e. to explore how well Irish firms harness capital and labour relative to those firms that manage these factors of production globally. Given the potential importance of foreign MNC's to the Irish economy, it is important to attempt to quantify how productive each of these 'types' of firms are and to highlight any production lessons that indigenous firms can learn from foreign MNC's.

An important feature of the econometric study of the production function in this chapter concerns the analysis of the productivity of the various divisions of labour in the Irish manufacturing sector. To be specific, labour is grouped into six categories for the purpose of estimation; family members (and proprietors), managerial/technical staff, clerical staff, industrial workers, apprentices and outside piece workers[71]. These subdivisions of labour allow for the examination of the importance of each category to the production process and also permit the comparison of the usage of each section of

[70] A discussion on the merits of the Cobb-Douglas production function is presented in Section 5.2.
[71] In keeping with Chapters 3 and 4, we explore different types of labour in the estimation process. However, unfortunately due to data limitations, the categories of labour included are not consistent across the data sets employed in the previous two chapters.

the labour force between the Irish firms and the foreign firms in the manufacturing sector. This analysis is believed to be the first of its type applied to the Irish manufacturing sector that utilises CIP panel data from 1991 to 2000[72]. The history and merits of the four estimation techniques (OLS, within (fixed effects), GMM and system GMM) associated with production function estimation are discussed in Section 5.2 and all four approaches are used in the empirical analysis of an Irish production function. This econometric analysis will add to the literature already in existence which focuses upon which estimation technique is best suited to production function estimation. For purposes of comparison, the Cobb-Douglas production function is the specification used in the estimations of the Irish manufacturing sector presented in this chapter since this is the functional form most commonly utilised in such studies. The advantages of the Cobb-Douglas function are numerous, but the most frequently postulated benefits are its ability to carry out estimation in the presence of multiple factors of production and its reliability in not adding to the distortion of estimates of capital and labour in markets that may be already distorted in themselves, i.e. if the market for capital or labour contains imperfections the Cobb-Douglas specification will not add a distortion of its own (Bhanumurthy, 2002) [73].

Given the activities that MNC's often engage themselves in (i.e. profit repatriation and transfer pricing), researchers must be careful in assuming the complete validity of any econometric study founded upon MNC's data. Indeed, *The Economist* in its "Guide to Economic Indicators" (2000) relabelled GDP to "Grossly Deceptive Product" due to the lack of credibility of national accounts. This reference is arguably more apt in Ireland than any other EU economy and it has already been pointed out in an earlier Chapter (Section 2.2 of Chapter 2) that the difference between GDP and GNP in 2002 was a staggering 20%. Also one should be cautious when comparing indigenous firms against MNC's. As Griffith (1999) points out, it is often the case that the most productive and efficient firms will choose to locate plants in foreign economies and

[72] The data set for this Chapter does not run beyond 2000 as at the time of estimation no data beyond that year was available. The CIP data was provided by the CSO.
[73] For a detailed discussion on the advantages and disadvantages of the Cobb-Douglas production function see Bhanumurthy (2002).

indeed in the most productive sectors of these economies, while the set of indigenous firms in the sample will include firms on the margins of entry and exit, thus like with like comparisons in the strictest sense may not be appropriate.

This chapter follows the following format. In Section 5.2 some relevant production function theories and debates are reviewed. The main methodologies employed by the study are laid out in Section 5.3, along with a description of the data used in the study. The penultimate section (Section 5.4) presents the econometric results and conclusions drawn are discussed in Section 5.5.

5.2 Literature Review

5.2.1 Production Function Estimation

This section of the chapter focuses on the evolution of the production function in an econometric sense, commencing with a standard definition of the production function and reviewing some of the early studies and associated econometric problems in this area. The review then concentrates on one of the early responses to the several econometric problems of the production function, namely within estimation. Estimating production functions using a GMM estimator historically was a result of the relative failure of the within estimator to generate reliable estimates and this is also discussed in detail below. The advancement of the two latest responses to weaknesses in production function estimates, structural solutions and a system GMM estimator, are discussed in the latter end of the section along with further applications of the production function in relation to foreign direct investment studies.

The production function according to Coelli et al. (2003) describes the technical relationship between the inputs and the outputs of a production process; it defines the maximum output attainable from a given vector of inputs. Coelli et al. (2003) also outline the main branches of production function analysis, with the primary use of the production function sighted as the examination of economies of scale within firms, industries or economies. From a finance viewpoint, the production function has been utilised in studies examining pricing (see Hall (1988) and Klette (1994)) and, in

corporate finance, the production function has been used to measure the economic benefits for firms who have been involved in merger or management buyout activity (Harris et al., 2005).

The functional form that the production function takes will vary from study to study, depending on the flexibility required. However, there are three functional forms that are mainly used in empirical studies of the production function and these are discussed below; the Cobb-Douglas production function, the constant elasticity of substitution production function and the translog production function. Cobb and Douglas (1928) pioneered the econometric estimation of the production function. Early studies in the field tended however to focus on agricultural issues and/or marginal productivity theory (Grilliches and Mairesse, 1995) [74]. The Cobb-Douglas production function takes the form of equation (5.1):

$$Y = AL^{\alpha}K^{\beta}. \tag{5.1}$$

where Y is output, L is the labour employed, K is capital and A is viewed as a 'measure' of productivity. When transformed into logs, where ln denotes the natural logarithm, the Cobb-Douglas production function proved to be a popular (the reasons for which are discussed below) functional form for econometricians to use:

$$\ln Y = \ln A + \alpha \ln L + \beta \ln K. \tag{5.2}$$

Indeed, this functional form still describes the workings of modern production processes quite well, as it is still a widely used functional form in panel data studies today despite the amount of restrictions imposed on the model. The restrictions imposed include that the model will display homogeneity of degree $\alpha + \beta$, that there is unit elasticity of substitution, that there will be constant factor shares and that positive amounts of all inputs are required.

[74] Much of the historical material on the production function literature discussed in this section is drawn from Grilliches and Mairesse (1995).

The constant elasticity of substitution production function (equation 5.3 below) relaxes the unit elasticity of substitution assumption, while the translog production function (equation 5.4 below) relaxes all the above assumptions except the unity of elasticity of substitution assumption where g is the elasticity of substitution and v equates to returns to scale:

$$Y = A\,[\alpha L^{-g} + (1 - \alpha)\,K^{-g}]^{-v/g}. \qquad (5.3)$$

$$\ln Y = \alpha_0 + \alpha_1 \ln L + \alpha_2 \ln K + \tfrac{1}{2}[\alpha_3 (\ln L)^2 + \alpha_4 (\ln K)^2] + \alpha_5 \ln K \ln L. \qquad (5.4)$$

Although these are the three main functional forms adopted in empirical studies, there are other functional forms that have been proposed and used. For example, Zellner and Revankar (1969) used a functional form which allowed returns to scale to vary across output levels, while the generalised Leontief production function was useful in the rare cases where negative inputs were observed[75]. Bhanumurthy (2002) reviews the suitability of the Cobb-Douglas production function and concluded that the Cobb-Douglas production function is the most suitable for empirical work, not because of its simplicity, but rather because of its reliability and highlights its two main qualities. These are reported as its ability to handle multiple inputs in production and also its capabilities in handling markets which may be distorted. Mendershausen (1938) was one of the first to question the validity of the work of Cobb and Douglas (1928). His argument was based around multicollinearity and the reliability of the estimators produced by Cobb and Douglas (1928). If, as Mendershausen (1938) argues, the relevant input variables are determined simultaneously by identical forces, then the production function would be impossible to identify. Grilliches and Mairesse (1995) formulate this idea by stating that if all firms were on the same production frontier and faced the same prices, then they would have the same input ratios. If this were the case then there would be no real variability upon which to estimate the production function. Marschak and Andrews (1944) gave an insight into the aforementioned simultaneity

[75] This situation may arise where profit or loss is used as a proxy for output.

problem and it can be explained by examining the cross-sectional Cobb Douglas production function below:

$$Y_i = \alpha L_i + \beta K_i + a_i + \varepsilon_i. \quad (5.5)$$

where a_i are unobserved (to the econometrician) inputs and ε_i accounts for measurement errors. These unobserved inputs might be, for example, the skill level of firm 'i's' management or the quality of land or labour available to firm 'i'. However, as these inputs (a_i) are known to the firm when determining input levels K_i and L_i, the observed inputs of capital and labour are going to be correlated with the 'unobserved' a_i and, therefore, the OLS estimates of α and β will be biased. Muendler (2004) further demonstrates how productivity change can be in fact endogenous in the production function model. If firms promote and invest in assets/subsidiaries that are more productive in boom periods, while allowing the decay of less productive units in slumps, the firm's management is possibly dictating what productivity levels are and this may bias estimates. Others such as Hoch (1962) and Mundlak (1961) also stress the importance of this point in empirical work on production functions.

In order to discuss a range of potential solutions to the simultaneity problem, Grilliches and Mairesse (1995) highlight the need to decompose the error term (μ) in panel data context, see equation (5.6) below, associated with the production function. Each component of this decomposition then needs to be examined with a view to eliminating any effect it may have on the right hand side of the production function.

$$Y_{it} = \alpha L_{it} + \beta K_{it} + \mu_{it}$$
$$\mu_{it} = a_{it} + e_{it} + \varepsilon_{it}. \quad (5.6)$$

Equation (5.6) focuses upon the potential sources of the disturbance term generated by a production function. The 'ε' component of the error term is simply that part of the residual that attempts to pick up measurement errors in variables and errors generated by incorrect procedures. Given that the researcher has 'control' of 'ε', it should never

be correlated with the observable inputs and, therefore, will have no effect on firm behaviour in the model. The 'a' element is viewed as that part of the disturbance term that is observable to the firm, but not to the econometrician, and it is this asymmetry of production information that can generate the simultaneity problem in estimation. The influence of 'a', according to Grilliches and Mairesse (1995), is transmitted to the production function to the extent that it is relevant to the choice of the level of labour selected by the firm in the short-run. 'Delayed transmission' can also occur in the long-run if 'a' has an influence on the long term selection of capital stock for the firm. Conversely, the 'e' component of the disturbance term will remain serially uncorrelated with the input choices that the firms make. This component exists to represent unobserved changes within the production frontier process.

The initial response to much of the criticism of the Cobb and Douglas (1928) work was to source different types of data sets. Due to the lack of availability of firm level data at the time, most estimations were carried out using macro-level data (see Solow (1970) for example). According to Grilliches and Mairesse (1995), such criticisms led to economists looking towards micro-level data, particularly in agricultural empirical work, where, for example, Tintner (1944) and Heady and Dillon (1961) both used firm level data sets for agricultural production function analysis. Others, such as Solow (1957), reacted to the simultaneity problem by assuming that firms were in a state of profit maximisation, which allowed the use of factor shares to act as the 'estimators' in the production function and applied this technique to aggregate production functions to obtain productivity residuals.

In estimating agricultural production functions, Zellner et al. (1966) attempted to theorise a solution to the simultaneity problem. They assumed that the disturbance term (μ) in a production function in an agricultural setting was created by genuine shocks to the model, for example, by weather or attacks by pests, and that the farmer had no control over these genuine economic shocks. It was also assumed that the land, labour and equipment available were predetermined or, indeed, fixed. This argument suggests that no correlation exists between μ and the observed inputs of capital and

labour and, therefore, the simultaneity bias disappears. However, this argument still did not account for differentials in land, labour and machine quality that exist in practice and had no or limited relevance in an industrial production function study, where the types of random shocks experienced are very different in nature to those in the agricultural sector.

According to Grilliches and Mairesse (1995), the panel data response to the criticisms of Marschak and Andrews (1944) involved the assumption that the errors that were being transmitted to the right hand side of the production function were in general 'fixed' over time. If it can be assumed that the differentials in land, labour and managerial quality that are available to firms are fixed over the time frame of the panel data set, then it is possible to solve the simultaneity problem by utilising a within transformation of the data. Hoch (1955) was the first to utilise the within transformations (fixed effects estimator) as a solution to the simultaneity problem. The Cobb-Douglas production function in this instance can be written as:

$$Y_{it} = \alpha L_{it} + \beta K_{it} + a_i + \lambda_t + e_{it}. \qquad (5.7)$$

Here, the a_i's and the λ_t's are fixed firm and time effects and theoretically can be eradicated by subtracting the firm and time means, as shown in equation (5.8):

$$(Y_{it} - \bar{Y}_i) = \alpha(L_{it} - \bar{L}_i) + \beta(K_{it} - \bar{K}_i) + (e_i - e\bar{\lambda}_t). \qquad (5.8)$$

The $\bar{Y}_i$ notation denotes the averaging over the time dimension for each 'i'. To the extent that 'e' is serially uncorrelated with the observable inputs, the simultaneity bias will be removed. Mundlak (1961), Hoch (1962) and Mundlak and Hoch (1965) carried out similar work.

Grilliches and Mairesse (1995) report that as more panel data analysis was carried out, the within transformations failed to produce plausible production function estimates.

Such studies include Ringstad (1971) and Mairesse (1975). The estimates for the capital coefficients were unsatisfactorily low and often were deemed statistically insignificant. Returns to scale values were also being reported in relatively low magnitudes. Grilliches and Mairesse (1995) maintain, that theoretically, the within transformations were not managing to stabilise the simultaneity problem or that the transformation had served only to generate other econometric problems, which may have been the cause of the low capital elasticities.

Chamberlin (1982) was one of the first to highlight faults inherent in the within transformations of production functions. Although by definition the within transformations eliminated the 'a' component of the residual, they do not remove the 'e' element of error in equation (5.6). Grilliches and Mairesse (1995) suggest that the right hand side of the production function must now be strictly exogenous and that the only error accommodated for in this system is "pure" errors (e.g. random shocks) in estimation. Anything outside of these exogenous and pure error boundaries will thus generate a bias in the results. Following on from this, Chamberlin (1982) also was the first to emphasise the need for first differencing of panel data as a response to the strict exogeneity required by the production function. This transformation in conjunction with the GMM estimation process would help eliminate (in theory) firm fixed effects as equation (5.9) shows:

$$Y_{it} - Y_{it-1} = \alpha(L_{it} - L_{it-1}) + \beta(K_{it} - K_{it-1}) + \Delta_t + e_{it} - e_{it-1}. \qquad (5.9)$$

where $\Delta_t = \lambda_t - \lambda_{t-1}$. In this set-up, if e_{it} is a random shock that is not correlated with the inputs (L or K), then equation (5.9) can be estimated without the presence of bias in the resulting output. In essence, the GMM estimator takes first differences to eliminate unobserved firm specific effects and uses lagged instruments to correct for simultaneity (Blundell and Bond, 2000). However, if, as is usually the case empirically, the shocks contained within e_{it} do influence the selection of K, then instrumental variables will be required to aid the estimation process. The availability of instrumental variables to researchers (usually lagged K's and L's) will vary depending on the length of the panel

assembled. To introduce some sort of uniformity on this matter, GMM estimation was adopted to produce production function estimates. Arguably, the most important of the GMM studies was carried out by Arellano and Bond (1991). Others such as Keane and Runkle (1992), Mairesse and Hall (1993), Mairesse and Hall (1996) and Grilliches and Mairesse (1997) also followed the same procedure, but all were faced with the same econometric issue; the availability of instrumental variables that were 'strong' enough to make estimations unbiased and precise. Blundell and Bond (1998) show how the use of weak instrumental variables in GMM estimation can lead to a bias when using first differences. They find that the first differenced GMM estimates were biased and imprecise when the lagged levels of the variables were only weakly correlated with subsequent first differences. Benkard (2000) explored the impact of production experience on the production frontier, estimating the extended (for past production experience) model using GMM. Insignificant amounts of spillovers from past production experience were found to occur, which may be due to high staff turnover. Crépon and Duguet (1997), on the other hand, use GMM to estimate a production function that includes the impact of innovation of the production process, with patents being used as a proxy for innovation.

Having looked towards theory (Zellner et al., 1966), fixed effects estimation and now first differences coupled with GMM estimators, researchers were still faced with unreliable production function estimates. The within transformation was hindered by the exogenous independent variable problem, while the GMM approach was inhibited by an apparent lack of suitable instrumental variables. Potentially, these estimates were the result of either incorrect estimation procedures or measurement errors. For example, those potentially generated by estimating levels of capital stock for firms were generating inaccurate estimates. Perhaps the assumptions that producer behavioural theory were founded upon, such as the perfectly competitive market conditions, did not reflect the economic reality within which firms existed (Grilliches and Mairesse, 1995). Klette and Grilliches (1994) propose that using unrealistic 'measures' of output, such as sales, can lead to biased results. Using sales as a proxy for output is based upon the assumption that the law of one price holds in the markets

being analysed. If firms sell at slightly different prices due to marginal product differentials or even due to differing brand names, then in these instances, the firm determines price and thus sales will be correlated with labour and capital, leading to correlation between the dependent and independent variables in the model.

Whatever econometric problem that the production function studies were facing, neither within transformations nor GMM estimators resolved it. As Muendler (2004) points out, production function estimation with micro data displays a persistent unobserved variable that will vary within firms over time, but seems to resist treatment and may be the cause of biased estimates. Ackerberg and Caves (2003) summarised the situation at this stage by using a typical production function:

$$Y_{it} = \alpha K_{it} + \beta L_{it} + \omega_{it} + \varepsilon_{it}. \quad (5.10)$$

where Y_{it} is the natural log of output of firm i at time t, K_{it} is the natural log of capital stock of firm i at time t, L_{it} is the natural log of labour employed by firm i at time t, ω_{it} is firm i's productivity shock observed in time t and ε_{it} accounts for measurement errors. It is assumed that the productivity shock evolves exogenously, following an auto regressive (AR (1)) process, where P is the probability:

$$P(\omega_{it} | \omega_{it-1}, \ldots\ldots, \omega_{i0}) = P(\omega_{it} | \omega_{it-1}). \quad (5.11)$$

Ackerberg and Caves (2003) explain that the simultaneity problem had led economists at this point to two econometric "cull de sacs". Firstly, fixed effect estimation required the assumption outlined in equation (5.11) to hold for all time periods. Secondly, for GMM estimation to be successful, instrumental variables had to be located that were correlated with the optimal input choices for each firm (K_{it}, L_{it}), but uncorrelated with the productivity shock (ω_{it}).

Olley and Pakes (1992) were concerned with both the simultaneity and the selectivity problems associated with production function estimation. They introduced an

investment function to serve as a proxy for that component of the production function disturbance term that is transmitted to the observable inputs in the process. Grilliches and Mairesse (1995) find that this technique is advantageous in two ways; firstly, it does not assume that the 'a' component of the error term reduces to a fixed firm effect across time, as the within estimation process does; and secondly, it leaves more identifying variance in the inputs, which renders it a "less costly" solution to the simultaneity problem.

Olley and Pakes (1996) again tackle the structural identification of the production function, as opposed to looking towards the dynamic panel data solutions to the simultaneity and selectivity problems of production function estimation[76]. They dealt with the endogeneity problem by assuming that the level of capital stock is fixed subject to the investment that the firm partakes in. The current level of capital stock depends upon last period's capital stock and investment. This strict timing argument 'solves' the endogeneity problem between productivity and capital stock, i.e. K_{it} and ω_{it} are uncorrelated as K_{it} is decided upon by investment decisions carried out in time period t-1.

To solve the endogeneity problem surrounding the labour input in the production function, Olley and Pakes (1996) look at the firm's investment decisions and find conditions under which a firm's optimal investment choice is an increasing function of their productivity. The investment function faced by a firm is outlined below:

$$i_{it} = f_t (\omega_{it}, K_{it}). \qquad (5.12)$$

where i_{it} is the investment level selected by firm 'i' at time 't', ω_{it} is firm 'i's productivity level in time 't' and the level of capital stock employed by firm 'i' at time 't' is K_{it}. Olley and Pakes (1996) assume that equation (5.12) is monotonic, and is inverted to solve for ω_{it}:

[76] The discussion of Olley and Pakes (1996) and Levinsohn and Petrin (2000) presented in this chapter is mainly drawn from Ackerberg and Caves (2003).

$$\omega_{it} = f_t^{-1} (i_{it}, K_{it}). \quad (5.13)$$

Equation (5.13) is used by Olley and Pakes (1996) to control for the effects of productivity in the production function. When equation (5.13) is substituted into equation (5.10) it must be treated as a non-parametric function due to the form which the 'investment function' takes that replaces productivity:

$$Y_{it} = \alpha K_{it} + \beta L_{it} + f_t^{-1} (i_{it}, K_{it}) + \varepsilon_{it}. \quad (5.14)$$

Due to the fact that capital stock is collinear with the productivity substitute in equation (5.14), this expression cannot be directly estimated. The labour estimator can be obtained directly but not the capital coefficient. In effect, Olley and Pakes (1996) invert the investment equation and treat the resulting outcome non-parametrically in an attempt to control for the simultaneity problem faced by production function estimation. In a similar fashion, Van Biesebroeck (2003) inverts labour demand to control for capital productivity differences in the automobile industry.

Levinsohn and Petrin (2000) criticise Olley and Pakes (1996) on the basis that the assumption of monotonicity in the investment function may be misguided. Ackerberg and Caves (2003) point out that actual firm investment data has a lot of null or missing values reported and, in addition, they are doubtful that investment functions are monotonic in productivity in practice. Levinsohn and Petrin (2000) try to improve upon the model by using an intermediate input demand equation to control for productivity in the production function and use the following extended (from equation (5.10)) production function specification:

$$Y_{it} = \alpha K_{it} + \beta L_{it} + \phi M_{it} + \omega_{it} + \varepsilon_{it}. \quad (5.15)$$

where M_{it} is an intermediate input such as fuel. Again the appropriate demand function is stated (intermediate input demand):

$$M_{it} = f_t (\omega_{it}, K_{it}). \quad (5.16)$$

The assumption of monotonicity in ω_{it} is adopted, and equation (5.16) is inverted to solve for ω_{it}:

$$\omega_{it} = f_t^{-1} (M_{it}, K_{it}). \quad (5.17)$$

As with Olley and Pakes (1996), equation (5.17) is substituted in for productivity in the original production function expression (equation 5.15) and estimated non-parametrically:

$$Y_{it} = \alpha K_{it} + \beta L_{it} + \phi M_{it} + f_t^{-1} (M_{it}, K_{it}) + \varepsilon_{it}. \quad (5.18)$$

Ackerberg and Caves (2003) point out that the both the Olley and Pakes (1996) and the Levinsohn and Petrin (2000) procedures are built upon three key assumptions. Firstly, if the monotonicity assumption does not hold, endogeneity cannot be removed from the model by controlling productivity. Secondly, it is assumed that productivity is the only unobservable element of the investment or intermediate input demand equations. This eliminates the possibility of creating measurement or optimisation errors and having plausible outputs. The final assumption deals with timing assumptions and productivity. If input choices are not made as assumed by the model, then the endogeneity argument arises again.

Ackerberg and Caves (2003) express reservations about the foundations upon which the structural solutions to the estimation problems provided by Olley and Pakes (1996) and Levinsohn and Petrin (2000) are built. In relation to Levinsohn and Petrin (2000), Ackerberg and Caves (2003) argue that if the labour input and the intermediate input demand function are determined in conjunction with each other, then the labour input will be collinear with the non-parametric element of the production function. Ackerberg and Caves (2003) put forward a technical solution to this collinearity. If, in attempting to optimise their labour inputs, firms experience optimisation errors, their

labour input selection, L_{it}, will move independently of the non-parametric function, leaving the labour coefficient solvable. It should be noted however that the authors contest that the extent of identification will be a function of the severity of the optimisation error. They also suggest that there is a need to assume an optimisation error in selecting the labour levels, but no optimisation error is permitted in selecting the intermediate input goods, as the inversion procedure would then be invalid. They note that if the level of labour input is chosen prior to the level of the intermediate input goods, then the selection of the intermediate input goods will now be dependent upon the level of labour selected (i.e. $M_{it} = f_t (\omega_{it}, K_{it}, L_{it})$), so the function will no longer be able to be estimated.

According to Ackerberg and Caves (2003), the perfect environment for this model to operate efficiently in is to have a firm specific shock to the price of labour that will occur between selecting the intermediate input goods and the level of labour. This shock will force L_{it} to move independently, but must vary across firms and not be persistent in nature. In summary, it is believed that for the Levinsohn and Petrin (2000) model to work, either, an optimisation error must occur in the selection of labour but not in the selection of the intermediate input goods, or the level of labour required by the firm is decided after the levels of the intermediate input goods to be used are selected, and that in the interim there is a firm specific (non-persistent) shock to wage costs.

Similarly, Ackerberg and Caves (2003) find collinearity inherent in the Olley and Pakes (1996) framework. The labour input (L_{it}) will be collinear with the non-parametric element of the production function. Just as with the Levinsohn and Petrin (2000) model, Ackerberg and Caves (2003) suggest a set of circumstances where the model might survive estimation without bias: firstly if optimisation error occurs in selecting levels of labour; secondly if investment is chosen before labour and a firm specific shock affects the price of labour in the interim; and finally if the level of labour is selected before the level of investment is decided and productivity changes in-between the two selections. By means of extension, Ackerberg and Caves (2003)

propose an alternative structural solution that combines the basic ideas of Olley and Pakes (1996) and combines them with the use of intermediate input demand as a proxy as used by the Levinsohn and Petrin (2000) model. They rely however upon additional assumptions in performing the non-parametric inversion in order to avoid the collinearity problems that adversely affect both the Olley and Pakes (1996) and the Levinsohn and Petrin (2000) models.

Parallel to the structural identification production function work ran the evolution of the GMM estimation process. Arellano and Bover (1995) show that improvement upon the standard GMM estimates can be achieved by using lagged first differences as instruments for equations in levels, in addition to the usual lagged levels as instruments for equations in first differences. Blundell and Bond (2000) were one of the first studies to 'successfully' tackle the problem of the lack of 'quality' instruments available to the production function GMM estimation process, in developing a 'system' GMM estimator. Using a Cobb-Douglas specification they estimate a production function based on a panel of firms from the US. They find that using the standard GMM estimator yields less than satisfactory results and attribute the cause of this inadequate performance to the poor quality instruments used in the estimation. Blundell and Bond (2000) theorise that sales, capital and labour are highly persistent, rendering lagged levels of these variables as being weakly correlated with the first differences, thus explaining the poor GMM results. It is proposed by the authors that this system GMM estimator, where lagged first differences are also used as 'improved' instruments for the levels of the equations, will produce more precise results than the standard GMM process. Blundell and Bond (2000) using the system GMM estimator find large and strongly statistically significant capital coefficients relative to those estimates produced by the standard GMM estimator and do not reject constant returns to scale, contrary to previous studies using the standard GMM estimator. The model used emphasises the need to allow for a serially correlated component in the error term of the production function. This serial correlation is needed to obtain valid lagged internal instruments for the system GMM estimator. Using 509 research and development performing US manufacturing firms observed between 1982 and 1989,

Blundell and Bond (2000) find that system GMM estimates were more precise than OLS, within or standard GMM estimates and conclude that weak instruments are a potential problem when relying upon standard GMM estimates.

Alonso-Borrego and Sánchez-Mangas (2001) also apply the system GMM estimator to a Cobb-Douglas production function using an unbalanced panel data set of 1272 Spanish manufacturing firms observed between 1990 and 1997. Again it is found that the system GMM estimators are the most precise for production function estimation. Harris et al. (2005) use the system GMM estimator to calculate total factor productivity (using a Cobb-Douglas production function) of firms involved in management buyouts. Previous studies in this area (Lichtenberg and Siegel (1990) for example) had retrieved total factor productivity using the within estimation procedure. In accordance with their expectations, Harris et al. (2005) find that firms experience increases in total factor productivity as a result of management buyouts.

Others who have reported improved estimations while using the system GMM procedure include; Bond et al. (2003a) while estimating UK and German production functions; Blundell and Bond (1998) used the estimator for labour demand work; Bond et al. (2003b) analysed investment functions; Bond et al. (2001) analyse aggregate production functions using the system GMM approach; Blundell et al. (2000) further investigates the properties of the system GMM estimator via a production function analysis utilising US panel data.

5.2.2 Production Functions and Foreign Direct Investment

The production function has been utilised in a variety of econometric studies examining the impact of FDI upon firms, markets or economies. The following are a small subset of such studies which in the main are based upon data from the UK or Ireland. Griffith (1999) analyses foreign owned firms in the UK car industry and their productivity levels relative to those of domestic firms in the same sector. Again a system GMM estimator is used with a Cobb-Douglas production function to retrieve total factor productivity (the production function residual), which is used to gauge

productivity. In conclusion, Griffith (1999) finds that firms of German origin located in the UK are more efficient than any other foreign or indigenous firms in the sector. Barrios et al. (2005) examine the impact of FDI on domestic firms in Ireland. It is reported that the competition effect created by foreign firms entering the market initially is prohibitive for domestic firms looking to enter the industry, but the positive externalities that result from the presence of the foreign firms in the market eventually outweigh this effect. Girma and Görg (2004) examine the impact of outsourcing upon productivity for manufacturing firms based in the UK. The key findings suggested that MNC's have higher levels of outsourcing than indigenous firms and that outsourcing was positively linked with both higher labour and total factor productivities. This effect was also found to be more pronounced for the foreign firms in the sector. Ten and Wolff (2001) also report a positive relationship between outsourcing and total factor productivity growth for manufacturing firms in the US. Görg and Hanley (2005) find that outsourcing of materials provides significant productivity gains for firms in the electronics sector in Ireland, but that this effect only holds for firms with a low export base. Görg et al. (2008) examine the impact of international outsourcing on the productivity of firms in the Irish manufacturing sector. Both domestic and foreign owned firms that are export driven, experience positive effects from outsourcing services inputs. Görg and Strobl (2005) examine the relationship between worker mobility and potential spillovers from MNC's and find that Ghanaian firms run by owners who worked for foreign firms prior to entering the same market are more productive than other indigenous firms. Smarzynska-Javorcik (2004) finds that domestic firms in Lithuania benefit via inter-industry productivity spillovers from MNC's.

From an Irish perspective, despite several productivity studies such as those outlined above, there is not a vast bank of recent empirical work on the production function. Sadeg (1996) examines an aggregate production function with a view to explaining Irish economic growth. Both Cobb-Douglas and constant elasticity of substitution functional forms are used on a time series data set running from 1951 to 1984. Sadeg (1996) concludes that the Cobb-Douglas functional form fits the data set best and that a

constant elasticity of substitution between the factors of productions exists. Conversely, McQuinn (2003) in building on Slevin (2001) finds that a translog production function best explains the workings of the Irish economy between 1991 and 1998.

To summarise, as Grilliches and Mairesse (1995) state, the response to the endogeneity problem in a panel data context seems to be to take thinner wedges of data in hope that the problem will disappear. They argue that more investigation is warranted into why firms invest and use research and development differently, and that more detailed financial data is required to analyse, for example, the impact of tax changes on the model. On this note and in conclusion, despite the system GMM estimation procedure's drawbacks, it is currently arguably one of the best responses to the initial problems found in Cobb and Douglas's (1928) production function model and the system GMM estimator is arguably currently the most reliable way of producing production function estimates for a panel data set of manufacturing firms. Hence, it is used in the empirical analysis below. In addition, the other estimation techniques surveyed (OLS, within and GMM) are also adopted below for purposes of comparison.

5.3 Methodology and Data

The literature review in the previous section has identified a range of estimation techniques that have evolved in the cause to procure unbiased production function parameters. Given the history of the production function methodological debate, this section of the chapter briefly outlines the four (OLS, fixed effects, GMM and system GMM) main techniques that have been utilised over the last eighty or so years in this field. In keeping with comparable studies in the area, all four estimators will be applied to the Irish production function so as to provide comparisons between the Irish case and similar studies (see Blundell et al. (2000) or Griffith (1999) for example) where the system GMM estimator has been seen to be the most reliable way of estimating production functions. The OLS estimator has been described by Stigler (1981) as the "automobile of modern statistical analysis", in referring to its widespread use in econometric studies. For a detailed discussion of the OLS estimator see

Maddala (2001). The following material in this section will be a review of the fixed effects, GMM and system GMM estimators.

5.3.1 The Fixed Effects Estimator

A fixed effects model is a linear regression model in which the intercept terms vary over the individual units in the data set (Verbeek, 2004)[77]. Baltagi (2008) suggests that the fixed effects model is an appropriate specification if the study is focused on a specific set of *n* firms and inference is restricted to the behaviour of this set of firms. In essence, the fixed effects estimator concentrates on differences 'within' firms. As is the case for the OLS estimator, the reason for including the fixed effects estimator in this production function study is based upon prior research in the field.

Given the following linear regression model:

$$Y_{it} = \alpha_i + X_{it}'\beta + \varepsilon_{it},\ \varepsilon_{it} \sim \text{N.I.I.D. } (0, \sigma_2). \tag{5.19}$$

where i refers to the firm and t refers to the relevant time period. It is assumed that all X_{it} are independent of all the disturbance terms (ε_{it}). Estimates of the vector of slope coefficients (β) are retrieved by deviations from firm means. This allows for the firm specific effects (α_i) to be eliminated by transforming the data:

$$\overline{Y}_i = \alpha_i + \overline{X}_i'\beta + \overline{\varepsilon}_i. \tag{5.20}$$

where $\overline{Y}_i = T^{-1}\sum_t Y_{it}$ and, similarly, for $\overline{X}_i$. This gives the following transformation:

$$Y_{it} - \overline{Y}_i = (X_{it} - \overline{X}_i)'\beta + (\varepsilon_{it} - \overline{\varepsilon}_i). \tag{5.21}$$

[77] The analysis of the fixed effect estimator in this chapter is drawn mainly from Verbeek (2008).

This is a regression model in deviations from firm means and does not include the firms' specific effects. This transformation is known as a within transformation, i.e. it produces observations in deviations from firm means. The OLS parameter for β obtained from the transformed model is called the within or fixed effects estimator $(\hat{\beta}_{FE})$:

$$\hat{\beta}_{FE} = (\sum_{i=1}^{n}\sum_{t=1}^{T}(X_{it} - \overline{X}_i)(X_{it} - \overline{X}_i)')^{-1}\sum_{i=1}^{n}\sum_{t=1}^{T}(X_{it} - \overline{X}_i)(Y_{it} - \overline{Y}_i). \quad (5.22)$$

If the assumption is made that all the explanatory variables are independent of the error term, then the fixed effects estimator will be unbiased. Similarly, if normality of the error term is imposed on the model then the fixed effects estimator will also have a normal distribution. For the property of consistency to apply, the following condition is required:

$$E\{(X_{it} - \overline{X}_i)\varepsilon_{it}\} = 0. \quad (5.23)$$

This implies that the independent variable (X_{it}) is uncorrelated with the error term (ε_{it}) and that the mean value $(\overline{X}_i)$ is also uncorrelated with the error term (ε_{it}). Under these assumptions the independent variables can be seen to be strictly exogenous, i.e. their values in no way depend upon current, future or present values of the disturbance term. Having established the independence of the explanatory variables, the *n* intercept values are estimated unbiasedly:

$$\alpha_i = \overline{Y}_i - \overline{X}_i'\overline{\beta}_{FE}. \quad (5.24)$$

Given the previous assumption, this estimator is consistent for the fixed effects (α_i) provided T goes to infinity. Fixed effect estimates of the production function are presented and analysed in Section 5.4 of this chapter.

5.3.2 The Generalised Method of Moments and System GMM Estimators

The GMM estimator does not require the complete specification of a model and its associated probability distributions, but only the specification of a set of moment conditions that the model should satisfy. This is the main difference between GMM and other techniques for estimating models (Mátyás, 1999)[78]. The GMM technique is based upon the Method of Moments estimator, which is a technique where the unknown parameters of a model should be estimated by matching population moments with the appropriate sample moments. Maddala (2001) uses a linear regression model in explaining the GMM estimation method:

$$Y = X\beta + U. \tag{5.25}$$

The GMM estimator minimises (U'XWX'U) where W is a weighting matrix. Minimising (Y - Xβ)'WXW'(Y - Xβ) gives X'XWX'Y. If (X'X) and W are non-singular then:

$$\hat{\beta} = (X'X)^{-1}X'Y. \tag{5.26}$$

which is the OLS estimator. Verbeek (2008) attributes the workings of the GMM estimator to Hansen's (1982) approach of estimating the parameters for a model directly from the moment conditions imposed by the model itself. A model consisting of R moment conditions is evaluated:

$$E\{f(W_t,Z_t,\theta)\} = 0. \tag{5.27}$$

where f is a vector function with R elements and θ is a K-dimensional vector containing all unknown parameters. W_t is a vector of observable variables that can be exogenous or endogenous and Z_t is a vector of instrumental variables. To estimate θ, Verbeek (2008) examines the sample equivalent of equation (5.27):

[78] For a detailed discussion of the GMM estimator see Mátyás (1999).

$$g_T(\theta) = \frac{1}{T}\sum_{t=1}^{T} f(W_t, Z_t, \theta). \quad (5.28)$$

If the number of moment conditions (R) equals the number of parameters in the model (K), it is possible so set the R elements in equation (5.28) to zero and solve for θ to find the estimator. If, however, R is exceeded by K, the parameter vector (θ) is unidentifiable.

$$\underset{\theta}{Min} Q_T(\theta) = \underset{\theta}{Min} g_t(\theta)' W_T g_t(\theta). \quad (5.29)$$

Conversely, if R exceeds K, the unknown parameter vector (θ) cannot be solved uniquely by setting (Y) to zero. It is proposed by Verbeek (2008) in this instance to select an estimator for θ such that the vector of sample moments is as close to zero as possible, i.e. a quadratic form in $g_t(\theta)$ is minimised. Here, W_T is a positive definite matrix and the solution to this equation provides the GMM estimator $(\hat{\theta})$.

The system GMM estimator builds upon the standard GMM estimator by attempting to improve the validity of the instrumental variables. It does this by using lagged first differences as instruments for equations in levels, in addition to the usual (in the case of the GMM estimator) lagged levels as instruments for equations in first differences. Blundell and Bond (2000) provide an explanation of the system GMM estimator by focusing on a dynamic Cobb-Douglas production function. The model estimated by Blundell and Bond (2000) is outlined below:

$$Y_{it} = \alpha L_{it} + \beta K_{it} + \lambda_t + (\eta_i + \nu_{it} + m_{it}). \quad (5.30)$$

$$\nu_{it} = \rho \nu_{it-1} + e_{it}.$$

$$e_{it}, m_{it} \sim \text{MA}(0).$$

where Y_{it} is the log of sales of firm i in year t, L_{it} is the log of employment of firm i in year t, K_{it} is the log of the capital stock of firm i in year t, λ_t is a year specific intercept, η_i represents unobserved firm specific effects, ν_{it} is an auto regressive productivity shock and m_{it} reflects serially uncorrelated measurement error. Blundell and Bond (2000) also present the model in a dynamic format as in equation (5.31) below:

$$Y_{it} = \pi_1 L_{it} + \pi_2 L_{it-1} + \pi_3 K_{it} + \pi_4 K_{it-1} + \pi_5 Y_{it-1} + \lambda_t^* + (\eta_i^* + \omega_{it}). \quad (5.31)$$

Equation (5.31) is subject to two common factor constraints: $\pi_2 = -\pi_1\pi_5$ and $\pi_4 = -\pi_3\pi_5$. If it is assumed that $E[\Delta L_{it}\eta_i^*] = E[\Delta K_{it}\eta_i^*] = 0$ and that $E[\Delta Y_{i2}\eta_i^*] = 0$ also holds, then the following extra moment condition is generated:

$$E[\Delta X_{i,t-s}(\eta_i^* + \omega_{it})] = 0. \quad (5.32)$$

where $X_{it} = (K_{it}, \eta_{it}, Y_{it})$, for S = 1 when $\omega_{it} \sim$ M A (0) and S = 2 when $\omega_{it} \sim$ M A (1) and where MA is a moving average process, which according to Blundell and Bond (2000), allows the use of lagged first differences of the variables as instrumental variables for the equation in levels. Combining this set of moments with the set of moments discussed in the GMM estimator analysis gives rise to the system GMM estimator.

5.3.3 Model Specifications

In the penultimate section of this chapter, the results of estimating four models are presented. The specification of these models is discussed in detail below:

Model 1:

$$Y_{it} = \alpha_i + \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 D_{it} + \mu_{it}. \quad (5.33)$$

Model 2:

$$Y_{it} = \alpha_i + \beta_1 K_{it} + \beta_2 La_{it} + \beta_3 Lb_{it} + \beta_4 Lc_{it} + \beta_5 Ld_i + \beta_6 Le_{it} + \beta_7 Lf_{it} + \beta_8 D_{it} + \mu_{it}. \quad (5.34)$$

Model 3:

$$Y_{it} = \alpha_i + \beta_1 K_{it} + \beta_2 L_{it} + \mu_{it}. \quad (5.35)$$

Model 4:

$$Y_{it} = \alpha_i + \beta_1 K_{it} + \beta_2 La_{it} + \beta_3 Lb_{it} + \beta_4 Lc_{it} + \beta_5 Ld_i + \beta_6 Le_{it} + \beta_7 Lf_{it} + \mu_{it}. \quad (5.36)$$

where Y_{it} is the natural log of gross value added for firm i in year t. Gross value added is defined as production value less intermediate consumption and is measured in thousands of 1995 Euros. Production value is defined as the sum of total turnover, capital assets manufactured by enterprises for their own use, increases in stocks of finished goods and work in progress and increases in stocks of goods for resale without further processing, less purchases of goods for resale without further processing. Intermediate consumption is defined as the sum of purchases of materials and fuel, the cost of industrial services, and the cost of non-industrial services, less increases in stocks of materials and fuel.

K_{it} is the natural log of firm i's capital stock in year t. Capital Stock is derived by applying the perpetual-inventory method (this method is explained in greater detail later in this section) to the additions to and sales of capital assets variable and is measured in thousands of 1995 euros. Capital assets (land, buildings, plant and equipment) are defined as goods with an expected useful life of more than one year intended for use by the local unit itself. Acquisitions include purchases from other local units and production by the local unit itself of capital goods for its own use. Major alterations, improvements and repairs that extend the useful life of an asset or increase its productivity are included. The value of work put in place during the year is included whether or not it is completed. Additions are valued at total cost including installation charges and fees or duties by excluding deductible Value Added Tax (VAT) and financial costs. Sales of assets are valued at the price actually received excluding VAT.

L_{it} is the natural log of firm i's total employment level in year t. Total employment is defined as the total number of employees (managerial and technical, clerical, industrial, apprentices and outside piece workers) added to the number of proprietors and unpaid family workers. D_{it} is a dummy variable which equals one if firm i is a foreign firm

located in the Irish manufacturing sector and a value of zero if firm i is an Irish firm located in the Irish manufacturing sector. Nationality of ownership is attributed to the nationality of the owners (as defined by the CSO) of 50% or more of the share capital in a firm. In the second model specified, labour is split by classification. La_{it} measures the natural log of the number of family members employed (and proprietors) by firm i in year t, Lb_{it} is the natural log of the number of managerial/technical staff (these are defined as managerial, technical and other salaried staff) employed in time t by firm i, Lc_{it} is the natural log of the number of clerical staff (these are defined as clerical and other office staff, including supervisory clerical staff and sales representatives) employed by firm i in time period t, while Ld_{it} is the natural log of the number of industrial workers (these are defined as operatives, packers, cleaners, maintenance, stores, delivery personnel, foremen and production supervisors) hired by firm i in time t, Le_{it} is the natural log of the number of apprentices (these are defined as persons serving apprenticeships) employed by firm i in time t and Lf_{it} is the natural log of the number of outside piece workers (these are defined as persons who work for an enterprise but not on the premises) utilised by firm i in time t[79].

Model 1 is the standard Cobb-Douglas production function, which will determine the effects of capital and labour on output. It also incorporates a dummy variable in an attempt to quantify the impact of being a foreign corporation in the Irish manufacturing sector. The intuition behind the inclusion of the dummy variable in this model is based on the hypothesis that foreign firms located in Ireland are a key driver of productivity and growth in the Irish economy and that this dummy variable will control for this perceived difference. When examining either Irish or foreign firms in isolation, this dummy variable will obviously be excluded from the set of explanatory variables. In this instance, model 3 will be utilised in place of model 1. The reasoning behind analysing the production process with distinct divisions of labour is to highlight which sections of the manufacturing labour force have the greatest effects on output. Given that the models will be estimated for all firms, as well as foreign and Irish firms in the panel independently, it will also permit a comparison between Irish and foreign usage

[79] Definitions of the variables used are also outlined in Appendix 5.1.

of labour. Rather than utilising interaction variables that incorporate the nationality dummy in conjunction with the other independent variables in the models, separate estimations are carried out for the subsamples containing Irish and foreign firms only in the panel. Again, model 4 will be estimated in place of model 2 when estimating production functions for Irish or foreign firms in isolation. All four models will be estimated using the four prevalent estimation techniques used in production function analysis that have been identified in the literature review; OLS, within, GMM and system GMM. The models are assumed to be Cobb-Douglas specified and the presence of constant returns to scale is tested in the empirical section. This involves testing if:

$$\beta_1 + \beta_2 = 1. \tag{5.37}$$

in models 1 and 3, while constant returns to scale in models 2 and 4 would entail the following restriction:

$$\beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6 + \beta_7 = 1. \tag{5.38}$$

The error term (μ_{it}) in all four models is assumed to have a two-way error component.

$$\mu_{it} = \mu_i + \pi_{it} + \nu_{it}. \tag{5.39}$$

The disturbance term is split between the unobservable firm specific effect (μ_i), a potentially autoregressive productivity shock (π_{it}) and the remaining disturbance term (ν_{it}) caused by traditional random economic conditions (Baltagi, 2001). The firm specific effect could be generated in a production function context by firms following different accounting policies, investment criteria or having differences in managerial ability. The remaining disturbance term, as stated above, can be generated, for example, by random shocks to markets, economies or countries.

As mentioned above, the measure of capital stock is approximated using the perpetual-inventory method. Barro and Sala-I-Martin (2004) outline the functioning of this technique in detail. Here, the capital stock available in time frame t+1 (K_{t+1}) is the sum of the capital stock remaining from period t (K_t) plus capital acquisitions during the period (I_t). The capital stock from period t is depreciated at the appropriate deprecation rate for the economy (δ). Based upon provisions for depreciation of gross domestic fixed capital formation calculated by the CSO, the average depreciation rate (δ) calculated for the period is 4.69% per annum. By comparison, Nadiri and Prucha (1997) calculate the equivalent figure for the US manufacturing sector to be 5.9% per annum. Therefore, based upon the perpetual-inventory method, the value for capital stock in period t+1 will be:

$$K_{it+1} = K_{it} - \delta K_{it} + I_{it}. \qquad (5.40)$$

In line with Bond (2002), the GMM and the system GMM estimator both use for each time period, all available lags of the specified variables in levels dated t-1 and earlier as instruments for the first-difference equations. The system GMM estimator uses additional moment conditions in that first differences are used as instruments for levels[80].

5.3.4 Data Description

The CSO provided the data used in this study. The annual CIP contains information on all firms operating in the manufacturing sector in the Irish economy and is the main source of such industry data for Ireland. The data is a panel running over 10 years (1991 - 2000) and is comprised of both foreign and Irish firms that were operating in the manufacturing sector of the Irish economy during this period. The breakdown of firms between Irish and foreign is discussed later in this section. Baltagi (2008) discusses the advantages of using panel data as opposed to cross-sectional or time-series data sets. In using panel data sets, it is possible to control for individual

[80] See Bond (2002) or Griffith (1999) for a comprehensive discussion of the use of instruments in system GMM estimation.

endogeneity, while simultaneously having more informative data, more variability, less collinearity among the variables, higher degrees of freedom and more efficiency. A panel of data enables the researcher to be better able to study the dynamics of adjustment, as the individual firms are observed over several time periods. Micro level panel data sets allow greater accuracy in the measurement of firms and their use will remove biases resulting from aggregation over firms. Verbeek (2008) considers panel data particularly useful in cases where analysis of change on an individual or firm is required and when researching why given individuals or firms behave differently at different points in time. In the context of this production function analysis, the panel of firms in the Irish manufacturing sector will allow the indigenous firms observed to be compared against foreign firms represented in the surveys in the sector over a ten year period, which will allow a comparison of the productivity of both elements (Irish and foreign) in the panel without either disguising the effect of the other.

Baltagi (2008) also highlights some of the limitations of using panel data in empirical work. The inherent problems of data collection such as coverage of the population, non-response or recall problems of those submitting the responses and potential interview bias are the main concerns surrounding gathering data at the individual level and/or over successive time periods. These problems are not of major concern with respect to how the data analysed in this chapter is collected given that it is a census of the entire manufacturing sector and its collection is enforced by legislation. Baltagi (2008) also raises the possibility of distortion of measurement errors by 'faulty' responses and selectivity problems, which may lead to bias in the data. This may raise more questions about the reliability of the CIP data than any of the other potential problems outlined above due to the potential impact of transfer pricing upon data collection in the sector[81]. Given that many of the foreign firms choose to operate out of the Irish marketplace due to the low corporate tax rate available there, inevitably the practice of transfer pricing becomes a realistic vehicle for data distortion. Any study

[81] Similar to the Annual Business Inquiry data set in the UK, the CIP data has restricted access and all statistical work carried out for this chapter was done in the offices of the CSO.

involving the Irish economy and MNC's is carried out in the shadow of transfer pricing and one must take care in not overstating the importance of results found.

5.3.5 Descriptive Statistics

The analysis in this section concentrates on the characteristics of the unbalanced panel data set (the corresponding analysis for the balanced panel is presented in Appendix 5.2). According to Baltagi (2008) unbalanced panel data sets exist in cases where all the firms in the set are not observed over the entire sample period. Given the potential entry of new firms into a sector or the exit of incumbent firms, it is anticipated that panel data sets of firms will be unbalanced. Table 5.1 below gives the breakdown of firms between indigenous and foreign for the duration of the panel.

Table 5.1 suggests that there was a steady growth in the creation of Irish firms in the manufacturing sector over the sample period, while the number of foreign corporations operating in the Irish economy fell in 1999 and 2000. This may suggest that the often analysed 'critical mass' effect (see Sacco and Scarpa (2000) for example) had already taken place in this sector of the Irish economy and that those international firms wishing to avail of the Irish Government's generous tax regime and subsidy schemes had already done so by 1991.

Any growth in the number of foreign firms locating in the manufacturing sector in the Irish economy during the duration of the panel could be viewed as being those firms catching the tail end of the low corporation tax policy in operation in the Irish economy. On the other hand, the steady creation of Irish firms throughout the same period supports the existence of the 'Celtic Tiger' in this sector and arguably reflects the willingness of Irish investors to back a growing economy. If one were to analyse the service sector in the Irish economy for the same time frame, the picture may not be as clear cut, but such analysis is not possible as this census (CIP) only covers the manufacturing sector. Expansion in the financial services sector in particular, as a result of foreign investment has been one of the drivers of recent Irish economic growth. On average, there was an annual increase of 5.15% in the number of Irish

firms operating in the manufacturing sector between 1991 and 2000, while the corresponding figure for foreign firms is just 0.36%.

Table 5.1: Number of Observations by Nationality.

Year	Irish Firms	Foreign Firms	Total Firms
1991	2145 (80%)	533 (20%)	2678
1992	2332 (81%)	556 (19%)	2888
1993	2508 (82%)	554 (18%)	3062
1994	2673 (82%)	592 (18%)	3265
1995	2737 (82%)	603 (18%)	3340
1996	2805 (82%)	609 (18%)	3414
1997	2950 (83%)	618 (17%)	3568
1998	3019 (83%)	608 (17%)	3627
1999	3048 (84%)	579 (16%)	3627
2000	3357 (86%)	547 (14%)	3904

Data Source: Census of Industrial Production 1991-2000.

Some key performance ratios are reported in Table 5.2 below for all firms, foreign firms and the Irish firms that comprise the entire unbalanced data set. These figures are calculated as averages over the entire sample period and an annual analysis of these statistics is discussed later in this section. On average, foreign manufacturing firms add twelve and half times as much gross value added to the economy than Irish firms, have invested eight times heavier in capital stock than Irish firms and have employment levels almost four times above that of their Irish counterparts. The picture in terms of the division of labour is quite similar with only the sparse levels of outside piece workers employed comparable in terms of magnitude. There are an extra fivefold managerial and technical workers employed by foreign firms in the manufacturing sector in Ireland relative to the indigenous firms in this sector, while clerical and industrial employment levels are four times higher within the foreign firms in this sector. This input/output differential between the two 'classifications' of firms may potentially point to possible greater economies of scale being achieved by more

efficient multi-located foreign firms or, alternatively, it may indicate potential anomalies buried in the statistics. As stated in the introduction, the majority of the foreign firms will be leaders in their respective sectors, while many of the Irish firms will be on the margin of entry and exit. In addition, the concern over foreign firms' data reporting practices in the face of transfer pricing should be acknowledged.

Table 5.2: Key Performance Statistics (Averages) for All, Foreign and Irish Firms[82].

Statistic	Irish Firms	Foreign Firms	Total Firms
Gross Value Added (€'000)	1806688	22700000	5444607
Capital Stock (€'000)	1235363	10100000	2772550
Total Employment	43.43	173.46	66.02
Gross Value Added per Worker (€'000)	29584.68	110827.2	43701.64
Capital Stock per Worker (€'000)	16078.9	42521.11	62975.5
Number of Family Members Employed	0.39	0.02	0.32
Number of Managerial/Technical Employees	5.61	29.18	9.71
Number of Clerical Employees	5.58	22.81	8.57
Number of Industrial Employees	30.61	119.90	46.13
Number of Apprentices Employed	0.85	1.16	0.90
Number of Outside Piece Workers Employed	0.38	0.39	0.38

Data Source: Census of Industrial Production 1991-2000.

From the average figures presented in Table 5.2 above, it is not possible to discern trends, so the next discussion will focus on how the above statistics performed over the duration of the panel. Tables A5.3.1 and A5.3.2 in Appendix 5.3 present these relationships over time. Both tables present the annual respective average values for both Irish and foreign firms and record the chronological path of these averages for the duration of the panel. The information presented in Table A5.3.1 reinforces the concept that foreign firms produce more value added than their Irish counterparts. In fact, this differential has grown at quite a rapid rate throughout the study period, with

[82] All monetary values presented in the tables throughout this chapter are measured in thousands of 1995 euros.

the annual average increase in gross value added for Irish firms in the sample being 0.31%, while the corresponding figure for the foreign firms in the panel is 11.9%. The widening of the gap between Irish and foreign contributions to value added coincides with an increased differential between GNP and GDP for Ireland. This gap can perhaps be explained by different accounting practices; Irish firms may be interested in reporting as low a profitability figure as possible for taxation purposes, while conversely foreign firms located in the Irish economy may be eager to have as much profit as possible taxable in the Irish system.

The average levels of capital stock and employment are in accordance with expectations given the output differential, with the capital stock of foreign firms growing at 35% per annum, while the 'Irish' capital stock grew at 21% per annum through the sample period. Similarly, with employment levels Irish manufacturing firms are behind their foreign counterparts. Foreign firms tended to increase their employment levels by 4.6% each year throughout the census period, while Irish firms in the sector actually experienced diminished employment levels (-1.6%) on average each year. This would suggest that foreign firms are rewarded for continuous increases in inputs with significant increases in outputs and that perhaps some form of increasing returns to scale is being achieved. The capital stock per worker figures show that, throughout the duration of the panel, foreign firms have consistently added more capital per worker than Irish firms, and that this margin has increased.

The gross value added per worker figures highlight the capacity of foreign firms to achieve greater value added per worker. This could be as a result of having more technology/capital, more efficient management structures or even the benefits of hiring at the efficiency wage rate[83]. It is important to reiterate that gross value added may be inflated by transfer pricing. With respect to the occupational categories, the most significant pattern arises from the managerial and technical employees (Table A5.3.2), where foreign firms have increased their use of managerial and technical workers. Foreign firms increased their labour force in this category on average by 8.41% each

[83] See Campbell III (1993) for a discussion on efficiency wages.

year, while the Irish firms' growth in this employment category was a static 0.02% per annum.

The statistics presented for clerical employees in Table A5.3.2 are as expected; firms that produce more output have greater administration staffing than those firms that produce less. What is also of interest from this particular occupational category is the consistent increases in staffing that are reported by foreign firms. Between 1991 and 2000, there was a dramatic increase of 106% in the average number of clerical employees hired by foreign firms in the Irish manufacturing sector. The equivalent statistic for indigenous firms in the sector is a 10% decrease. From an Irish perspective, it is surprising to see that such employment was contracting during the 'Celtic Tiger' period when MNC's were doubling their staffing requirements. Based on the information contained in Table A5.3 on industrial employees, there appears to be a divergence in levels of industrial staffing of foreign and Irish firms in the manufacturing sector in Ireland. On average, foreign firms increased their employment base in this area by 3% each year while Irish firms actually reduced their stock of industrial workers by 1.86% per annum. In conclusion, the figures reported on outside piece workers (Table A5.3.2) suggest that both Irish and foreign firms did not have a strong demand for the services of outside piece workers. The growth in the Irish firms' use of these workers was quite static (0.05% per annum) while foreign firms actually reduced 13.6% of their outside piece workers in each of the ten years of the panel, on average.

Finally, the correlation coefficients between the key variables are examined and are presented in Tables A5.3.3 to A5.3.5 in Appendix 5.3. The correlations for all firms in the unbalanced panel are presented in Table A5.3.3. Here the correlation coefficients between gross value added (GVA), capital stock (Capital), total employment (Labour), family members employed (Family), managerial and technical employees (Managerial), industrial workers (Industrial) and outside piece workers (OPW) are presented. Table A5.3.4 looks at the same descriptive statistics but for Irish firms only while Table A5.3.5 examines the correlations for foreign firms only. Irish firms have a

higher correlation between gross value added and capital (0.868) than foreign firms (0.53). The correlation between managerial labour and gross value added is also stronger for Irish firms (0.939 versus 0.497). As anticipated capital and labour have a strong positive correlation suggesting that these are indeed complementary inputs in production and even more so in the Irish firm context. According to the correlations, having family members as employees is negatively related to the performance of firms, with negative correlations reported in both the Irish (-0.037) and foreign (-0.028) cases. It may be the case that there are more efficient employees that could better perform the family members' tasks at lower cost and in a more productive manner. Interestingly, outside piece workers are also inversely related to gross value added with both foreign (-0.020) and Irish (-0.002) firms having negative relationships between output and the number of outside piece workers employed. It also appears that for Irish firms, the correlation between industrial and clerical workers and gross value added is higher than in the case of the foreign firms in the sample. In general, the correlation matrices present coefficients with the correctly anticipated signs but perhaps of slightly lower magnitudes than expected in the case of the foreign firms.

5.4 Results

This section of the chapter presents the analysis of the econometric results of estimating the production functions based on models 1 and 2 (i.e. equations 5.33 and 5.34) in the case of all firms in the sample and models 3 and 4 (i.e. equations 5.35 and 5.36) as outlined in Section 5.3.3. Model 1 is the standard Cobb-Douglas production function and also contains a dummy variable to control for the nationality of the firm (i.e. Irish or non-Irish), model 2 contains the labour splits and nationality dummy variable, model 3 is the equivalent of model 1 but does not include the nationality dummy variable while the same holds true for the difference between model 2 and model 4. The results are split into two sections, firstly the estimates for the unbalanced panel are presented and discussed and are followed by the corresponding estimates for the balanced panel of firms. Within each of the two cases, results are presented separately for Irish, foreign and all firms contained in the census. All four estimation techniques (OLS, within, GMM and system GMM) highlighted in the literature review

and the methodology section are applied. As outlined in Section 5.3..4, the data set used for the econometric study is from the CIP, between 1991 and 2000, which is a census of all manufacturing firms located in the Republic of Ireland and is carried out on an annual basis[84].

5.4.1 Unbalanced Panel Results: All Firms

This section contains results for models 1 (equation 5.33) and 2 (equation 5.34) for all firms in the unbalanced data set. Tables 5.3 and 5.4 present the estimates for models 1 and 2 respectively.

Table 5.3: Empirical Results for Model 1 for All Firms: Unbalanced Panel.

	OLS	**Within**	**GMM**	**System GMM**
Capital Stock (K_{it})	0.182 (56.53)	0.060 (19.18)	0.044 (2.63)	0.121 (10.72)
Labour (L_{it})	0.887 (148.27)	0.718 (63.01)	0.785 (8.38)	0.547 (23.39)
Ownership (D_{it})	0.480 (34.23)	-0.22 (-0.66)	0.146 (0.70)	0.023 (0.38)
CRS	0.00	0.00	0.05	0.00
Hansen-Sargan Test	-	-	0.04	0.00
R^2	0.81	0.79	0.78	0.76

(i) Dependent variable is the natural log of gross value added (Y_{it}).

(ii) Number of observations = 33,373.

(iii) T-statistics in parenthesis.

(iv) CRS is a p-value returned on an F-test of constant returns to scale (see equation 5.37).

(v) Hansen-Sargan Test is the p-value for a test of the validity of the instrumental variables used in estimation. Applicable to GMM and system GMM only.

(vi) Average, maximum and minimum number of years in panel is 5.4, 10 and 1.

(vii) GMM uses all available lags of the specified variables dated t-1 and earlier as instruments for the first difference equations.

(viii) System GMM uses instruments as outlined in (vii) as well as using first differences as instruments for levels.

Data Source: Census of Industrial Production 1991-2000.

[84] The CIP data was only available up to 2000 at the time estimations were carried out.

With respect to model 1, in three of the four estimations, the statistical significance of the nationality of ownership is rejected, with only OLS attributing statistical significance to this variable in the production function model. If, as Grilliches and Mairesse (1995) have hypothesised, there is an asymmetry of information between the researcher and corporation due to the fact that some inputs are known to the firm (management ability, research and development activity or intangible fixed assets for example) but not to the researcher, then part of the error component will record this anomaly. However, the error term is now correlated with the production function so potential bias is now generated by the OLS results. If it is argued that MNC's are better organised and more efficient than indigenous firms, then this bias should be stronger for foreign firms than Irish firms and the estimated coefficient on the ownership dummy may be displaying this bias. In essence, the OLS estimator produces larger coefficients for the production function perhaps because of the autocorrelation generated by such asymmetry of information.

The statistical significance of the dummy variable reported by the OLS estimator can be attributed to the endogeneity problem discussed in Section 5.2.1. It is then evident, that the nationality of ownership has no influence on the productivity of firms, a result in contrast with Griffith (1999) who finds that US firms are more productive than firms from any other origin in the UK car manufacturing sector. However, it should also be noted that Griffith (1999) did not find any similar effect for any other nationality. The nationality dummy variable in this study controls for Irish versus non-Irish firms. Unfortunately, an analysis similar to that of Griffith (1999) in terms of country of origin is not possible due to data limitations.

As theory would suggest, both inputs in production have positive and statistically significant effects upon output. This finding is evident regardless of which estimation process is used, a finding that is in contrast with some of the previous studies in the area. Mairesse and Hall (1993), Griffith (1999) and Blundell et al. (2000) all report "unsatisfactory" results for GMM production function estimates, with the capital coefficient found to be lower than anticipated, while both Blundell and Bond (2000)

and Alonso-Borrego and Sánchez-Mangas (2001) present insignificant capital coefficients when using the GMM estimator. Where the Irish result does support the previous studies outlined above is in the relatively low capital coefficient produced by the GMM estimator. Mairesse and Hall (1996) and Blundell and Bond (2000) outline the argument for the GMM estimator returning such a result. The GMM estimator was applied to production function estimates (see Chamberlin (1982)) in order to control for unobserved heterogeneity and simultaneity that were producing biased OLS estimates. There is evidence from this set of results to support the argument of biased OLS coefficients, as it is the OLS capital and labour coefficients that are the highest of all estimates produced. For every 1 percent increase in capital and labour, gross value added is reported by the OLS estimators to increase by 0.182 percent and 0.887 percent respectively. However, Blundell and Bond (2000) highlight the use of weak instruments in the GMM estimation process as being the cause of the low capital coefficient estimates and in this instance, the Hansen-Sargan statistic (p-value of 0.04) does not support the validity of the instruments used by the GMM estimator. The low capital coefficient produced by the GMM estimator is improved upon by the system GMM estimator. However, it should be noted that the p-value from the Hansen-Sargan test rejects the validity of the instrumental variables used in estimation, a result also reported by Griffith (1999). The null hypothesis of constant returns to scale is rejected in three of the four estimations, with the GMM estimate being the only one failing to reject the hypothesis. Overall, the results for Irish firms in the unbalanced panel are similar to a combination of results from previous studies: larger (relative to GMM estimates) capital coefficient estimates by the system GMM estimator; rejection of the use of the extra instrumental variables utilised by the system GMM estimator; and possible bias in the OLS estimates.

Table 5.4 below presents the results for model 2, which differs from model 1 in the inclusion of categories of labour as independent variables as opposed to total labour in model 1. Again the key result is the lack of a relationship between the nationality of ownership and the gross value added of firms in the Irish manufacturing sector, except

in the case of the OLS estimate, the rational for which was discussed above in the context of model 1.

Table 5.4: Empirical Results for Model 2 for All Firms: Unbalanced Panel.

	OLS	**Within**	**GMM**	**System GMM**
Capital Stock (K_{it})	0.166 (54.41)	0.069 (21.72)	0.060 (3.25)	0.128 (13.20)
Family Members (La_{it})	-0.038 (-2.36)	0.050 (2.97)	0.052 (1.21)	0.047 (2.24)
Managerial/Technical (Lb_{it})	0.355 (56.95)	0.173 (23.77)	0.091 (2.69)	0.152 (14.43)
Clerical (Lc_{it})	0.282 (44.42)	0.169 (24.17)	0.102 (3.31)	0.131 (12.87)
Industrial (Ld_{it})	0.369 (60.89)	0.331 (42.55)	0.345 (8.78)	0.221 (16.48)
Apprentices (Le_{it})	0.073 (9.35)	0.087 (9.83)	0.082 (3.82)	0.060 (5.20)
OPW (Lf_{it})	-0.039 (-3.15)	0.030 (1.59)	0.064 (1.24)	0.054 (2.23)
Ownership (D_{it})	0.427 (31.40)	-0.14 (-0.39)	0.050 (0.025)	0.064 (1.14)
CRS	0.00	0.00	0.06	0.00
Hansen-Sargan Test	-	-	0.09	0.00
R^2	0.82	0.80	0.74	0.76

(i) Dependent variable is the natural log of gross value added (Y_{it}).

(ii) Number of observations = 33,373.

(iii) T-statistics in parenthesis.

(iv) CRS is a p-value returned on an F-test of constant returns to scale (see equation 5.38).

(v) Hansen-Sargan Test is the p-value for a test of the validity of the instrumental variables used in estimation. Applicable to GMM and system GMM only.

(vi) Average, maximum and minimum number of years in panel is 5.4, 10 and 1.

(vii) GMM uses all available lags of the specified variables dated t-1 and earlier as instruments for the first difference equations.

(viii) System GMM uses instruments as outlined in (vii) as well as using first differences as instruments for levels.

Data Source: Census of Industrial Production 1991-2000.

The results follow the pattern of previous estimates analysed in this section of potentially biased OLS estimates, a low capital coefficient produced by both the within and GMM estimators and the system GMM estimator increasing the GMM estimate of the elasticity of capital. The results for the system GMM estimator suggest that industrial labour is the most productive element of the labour input in the manufacturing sector (i.e. a 1% increase in industrial labour leads to a 0.221% increase in gross value added), with family members (a 1% increase in the number of family members increases gross value added by 0.047%) and outside piece workers (a 1% increase in the number of outside piece workers increases gross value added by 0.054%) adding the least to gross value added. The key finding from the results is that in the manufacturing sector, family workers and outside piece workers have a relatively unproductive role to play and the impacts of these two groups of workers are discussed again when foreign firms are examined in isolation below.

Overall, the contribution of the results from these models to the production function debate is that: firstly, nationality of ownership is not found to have a contributing effect upon output in the Irish manufacturing sector; secondly, the results serve to illustrate how bias in the OLS estimates are generated and; thirdly outside piece workers and family members are the least productive factor input of the manufacturing industry in Ireland.

5.4.2 Unbalanced Panel Results: Irish Firms

The econometric results for the unbalanced panel of Irish firms are presented and discussed in this section. Table 5.5 below presents the results for model 3 for the Irish firms in the unbalanced panel. Model 3 (equation 5.35) is the basic static Cobb-Douglas production function and varies from model 1 in that it does not contain a dummy variable to control for Irish firms.

The results from model 3 are consistent with those reported for all firms (for model 1, see Table 5.3). The issues of potentially biased OLS estimates arises given the high capital coefficient (a 1% increase in capital leads to a 0.159% increase in gross value

added) and labour coefficient (a 1% increase in the level of labour leads to a 0.912% increase in gross value added) relative to the elasticities of capital and labour produced by the other 3 estimators. Both the within and GMM estimators return relatively low capital coefficients, which are found to increase when the system GMM estimator is applied. The instruments used in the system GMM estimation are considered invalid, while the instruments applied in the GMM estimator are reported as being valid, while only the GMM estimates fail to reject constant returns to scale at the one percent level of statistical significance.

Table 5.5: Empirical Results for Model 3 for Irish Firms: Unbalanced Panel.

	OLS	**Within**	**GMM**	**System GMM**
Capital Stock (K_{it})	0.159 (47.82)	0.063 (18.52)	0.053 (3.03)	0.119 (10.51)
Labour (L_{it})	0.912 (144.54)	0.673 (50.81)	0.741 (6.99)	0.528 (20.09)
CRS	0.00	0.00	0.04	0.00
Hansen-Sargan Test	-	-	0.49	0.00
R^2	0.77	0.76	0.70	0.72

(i) Dependent variable is the natural log of gross value added (Y_{it}).

(ii) Number of observations = 27,574.

(iii) T-statistics in parenthesis.

(iv) CRS is a p-value returned on an F-test of constant returns to scale (see equation 5.37).

(v) Hansen-Sargan Test is the p-value for a test of the validity of the instrumental variables used in estimation. Applicable to GMM and system GMM only.

(vi) Average, maximum and minimum number of years in panel is 5.1, 10 and 1.

(vii) GMM uses all available lags of the specified variables dated t-1 and earlier as instruments for the first difference equations.

(viii) System GMM uses instruments as outlined in (vii) as well as using first differences as instruments for levels.

Data Source: Census of Industrial Production 1991-2000.

Table 5.6 below presents results of OLS, within, GMM and system GMM estimates for model 4, for the Irish firms in the unbalanced panel.

Table 5.6: Empirical Results for Model 4 for Irish Firms: Unbalanced Panel.

	OLS	**Within**	**GMM**	**System GMM**
Capital Stock (K_{it})	0.147 (46.90)	0.068 (19.81)	0.084 (4.20)	0.129 (12.87)
Family Members (La_{it})	-0.311 (-1.91)	0.047 (2.76)	0.045 (1.00)	0.049 (2.30)
Managerial/Technical (Lb_{it})	0.336 (50.86)	0.170 (20.39)	0.083 (2.37)	0.162 (14.14)
Clerical (Lc_{it})	0.282 (52.22)	0.166 (20.11)	0.064 (1.81)	0.143 (13.14)
Industrial (Ld_{it})	0.419 (71.21)	0.316 (35.49)	0.287 (6.75)	0.228 (16.43)
Apprentices (Le_{it})	0.068 (9.17)	0.086 (8.83)	0.084 (3.74)	0.056 (4.88)
Outside Piece Workers (Lf_{it})	-0.024 (-1.73)	0.059 (2.68)	0.104 (1.52)	0.082 (3.08)
CRS	0.00	0.01	0.06	0.00
Hansen-Sargan Test	-	-	0.19	0.00
R^2	0.78	0.77	0.70	0.71

(i) Dependent variable is the natural log of gross value added (Y_{it}).

(ii) Number of observations = 27,574.

(iii) T-statistics in parenthesis.

(iv) CRS is a p-value returned on an F-test of constant returns to scale (see equation 5.38).

(v) Hansen-Sargan Test is the p-value for a test of the validity of the instrumental variables used in estimation. Applicable to GMM and system GMM only.

(vi) Average, maximum and minimum number of years in panel is 5.1, 10 and 1.

(vii) GMM uses all available lags of the specified variables dated t-1 and earlier as instruments for the first difference equations.

(viii) System GMM uses instruments as outlined in (vii) as well as using first differences as instruments for levels.

Data Source: Census of Industrial Production 1991-2000.

Model 4 (equation 5.36) varies from model 2 in that no dummy variable controlling for Irish firms in the sample is included in the specification. In model 4, there is a division of labour applied to the specification. It is the author's belief that in the context of Irish production function studies, this is the first time that such an empirical approach has been adopted. Labour is split between family workers (La_{it}), managerial/technical

employees (Lb_{it}), clerical workers (Lc_{it}) industrial workers (Ld_{it}), apprentices (Le_{it}) and outside piece worker (Lf_{it}).

As was the case with the earlier results examined in this section, the OLS estimator produces the highest capital coefficient of all four techniques. OLS is also the only estimator that reports both family members and outside piece workers as having negative impacts upon gross value added, although both estimated coefficients are significant at the 10% level only. The OLS results of arguably inflated capital coefficients and the negative relationships between two elements of the labour employed and output, may be further evidence of OLS producing biased results and supplements earlier evidence of biased OLS production function estimates as reviewed by Grilliches and Mairesse (1995). Finally, in relation to the OLS estimates of model 4, industrial labour has the largest impact of the six labour inputs upon gross valued added (a 1% increase in the level of industrial labour leads to a 0.419% increase in gross value added), a result replicated across the three other techniques, but with smaller estimated coefficients relative to that produced by OLS. Given that this is a study of the Irish manufacturing sector, this result is not unexpected.

Once again the within estimator reports a very low coefficient on capital stock, a result not unanticipated given the historical problems associated with this estimation technique in terms of production function analysis. Ringstad (1971) and Mairesse (1975) both provide evidence of low or statistically insignificant capital coefficients from within estimations of production functions. Grilliches and Mairesse (1995) argue that the history of within estimations consistently producing low capital coefficients, supports their view that switching to the within estimations from the OLS estimations fails to address the simultaneity problem inherent in production function estimations. In contrast with the OLS estimates, all labour inputs generated by the within estimator are reported as having both positive and statistically significant effects upon output, with, as anticipated, output responding most effectively to increases in industrial workers, while family workers, outside piece workers and apprentices have the lowest reported elasticities.

As was the case with model 3, the selection of instruments used in the GMM estimation is not rejected (Hansen-Sargan value of 0.19), but the capital coefficient is again quite low, relative to the system GMM coefficient, a result consistent with previous findings of Blundell et al. (2000). The effects of family members and outside piece workers are found to be insignificant, while the elasticity of clerical workers with respect to gross value added is only statistically significant at the 10% level. The three other labour inputs all have positive and statistically significant impacts upon output, with again industrial workers (0.287) having the largest influence.

Similar to model 1, the system GMM estimator does increase the magnitude of the capital coefficient (0.084 versus 0.129), but this result needs to be viewed in the context of the rejection of the validity of the instruments used in estimation, another result consistent with the outcome from model 1 and the earlier work of Griffith (1999). The system GMM estimator also provides arguably more plausible results for the labour inputs in the production function, as all six labour categories have both positive and statistically significant impacts on the dependent variable. As was the case with the within estimates, family workers provide the smallest impact upon output (a 1% increase in the level of family workers creates a 0.049% increase in gross value added) and industrial workers are attributed with the strongest impact (a 1% increase in the level of industrial workers leads to 0.228% increase in gross value added). With respect to constant returns to scale, the GMM estimates support this concept, with all other estimations rejecting the hypothesis.

5.4.3 Unbalanced Panel Results: Foreign Firms

Table 5.7 below presents estimates of model 1 for foreign firms only in the unbalanced panel. The most striking result is the statistically insignificant effect of capital stock on gross value added. Previous empirical studies have suggested that low and statistically insignificant capital coefficients are possible with a GMM estimator due to the impact of weak instrumental variables in the estimation, with Blundell and Bond (2000) and Alonso-Borrego and Sánchez-Mangas (2001) providing examples of this in the existing literature. However, as was the case with previous production function studies

(Blundell et al. (2000) for example), the system GMM estimator does dramatically increase the elasticity of capital, but the validity of the instrumental variables used by this estimator in its estimation procedure is rejected, which, as in the Irish case outlined below, is similar to the findings of Griffith (1999).

Table 5.7: Empirical Results for Model 3 for Foreign Firms: Unbalanced Panel.

	OLS	**Within**	**GMM**	**System GMM**
Capital Stock (K_{it})	0.290 (30.37)	0.044 (5.38)	-0.008 (-0.17)	0.159 (3.90)
Labour (L_{it})	0.776 (48.49)	0.854 (36.92)	0.774 (6.61)	0.704 (13.35)
CRS	0.00	0.00	0.043	0.045
Hansen-Sargan Test	-	-	0.10	0.01
R^2	0.71	0.67	0.61	0.65

(i) Dependent variable is the natural log of gross value added (Y_{it}).

(ii) Number of observations = 5,799.

(iii) T-statistics in parenthesis.

(iv) CRS is a p-value returned on an F-test of constant returns to scale (see equation 5.37).

(v) Hansen-Sargan Test is the p-value for a test of the validity of the instrumental variables used in estimation. Applicable to GMM and system GMM only.

(vi) Average, maximum and minimum number of years in panel is 6.4, 10 and 1.

(vii) GMM uses all available lags of the specified variables dated t-1 and earlier as instruments for the first difference equations.

(viii) System GMM uses instruments as outlined in (vii) as well as using first differences as instruments for levels.

Data Source: Census of Industrial Production 1991-2000.

The two consistent results of potentially biased OLS estimates and the low capital estimated coefficient produced by the within estimator are evident for the foreign firms in the unbalanced sample. The insignificant capital coefficient produced by the GMM estimator is possibly caused by the problem of the use of weak instruments in the estimation. Blundell and Bond (1998) suggest that GMM estimates may be biased when lagged levels of the variables are weakly correlated with subsequent first differences. It should also be noted that the differencing operation used in the GMM

estimation may also be a source of the insignificant capital coefficient. Such a situation could possibly occur if the capital variable does not display much variation over time. Constant returns to scale are rejected marginally in the cases of the GMM and system GMM estimators, while they are clearly rejected by the other two estimation procedures. When the system GMM estimates are compared with the equivalent for Irish firms (Table 5.5), the labour coefficient for foreign firms is found to be statistically significantly higher (t-value = 3.34, 95% significance level) than the equivalent for the Irish firms, but not so in the case of the capital elasticity. This result may suggest that foreign firms in the Irish manufacturing sector employ a more productive workforce, relative to indigenous firms in the sector. Griffith (1999) reports higher productivity levels among US firms in the UK car industry, but no similar effect for all other nationalities.

Table 5.8 below presents the results for model 4 for foreign firms only for the unbalanced panel. For all four of the estimations of model 4, family members are found to have no statistical significance in the production function of foreign firms, while both the system GMM and the within estimator found family members to be statistically significant contributors to the gross value added of Irish firms (Table 5.6) in the sample. This is a logical conclusion to draw, as large economically efficient, multi-located firms will not be dependent upon family labour, whereas smaller Irish firms may still have entrepreneurial and family input in the production process. This is an aspect of the management of foreign manufacturing firms that Irish firms can learn from and it is also a potential source of future growth development for Irish firms in the sector, as it may be more productive to hire labour that is appropriately trained as opposed to hiring family members. It was found that family members contributed least to output to Irish firms in the sample and this result may provide evidence of a mismatch between the skills and occupations of the family members. Bentolila et al. (2010) claim that economies and industries that rely upon contacts (such as family members) to fill labour market positions can exhibit low labour force quality and low returns to firms' investments and that social networks can generate underemployment traps whereby employment rates are high, but individuals are in occupations not suited

to their skills set, so productivity is lower than the optimal level. Only the OLS estimator suggests that outside piece workers have a statistically significant (negative) effect upon output. Given the reduction in the number of outside piece workers in the foreign firms' labour base highlighted earlier (Section 5.3.5), it would be anticipated that this variable would have a low or statistically insignificant impact in the model.

Table 5.8: Empirical Results for Model 4 for Foreign Firms: Unbalanced Panel.

	OLS	**Within**	**GMM**	**System GMM**
Capital Stock (K_{it})	0.242 (27.03)	0.073 (8.74)	0.024 (0.53)	0.205 (6.79)
Family Members (La_{it})	0.031 (0.19)	-0.076 (-0.36)	-0.535 (-1.75)	-0.294 (-1.54)
Managerial/Technical (Lb_{it})	0.373 (26.89)	0.165 (10.69)	0.061 (0.93)	0.136 (5.91)
Clerical (Lc_{it})	0.288 (19.39)	0.171 (12.40)	0.110 (2.01)	0.124 (5.77)
Industrial (Ld_{it})	0.213 (13.44)	0.382 (22.63)	0.320 (5.31)	0.268 (7.35)
Apprentices (Le_{it})	0.094 (4.02)	0.099 (4.63)	0.099 (2.14)	0.098 (3.20)
OPW (Lf_{it})	-0.078 (-2.80)	-0.050 (-1.36)	-0.050 (-1.14)	-0.043 (-1.15)
CRS	0.31	0.27	0.00	0.01
Hansen-Sargan Test	-	-	0.72	0.51
R^2	0.74	0.69	0.65	0.68

(i) Dependent variable is the natural log of gross value added (Y_{it}).

(ii) Number of observations = 5,799.

(iii) T-statistics in parenthesis.

(iv) CRS is a p-value returned on an F-test of constant returns to scale (see equation 5.38).

(v) Hansen-Sargan Test is the p-value for a test of the validity of the instrumental variables used in estimation. Applicable to GMM and system GMM only.

(vi) Average, maximum and minimum number of years in panel is 6.4, 10 and 1.

(vii) GMM uses all available lags of the specified variables dated t-1 and earlier as instruments for the first difference equations.

(viii) System GMM uses instruments as outlined in (vii) as well as using first differences as instruments for levels.

Data Source: Census of Industrial Production 1991-2000.

As has been evident throughout the results for both the Irish and foreign firms in the sample, the GMM estimator returns a low and statistically insignificant coefficient for capital stock, which is in line with Blundell and Bond (2000) and Alonso-Borrego and Sánchez-Mangas (2001), while also finding the effect of managerial labour statistically insignificant, while the within estimate of capital stock is relatively low, which corresponds with Ringstad (1971). The system GMM estimator produces an arguably more plausible (in that the effect of capital is found to be statistically significant) set of results for the foreign firms, with the increased (relative to the GMM estimates) capital and management estimated coefficients now supported by a model utilising valid instruments in its estimation. The system GMM results suggest that neither family members nor outside piece workers have an impact on the gross value added of foreign firms in the Irish manufacturing sector and that industrial workers (a 1% increase in the number of industrial workers leads to 0.268% increase in gross value added), management (a 1% increase in the number of management workers leads to a 0.136% increase in gross value added), clerical workers (a 1% increase in the number of clerical workers leads to a 0.124% increase in gross value added) and apprentices (a 1% increase in the number of apprentices leads to a 0.098% increase in gross value added) all contribute to output.

5.4.4 Balanced Panel Results: All Firms

The most notable result for the sample of all firms for model 1 in the balanced panel (Table 5.9) is the low capital coefficient estimated by the system GMM estimator. However, it should be noted that the instruments used in the system GMM estimations are deemed invalid (with the instruments used by the GMM estimator considered as being valid), while constant returns to scale are rejected in all four cases.

It would also appear to be the case that the OLS elasticities have an upward bias, a result that is not unexpected and that has been consistently found throughout the estimates. The results for model 1 are relatively consistent with the equivalent results for the unbalanced panel, with the foreign ownership dummy only being statistically significant in the OLS estimates with the same reasoning for this finding applicable as

was outlined in the case of model 1 for the unbalanced panel of data (see Section 5.4.1).

Table 5.9: Empirical Results for Model 1 for All Firms: Balanced Panel.

	OLS	**Within**	**GMM**	**System GMM**
Capital Stock (K_{it})	0.205 (37.03)	0.071 (17.14)	0.082 (4.89)	0.076 (6.48)
Labour (L_{it})	0.879 (90.99)	0.703 (44.80)	0.606 (7.98)	0.491 (13.35)
Ownership (D_{it})	0.503 (27.35)	0.033 (0.76)	0.012 (0.11)	0.039 (0.74)
CRS	0.00	0.00	0.00	0.00
Hansen-Sargan Test	-	-	0.13	0.01
R^2	0.84	0.82	0.77	0.79

(i) Dependent variable is the natural log of gross value added (Y_{it}).

(ii) Number of observations = 11,560.

(iii) T-statistics in parenthesis.

(iv) CRS is a p-value returned on an F-test of constant returns to scale (see equation 5.37).

(v) Hansen-Sargan Test is the p-value for a test of the validity of the instrumental variables used in estimation. Applicable to GMM and system GMM only.

(vi) GMM uses all available lags of the specified variables dated t-1 and earlier as instruments for the first difference equations.

(vii) System GMM uses instruments as outlined in (vii) as well as using first differences as instruments for levels.

Data Source: Census of Industrial Production 1991-2000.

Table 5.10 below presents the results for model 2, the model which contains both the split in labour and the nationality of ownership dummy variable. When compared with the equivalent results for the unbalanced panel (Table 5.4), there is evidence (GMM and system GMM estimates) to suggest that the output of firms who are in operation throughout the ten years of the panel is not influenced by either family labour or outside piece workers. In contrast, the unbalanced panel, which also contains firms on the margin of entry and exit from the sector, provided evidence that both family members and outside piece workers influenced gross value added.

Table 5.10: Empirical Results for Model 2 for All Firms: Balanced Panel.

	OLS	**Within**	**GMM**	**System GMM**
Capital Stock (K_{it})	0.182 (36.40)	0.086 (20.45)	0.096 (5.54)	0.092 (8.03)
Family Members (La_{it})	0.026 (1.16)	0.081 (3.37)	-0.058 (-1.28)	0.035 (1.04)
Managerial/Technical (Lb_{it})	0.328 (43.08)	0.148 (16.48)	0.047 (1.74)	0.106 (8.09)
Clerical (Lc_{it})	0.279 (35.17)	0.142 (16.31)	0.072 (2.68)	0.101 (8.08)
Industrial (Ld_{it})	0.365 (39.36)	0.319 (29.35)	0.251 (6.61)	0.191 (9.55)
Apprentices (Le_{it})	0.060 (6.06)	0.074 (7.38)	0.070 (3.30)	0.044 (2.91)
OPW (Lf_{it})	-0.057 (-3.78)	0.014 (0.67)	0.0165 (0.41)	0.038 (1.15)
Ownership (D_{it})	0.469 (27.49)	0.038 (0.86)	0.017 (0.16)	0.677 (1.14)
CRS	0.00	0.00	0.00	0.00
Hansen-Sargan Test	-	-	0.08	0.02
R^2	0.86	0.84	0.77	0.79

(i) Dependent variable is the natural log of gross value added (Y_{it}).

(ii) Number of observations = 11,560.

(iii) T-statistics in parenthesis.

(iv) CRS is a p-value returned on an F-test of constant returns to scale (see equation 5.38).

(v) Hansen-Sargan Test is the p-value for a test of the validity of the instrumental variables used in estimation. Applicable to GMM and system GMM only.

(vi) GMM uses all available lags of the specified variables dated t-1 and earlier as instruments for the first difference equations.

(vii) System GMM uses instruments as outlined in (vii) as well as using first differences as instruments for levels.

Data Source: Census of Industrial Production 1991-2000.

It should also be noted that again, the elasticity of capital with respect to gross value added produced by the system GMM estimator is lower than would be anticipated and that the instrumental variables utilised by the system GMM estimator are considered to be invalid. Constant returns to scale are rejected in all four cases. Again in the OLS

estimates, the effect of the nationality of ownership is statistically significant, which is viewed as being a symptom of inherent bias in the OLS coefficients.

5.4.5 Balanced Panel Results: Irish Firms

Table 5.11 below reports the Cobb-Douglas production function estimates for model 3 for the set of Irish firms in the balanced panel. As was the case for model 3 for the Irish firms in the unbalanced panel of data, all estimated coefficients are positive and statistically significant, which again is in contrast with Blundell and Bond (2000) and Alonso-Borrego and Sánchez-Mangas (2001), who both found evidence of the GMM estimator performing poorly via statistically insignificant capital coefficients in their respective production function studies.

Table 5.11: Empirical Results for Model 3 for Irish Firms: Balanced Panel.

	OLS	**Within**	**GMM**	**System GMM**
Capital Stock (K_{it})	0.161 (29.76)	0.071 (14.63)	0.075 (3.74)	0.081 (6.05)
Labour (L_{it})	0.924 (88.37)	0.690 (36.30)	0.690 (6.99)	0.482 (11.15)
CRS	0.00	0.00	0.01	0.00
Hansen-Sargan Test	-	-	0.18	0.02
R^2	0.82	0.81	0.78	0.80

(i) Dependent variable is the natural log of gross value added (Y_{it}).

(ii) Number of observations = 8,940.

(iii) T-statistics in parenthesis.

(iv) CRS is a p-value returned on an F-test of constant returns to scale (see equation 5.37).

(v) Hansen-Sargan Test is the p-value for a test of the validity of the instrumental variables used in estimation. Applicable to GMM and system GMM only.

(vi) GMM uses all available lags of the specified variables dated t-1 and earlier as instruments for the first difference equations.

(vii) System GMM uses instruments as outlined in (vii) as well as using first differences as instruments for levels.

Data Source: Census of Industrial Production 1991-2000.

The most striking result is the performance of the system GMM estimator, which only marginally increases the magnitude of the capital coefficient (when compared with the GMM coefficient), relative to the results produced for Irish firms in the unbalanced panel (0.053 versus 0.119, see Table 5.5). As was the case with the Irish firms in the unbalanced panel, constant returns to scale are rejected in all four estimations, while the Hansen-Sargan test supports the use of the instruments used in the GMM estimation, but not in the case of the system GMM estimation, a result that is in line with Griffith (1999).

Model 4 extends the production function to allow for the various inputs of labour, the results of which for Irish firms in the balanced panel are reported in Table 5.12 below. The most notable results from Table 5.12 relative to the equivalent estimates for the Irish firms in the unbalanced panel (see Table 5.6), are that according to the system GMM estimates, family workers have no influence on gross value added and that both sets of instruments used in the GMM and system GMM estimations are valid. The statistically insignificant coefficient of family workers can be explained by the type of firms one would expect to be present in this balanced panel, relative to the type of firms that will be present in the unbalanced panel. The duration of the panel is ten years, so any firm included in the study will have been in existence for at least ten years and will arguably have had sufficient time to develop and hire workers.

As was the case for model 1 for Irish firms in the balanced panel, the system GMM estimator does increase the estimated coefficient on capital relative to that produced by the GMM estimator, but the magnitude of this increase is relatively small when compared to the equivalent in the case of the unbalanced panel. As was the case for the unbalanced panel, Irish firms tend to have linkages with outside piece workers. Based on the same argument provided for the statistical insignificance of family workers in the balanced panel of Irish manufacturing firms, it may have been expected that outside piece workers would not have an influence on the production function, in line with what was found for foreign firms in the unbalanced panel. In conclusion, in the same way that more established firms do not depend upon family labour, Irish firms

should arguably follow the lead of foreign firms operating in the Irish manufacturing sector who have diminished their use of this particular labour input over time. Finally, only the within estimation does not fail to reject constant returns to scale.

Table 5.12: Empirical Results for Model 4 for Irish Firms: Balanced Panel.

	OLS	**Within**	**GMM**	**System GMM**
Capital Stock (K_{it})	0.148 (29.98)	0.081 (16.45)	0.095 (4.50)	0.098 (7.52)
Family Members (La_{it})	0.029 (1.26)	0.083 (3.35)	-0.037 (-0.76)	0.039 (1.17)
Managerial/Technical (Lb_{it})	0.285 (33.80)	0.151 (13.83)	0.071 (2.13)	0.121 (7.93)
Clerical (Lc_{it})	0.283 (33.18)	0.158 (14.60)	0.078 (2.16)	0.125 (8.28)
Industrial (Ld_{it})	0.440 (46.47)	0.318 (24.15)	0.268 (5.93)	0.212 (9.48)
Apprentices (Le_{it})	0.060 (6.35)	0.069 (5.92)	0.085 (3.36)	0.037 (2.15)
OPW (Lf_{it})	-0.041 (-2.74)	0.071 (2.68)	0.014 (0.24)	0.079 (2.72)
CRS	0.00	0.10	0.00	0.00
Hansen-Sargan Test	-	-	0.46	0.28
R^2	0.83	0.82	0.79	0.80

(i) Dependent variable is the natural log of gross value added (Y_{it}).

(ii) Number of observations = 8,940.

(iii) T-statistics in parenthesis.

(iv) CRS is a p-value returned on an F-test of constant returns to scale (see equation 5.38).

(v) Hansen-Sargan Test is the p-value for a test of the validity of the instrumental variables used in estimation. Applicable to GMM and system GMM only.

(vi) GMM uses all available lags of the specified variables dated t-1 and earlier as instruments for the first difference equations.

(vii) System GMM uses instruments as outlined in (vii) as well as using first differences as instruments for levels.

Data Source: Census of Industrial Production 1991-2000.

5.5.6 Balanced Panel Results: Foreign Firms

Tables 5.13 and 5.14 below report the results for models 3 and 4 respectively, for the set of foreign firms in the balanced panel. With respect to model 1, the key results are similar to those discussed for the equivalent unbalanced panel estimations (see Table 5.7). The GMM estimate of the capital coefficient is weak in that it is only statistically significant at the 10% level, while the system GMM estimator produces an increased capital coefficient. Again the validity of the instruments used in the system GMM estimation are rejected, while the instruments utilised in the GMM estimation are rejected at the 5% level. Also, the inherent bias in the OLS estimator produces an "inflated" capital coefficient, while constant returns to scale are rejected in all four estimations.

Table 5.13: Empirical Results for Model 3 for Foreign Firms: Balanced Panel.

	OLS	**Within**	**GMM**	**System GMM**
Capital Stock (Kit)	0.353 (21.97)	0.069 (7.65)	0.067 (1.85)	0.085 (3.15)
Labour (Lit)	0.727 (29.15)	0.745 (25.38)	0.500 (4.61)	0.613 (9.58)
CRS	0.00	0.00	0.00	0.00
Hansen-Sargan Test	-	-	0.07	0.04
R^2	0.89	0.69	0.61	0.65

(i) Dependent variable is the natural log of gross value added (Yit).

(ii) Number of observations = 2,620.

(iii) T-statistics in parenthesis.

(iv) CRS is a p-value returned on an F-test of constant returns to scale (see equation 5.37).

(v) Hansen-Sargan Test is the p-value for a test of the validity of the instrumental variables used in estimation. Applicable to GMM and system GMM only.

(vi) GMM uses all available lags of the specified variables dated t-1 and earlier as instruments for the first difference equations.

(vii) System GMM uses instruments as outlined in (vii) as well as using first differences as instruments for levels.

Data Source: Census of Industrial Production 1991-2000.

The results for the production function with the specification containing the division of labour (model 4) for foreign firms in the balanced panel are presented in Table 5.14 below.

Table 5.14: Empirical Results for Model 4 for Foreign Firms: Balanced Panel.

	OLS	**Within**	**GMM**	**System GMM**
Capital Stock (Kit)	0.281 (20.23)	0.099 (10.83)	0.091 (2.63)	0.130 (4.78)
Family Members (Lait)	-0.038 (-0.13)	0.059 (0.31)	-0.125 (-0.80)	-0.042 (-0.32)
Managerial/Technical (Lbit)	0.375 (22.49)	0.151 (8.70)	0.016 (0.36)	0.087 (3.61)
Clerical (Lcit)	0.286 (15.83)	0.122 (7.57)	0.051 (1.54)	0.071 (3.43)
Industrial (Ldit)	0.167 (7.40)	0.308 (15.41)	0.195 (4.70)	0.193 (4.58)
Apprentices (Leit)	0. 117 (4.33)	0.096 (4.61)	0.028 (0.63)	0.085 (2.85)
OPW (Lfit)	-0.080 (-1.46)	-0.113 (-3.08)	-0.032 (-1.05)	-0.096 (-1.66)
CRS	0.68	0.15	0.00	0.00
Hansen-Sargan Test	-	-	0.91	0.00
R^2	0.80	0.74	0.70	0.72

(i) Dependent variable is the natural log of gross value added (Yit).

(ii) Number of observations = 2,620.

(iii) T-statistics in parenthesis.

(iv) CRS is a p-value returned on an F-test of constant returns to scale (see equation 5.38).

(v) Hansen-Sargan Test is the p-value for a test of the validity of the instrumental variables used in estimation. Applicable to GMM and system GMM only.

(vi) GMM uses all available lags of the specified variables dated t-1 and earlier as instruments for the first difference equations.

(vii) System GMM uses instruments as outlined in (vii) as well as using first differences as instruments for levels.

Data Source: Census of Industrial Production 1991-2000.

The Hansen-Sargan test statistics again suggest that the GMM estimator is generated in the presence of valid instrumental variables, whereas the opposite is reported in the case of the system GMM estimator. The potential weakness of the GMM estimator is

highlighted by the statistically insignificant estimated coefficients associated with managerial/technical workers, clerical employees and apprentices, as one would expect all three of these labour inputs to in some way influence the gross value added of the firm. Such a result suggests that foreign firms' output levels depend solely upon capital and industrial workers' input. When the system GMM estimator is analysed, the results appear to be more in line with expectations (in comparison with the GMM estimator), where the evidence suggests that foreign firms' gross value added is independent of family workers and outside piece workers only, while simultaneously generating a stronger capital coefficient. This result would match the falling trend in employment levels of outside piece workers discussed in Section 5.3.5. One explanation for family workers having no influence on the gross value added of foreign firms was highlighted earlier in the discussion of the unbalanced panel results (Section 5.4.3), while the potential for Irish firms to follow the foreign firms in the sector by reducing their dependence upon outside piece workers was also highlighted in the same discussion. Both the OLS and within estimations fail to reject the constant returns to scale hypothesis, while both the GMM and system GMM estimations strongly reject this hypothesis.

5.5 Conclusion

The system GMM estimator was identified in Section 5.2.1 as being the most efficient estimation technique for production functions in the presence of simultaneity biases and this is the current theoretical position on production function estimation after almost a century of econometric debate. The initial Cobb-Douglas (1928) estimations utilised the OLS estimator and when the endogeneity problem was highlighted the response was to use panel data in conjunction with a fixed effects estimator. It is evident from the literature review that biased results and low capital coefficients were the norm of the within estimations of production functions, which resulted in a switch to the GMM estimator. Similarly, the literature review highlighted that weak instrumental variables were cited as the explanation for low capital coefficients from production function studies utilising the GMM estimator. This invalid instrument issue was corrected by an extended model (system GMM) which incorporated the use of

extra instrumental variables and yielded more plausible results in the case of estimates of the influence of the capital stock.

This chapter has analysed production function estimates for a panel (balanced and unbalanced) of firms, foreign and indigenous, located in the Irish manufacturing sector between 1991 and 2000. An initial preliminary look at the data suggested that foreign firms located in the Irish manufacturing sector tended to invest more in capital stock than Irish firms and that this investment differential could potentially account for the output differential in existence. Also foreign firms' declining use of outside piece workers may indicate that either they had learned from past experiences (or current experiences in other markets) that this form of labour was inefficient. It was also evident that there was little entry or exit of foreign firms from the Irish market, suggesting that the critical mass effect had already taken place in the Irish economy. Conversely, there were significant annual increases in the growth of Irish firms in the sector, which would be anticipated in an expanding economy.

In analysing the empirical results, it should be noted that Griffith (1999) suggests that direct comparisons between indigenous firms and MNC's in a sector are difficult to make, as some of the indigenous firms may be on the margins of entry and exit, while the MNC's will often be multi-located conglomerates with turnover comparable with the GDP nations. The empirical results from both the unbalanced and balanced panel data sets found no evidence of nationality of ownership impacting upon output. The OLS estimate of the coefficient of the nationality dummy variable was found to be both positive and statistically significant, but this statistical significance may be due to the endogeneity bias that has affected OLS production function estimates historically - in line with the work reviewed by Grilliches and Mairesse (1995). Perhaps the most noteworthy results from the unbalanced panel of firms was the contrast between Irish and foreign firms' dependence upon family labour and outside piece workers. In examining the system GMM estimates, it was evident that both the Irish and the all firm samples displayed a positive and statistically significant association between the two types of labour mentioned and gross value added, while when foreign firms were

examined in isolation no such evidence was found. When the same variables were examined in the balanced panel, it was found that the output of Irish firms was influenced by outside piece workers and that no relationship was found between family labour and the gross value added. This finding may reflect the fact that in this sample the firms, by definition, have been in existence for at least ten years and, therefore, may have had enough time to adjust to the most efficient processes in the sector.

The system GMM estimators were found in the majority of cases to be characterised by invalid instrumental variables, a result also reported by Griffith (1999) when estimating the static Cobb-Douglas production function. There was consistent evidence of the GMM estimator producing low and, in some cases, statistically insignificant capital coefficients, a result that supports the findings of Blundell et al. (2000) and Alonso-Borrego and Sánchez-Mangas (2001). However, it was often the case that these GMM coefficients were produced in the presence of valid instrumental variables, the opposite to which is often cited as the cause of the poor performance of the GMM estimator in producing production function estimates. In the case of the unbalanced panel and in line with the findings of Blundell and Bond (2000), the system GMM estimate of the capital coefficient tended to increase relative to the equivalent GMM estimate. However, in the case of the balanced panel, the system GMM estimate of the capital coefficient was often found to be as low as, or lower, than the elasticity of capital produced by the GMM estimator, which is the most surprising result from the estimations and may be explained by the consistent rejection of the instruments used by the system GMM model. In line with Ringstad (1971), the within estimates of the capital coefficient were consistently found to be relatively low, while the constant returns to scale hypothesis was rejected in the majority of the GMM and system GMM estimations.

It is worth noting that the availability of additional explanatory variables such as the location of the firm within the country, the type of manufacturing work the firms are engaged in and more detailed information on the ownership of the firms could potentially improve the estimates, but due to the limited information contained within

the CIP such analysis is not possible. Overall, this analysis of production functions has extended the empirical research in the Irish context by firstly, allowing for the division of labour in the model and, in so doing, highlighting how Irish firms arguably tend to over rely upon family labour and outside piece workers relative to MNC's and secondly by demonstrating the statistical insignificance of the nationality of ownership in the Irish manufacturing sector.

Appendix 5.1: Variable Definitions[85]

Additions to and Sales of Capital Assets: Capital assets (land, buildings, plant and equipment) are defined as goods with an expected useful life of more than one year intended for use by the local unit itself. Acquisitions include purchases from other local units and production by the local unit itself of capital goods for its own use. Major alterations, improvements and repairs that extend the useful life of an asset or increase its productivity are included. The value of work put in place during the year is included whether or not completed. Additions are valued at total cost including installation charges and fees or duties by excluding deductible VAT and financial costs. Sales are valued at the price actually received excluding VAT.

Capital Stock is derived by applying the perpetual-inventory method (see Section 5.3.3) to the additions to and sales of capital assets variable.

Production Value is defined as the sum of total turnover, capital assets manufactured by enterprises for their own use, increases in stocks of finished goods and work in progress and increases in stocks of goods for resale without further processing, less purchases of goods for resale without further processing.

Intermediate Consumption is defined as the sum of purchases of materials and fuel, cost of industrial services, and cost of non-industrial services, less increases in stocks of materials and fuel.

Gross Value Added is defined as production value less intermediate consumption.

Proprietors and Family Members are defined as the owner and his/her family members employed in the company.

[85] All definitions except the 'Capital Stock' are supplied by the CSO.

Managerial and Technical Employment are defined as managerial, technical and other salaried staff.

Clerical Employees are defined as clerical and other office staff, including supervisory clerical staff and sales representatives.

Industrial Employees are defined as operatives, packers, cleaners, maintenance, stores, delivery personnel, foremen and production supervisors.

Apprentices are defined as persons serving apprenticeships.

Outside Piece workers are defined as persons who work for an enterprise but not on the premises.

Total Employment is defined as the total number of employees (managerial and technical, clerical, industrial, apprentices and outside piece workers) added to the number of proprietors and unpaid family workers.

Appendix 5.2: Descriptive Statistics for the Balanced Panel of Data

This section presents an analysis of the descriptive statistics for the balanced panel created using the Irish and foreign firms that were in the panel for the entire period (1991-2000). A balanced panel according to Baltagi (2008) exists when all N firms are observed for all T time periods of the sample. In theory, this should make the Irish and foreign firms more comparable as these are the firms who were a going concern for the full ten years of the study and will not include firms exiting or entering the market throughout the panel. There were eight hundred and ninety four Irish firms that were represented for the full ten years in the census while two hundred and sixty two foreign firms are present for all ten years in the panel. The key variables in the study are highlighted in Table A5.2.1 below. These are average values for the entire period for the respective companies in the panel.

Table A5.2.1: Key Performance Statistics (Averages) for All, Foreign and Irish Firms.

Statistic	Irish Firms	Foreign Firms	Total Firms
Gross Value Added (€'000)	3255654	29700000	9236532
Capital Stock (€'000)	2497845	11700000	4547721
Total Employment	68.30	209.03	102.49
Gross Value Added per Worker (€'000)	31486.43	123889.2	52485.1
Capital Stock per Worker (€'000)	19222.50	47901.75	25523.71
Number of Family Members Employed	0.32	0.015	0.25
Number of Managerial/Technical Employees	8.65	33.40	14.49
Number of Clerical Employees	9.78	24.92	13.47
Number of Industrial Employees	47.47	148.94	72.31
Number of Apprentices Employed	1.26	1.24	1.25
Number of Outside Piece Workers Employed	0.82	0.52	0.72

Data Source: Census of Industrial Production 1991-2000.

As anticipated, foreign firms are more productive operating from a broader base in terms of capital stock and labour. On average, foreign firms manage to produce nine

times as much value added in their production processes than Irish firms. In doing so, they utilise over four and half times as much capital stock and three times as much labour as Irish firms do. The key labour categories (managerial/technical, clerical and industrial) differ between Irish and foreign firms in the region of three fold, with the managerial/technical differential being the highest (3.8). These values are far less divergent than the corresponding set for the unbalanced panel, reinforcing the idea that this subset of Irish firms will be more productive than the entire of set of Irish firms represented in the panel. In fact, the Irish firms represented in all ten years of the panel add almost twice as much value added to the economy each year, on average, than the entire set of Irish firms in the unbalanced panel, using twice as much capital stock and one and half times the labour levels. Again, just as in the case of the unbalanced panel set, it is important to examine these variables over the duration of the study to highlight any important trends that cannot be discerned from the average values in Table A5.2.1 above.

Both Tables A5.2.2 and A5.2.3 display annual average figures for the variables analysed over the duration of the panel, for both foreign and Irish firms. The information contained in Table A5.2.2 shows that foreign firms' output levels are growing at faster rates than Irish firms, but that this differential is not as large as that in the unbalanced case. Here, foreign firms managed to produce an extra 10.85% gross value added, on average, each year, while the contribution of Irish firms grew at 4.2% per annum, on average. This is a much better average performance by this subset of Irish firms than the entire set that only yielded annual increases in gross value added of 0.31%. This higher yield may be attributable to the fact that examining firms in the subset of a balanced panel will only include firms that may be viewed as being established, given their representation in every year of the panel.

The information presented in Table A5.2.2 on capital stock suggests that Irish firms increased their capital stock by almost 30% in each of the ten years on average, while foreign firms' investment grew at a slightly higher rate (33%). Similarly, the average values on the levels of employment contained in Table A5.2.2 demonstrates that the

Irish firms' adjustments of their stock of labour are also more in line with their foreign counterparts, relative to the results reported in the unbalanced panel. On average, they managed to add an extra 2% labour each year, while foreign firms add just under 4% per annum on average. This is in contrast with the average annual reduction in labour experienced by the entire census of Irish firms. Despite the increases of Irish firms' investments in labour and capital, their output per worker values still lag consistently behind that of foreign firms. On average, Irish firms increased this ratio by 1.23% per annum, while foreign firms generated an increase of 4.58% per annum.

Of the labour categories, it is apparent that, on average, foreign firms add over twice as much managerial/technical (see Table A5.2.3 below) staff to their stock of labour each year as Irish firms do (7.72% versus 3.17%). This pattern is replicated in the clerical sector also, while the industrial labour force grew at almost 3% per annum for an average foreign firm and only 1.95% for an average Irish firm. Finally, foreign firms discarded 12% of their outside piece workers each year while Irish firms added 4.25% to this category of labour each year, on average.

In conclusion of the analysis of the descriptive statistics relating to the balanced panel data set, the correlation coefficients between key variables are examined. Table A5.2.4 presents the correlations for all firms in the balanced panel set, with the correlation coefficients between gross value added (GVA), capital stock (Capital), total employment (Labour), family members employed (Family), managerial and technical employees (Managerial), industrial workers (Industrial) and outside piece workers (OPW) reported. Table A5.2.5 looks at the same measures but for Irish firms only while Table A5.2.6 examines the correlations for foreign firms only.

As anticipated, positive relationships exist between the main inputs in production (Capital and Labour) and output (GVA). In the case of foreign firms, there is a stronger correlation between capital and gross value added than between labour and gross value added (0.601 and 0.282), while the opposite is experienced by Irish firms (0.884 and 0.967). The extremely high correlation between labour and gross value

added for Irish firms offers an almost one for one input/output increase, yet the corresponding statistic for foreign firms is appreciably closer to zero than unity. This may intimate that foreign firms are very close to, if not at, optimality in terms of the labour input choice, while Irish firms are still some measure away from this particular solution. The pattern is similar, but not as dramatic, for capital. For both categories of firms, all the main labour divisions (managerial/technical, clerical and industrial) have positive correlations with output. As in the unbalanced data set, family members and outside piece workers have weak inverse correlations with gross value added for potential reasons argued earlier in this section. Overall the correlations are very similar to those reported in the unbalanced panel.

Table A5.2.2: Comparison of Gross Value Added, Capital stock, Average Level of Employees, Capital Stock Per Worker and GVA Per Worker.

Year	Irish GVA	Foreign GVA	Irish CS	Foreign CS	Irish Employment	Foreign Employment	Irish CS Per Worker	Foreign CS Per Worker	Irish GVA Per Worker	Foreign GVA Per Worker
1991	2702833	18000000	518903	2045459	62.20	172.42	5071.40	12124.72	30660.41	99606.47
1992	2813527	20900000	947293	4553605	63.91	178.47	8717.74	22664.38	29939.81	106406.10
1993	2984694	23200000	1363923	6431919	64.60	184.63	11402.79	31814.11	30163.37	115560.10
1994	2964675	25400000	1750185	8043371	66.07	194.57	14422.61	38083.07	30852.81	121342.80
1995	3142601	27600000	2123343	10100000	68.07	209.36	17270.42	43868.81	31088.09	123143.20
1996	3470676	28600000	2568536	12200000	69.28	211.73	20135.22	54368.39	33120.37	121307.50
1997	3385101	31700000	3032592	14300000	70.53	225.27	23258.16	58325.08	31598.87	124846.80
1998	3470222	36100000	3605927	17000000	70.90	236.12	26821.80	65772.42	31412.44	134815.50
1999	3729241	40700000	4213923	19900000	73.04	236.37	30636.36	73055.03	31976.84	143344.50
2000	3892975	45300000	4853823	22400000	74.38	241.38	34488.49	77941.51	34051.30	148518.70

Data Source: Census of Industrial Production 1991-2000.

(i) Gross Value Added and Capital Stock are measured in thousands of 1995 euro. All figures are averages.

(ii) GVA is Gross Value Added.

(iii) CS is Capital Stock.

Table A5.2.3: Comparison of Average Employment Levels.

Year	Irish Family	Foreign Family	Irish Manag.	Foreign Manag.	Irish Clerical	Foreign Clerical	Irish Indus.	Foreign Indus.	Irish App.	Foreign App.	Irish OPW	Foreign OPW
1991	0.31	0.02	7.55	24.60	8.88	20.37	43.23	125.48	1.57	1.15	0.66	0.80
1992	0.32	0.02	7.79	25.76	9.11	21.20	44.66	129.82	1.45	1.11	0.59	0.56
1993	0.31	0.02	7.93	26.79	9.69	21.42	44.58	134.68	1.26	1.17	0.83	0.56
1994	0.33	0.02	8.21	28.92	9.72	21.67	45.57	142.18	1.40	1.18	0.84	0.60
1995	0.35	0.01	8.34	30.05	9.83	22.94	47.32	154.98	1.28	0.88	0.95	0.47
1996	0.32	0.01	8.88	32.50	9.77	25.69	48.11	150.66	1.31	2.40	0.90	0.47
1997	0.32	0.01	8.93	36.87	9.45	25.92	49.75	161.21	1.20	0.79	0.89	0.46
1998	0.32	0.01	9.28	40.65	10.22	27.58	49.34	166.42	0.99	0.85	0.75	0.60
1999	0.34	0.04	9.65	40.32	10.45	31.29	50.72	162.32	1.00	1.83	0.87	0.57
2000	0.31	0.01	9.97	47.51	10.70	31.13	51.37	161.65	1.15	1.00	0.87	0.07

Data Source: Census of Industrial Production 1991-2000.

(i) All values are number of employees.

(ii) Family is proprietors and family members (see Appendix 5.1).

(iii) Manag. is managerial and technical employees (see Appendix 5.1).

(iv) Clerical is clerical employees (see Appendix 5.1).

(v) Indus. is industrial employees (see Appendix 5.1).

(vi) App. is apprentices (see Appendix 5.1).

(vii) OPW is outside piece workers (see Appendix 5.1).

Table A5.2.4: Correlation Coefficient Matrix for All firms.

	GVA	Capital	Labour	Family	Managerial	Clerical	Industrial	OPW
GVA	1							
Capital	0.618	1						
Labour	0.556	0.7533	1					
Family	-0.057	-0.0419	-0.071	1				
Managerial	0.605	0.762	0.883	-0.072	1			
Clerical	0.528	0.754	0.921	-0.045	0.8095	1		
Industrial	0.510	0.689	0.980	-0.078	0.8102	0.849	1	
OPW	-0.009	-0.0069	0.031	0.0003	-0.0095	-0.0062	-0.0041	1

Data Source: Census of Industrial Production 1991-2000.

Table A5.2.5: Correlation Coefficient Matrix for Irish Firms.

	GVA	Capital	Labour	Family	Managerial	Clerical	Industrial	OPW
GVA	1							
Capital	0.884	1						
Labour	0.967	0.801	1					
Family	-0.034	-0.022	-0.042	1				
Managerial	0.962	0.829	0.973	-0.047	1			
Clerical	0.959	0.799	0.970	-0.033	0.949	1		
Industrial	0.946	0.772	0.991	-0.047	0.951	0.937	1	
OPW	-0.004	-0.0032	0.039	-0.016	-0.0036	-0.0034	-0.0002	1

Data Source: Census of Industrial Production 1991-2000.

Table A5.2.6: Correlation Coefficient Matrix for Foreign Firms.

	GVA	Capital	Labour	Family	Managerial	Clerical	Industrial	OPW
GVA	1							
Capital	0.601	1						
Labour	0.282	0.510	1					
Family	-0.028	-0.036	-0.030	1				
Managerial	0.397	0.603	0.651	-0.041	1			
Clerical	0.277	0.415	0.721	-0.0398	0.418	1		
Industrial	0.192	0.400	0.966	-0.0341	0.464	0.616	1	
OPW	-0.025	-0.033	-0.003	0.5452	-0.037	-0.0345	-0.0143	1

Data Source: Census of Industrial Production 1991-2000.

Appendix 5.3: Tables

Table A5.3.1: Comparisons of Gross Value Added, Capital stock, Average Level of Employees, Capital Stock Per Worker and GVA Per Worker.

Year	Irish GVA	Foreign GVA	Irish CS	Foreign CS	Irish Employment	Foreign Employment	Irish CS Per Worker	Foreign CS Per Worker	Irish GVA Per Worker	Foreign GVA Per Worker
1991	1824058	14500000	357811	1566416	46.57	148.75	7202.95	12195.21	29431.04	90878.13
1992	1845086	15300000	602554	3023918	46.15	148.43	8472.91	18217.18	28367.90	91936.72
1993	1804785	16600000	727784	4375714	44.55	152.03	10371.29	27894.86	28646.88	103019.90
1994	1764673	17100000	1034920	6763981	42.91	152.63	13158.87	36935.56	29574.62	103544.70
1995	1784348	19700000	1093730	8046901	44.14	163.64	13472.53	42237.33	27716.23	103108.20
1996	1851027	20600000	1280668	10000000	43.87	168.71	17111.28	46862.40	29104.20	105825.30
1997	1742233	23900000	1361645	11900000	43.13	181.71	17372.97	52893.37	28618.79	117348.40
1998	1743506	26000000	1573951	14900000	43.03	187.58	20289.56	55937.84	28402.43	112339.20
1999	1841902	33400000	1784659	18200000	41.81	207.44	22708.80	61753.43	31557.60	140327.80
2000	1866444	39100000	1837907	21200000	40.19	222.29	23942.00	66123.69	33282.29	139059.30

Data Source: Census of Industrial Production 1991-2000.

(i) Gross Value Added and Capital Stock are measured in thousands of 1995 euro. All figures are averages.

(ii) GVA is Gross Value Added.

(iii) CS is Capital Stock.

Table A5.3.2: Comparison of Average Employment Levels.

Year	Irish Family	Foreign Family	Irish Manag.	Foreign Manag.	Irish Clerical	Foreign Clerical	Irish Indus.	Foreign Indus.	Irish App.	Foreign App.	Irish OPW	Foreign OPW
1991	0.349	0.02	5.65	21.73	5.92	17.75	33.04	107.49	1.17	0.99	0.44	0.75
1992	0.355	0.03	5.74	21.66	5.84	17.36	32.85	107.91	1.06	1.01	0.31	0.46
1993	0.337	0.03	5.55	22.60	5.84	17.06	31.52	110.61	0.94	1.32	0.36	0.40
1994	0.411	0.02	5.54	22.00	5.55	17.83	30.14	111.09	0.89	1.21	0.38	0.47
1995	0.438	0.01	5.54	25.22	5.60	18.64	31.19	118.63	0.96	0.70	0.49	0.44
1996	0.428	0.01	5.67	29.06	5.57	21.02	30.87	116.72	0.97	1.61	0.37	0.30
1997	0.402	0.01	5.53	32.64	5.25	23.48	30.77	124.40	0.77	0.92	0.41	0.28
1998	0.401	0.01	5.62	35.39	5.59	25.53	30.37	125.38	0.67	0.92	0.38	0.35
1999	0.377	0.02	5.66	36.90	5.50	33.01	29.26	135.60	0.63	1.57	0.39	0.35
2000	0.358	0.01	5.65	44.08	5.31	36.48	27.83	140.25	0.66	1.35	0.38	0.12

Data Source: Census of Industrial Production 1991-2000.

(i) All values are number of employees.

(ii) Family is proprietors and family members (see Appendix 5.1).

(iii) Manag. is managerial and technical employees (see Appendix 5.1).

(iv) Clerical is clerical employees (see Appendix 5.1).

(v) Indus. is industrial employees (see Appendix 5.1).

(vi) App. is apprentices (see Appendix 5.1).

(vi) OPW is outside piece workers (see Appendix 5.1).

Table A5.3.3: Correlation Coefficient Matrix for All firms.

	GVA	Capital	Labour	Family	Managerial	Clerical	Industrial	OPW
GVA	1							
Capital	0.606	1						
Labour	0.552	0.639	1					
Family	-0.055	-0.036	-0.083	1				
Managerial	0.613	0.720	0.842	-0.078	1			
Clerical	0.548	0.703	0.876	-0.053	0.759	1		
Industrial	0.471	0.515	0.968	-0.092	0.726	0.757	1	
OPW	-0.005	-0.004	0.033	0.0009	-0.0055	-0.0029	0.0021	1

Data Source: Census of Industrial Production 1991-2000.

Table A5.3.4: Correlation Coefficient Matrix for Irish Firms.

	GVA	Capital	Labour	Family	Managerial	Clerical	Industrial	OPW
GVA	1							
Capital	0.868	1						
Labour	0.947	0.771	1					
Family	-0.037	-0.022	-0.0519	1				
Managerial	0.939	0.796	0.950	-0.057	1			
Clerical	0.950	0.792	0.949	-0.0362	0.924	1		
Industrial	0.907	0.720	0.986	-0.0609	0.907	0.8937	1	
OPW	-0.002	-0.0018	0.041	-0.0063	-0.0017	-0.0005	0.0037	1

Data Source: Census of Industrial Production 1991-2000.

Table A5.3.5: Correlation Coefficient Matrix for Foreign Firms.

	GVA	Capital	Labour	Family	Managerial	Clerical	Industrial	OPW
GVA	1							
Capital	0.53	1						
Labour	0.418	0.528	1					
Family	-0.028	-0.0186	-0.0403	1				
Managerial	0.497	0.652	0.7235	-0.0364	1			
Clerical	0.430	0.663	0.6759	-0.0301	0.550	1		
Industrial	0.261	0.280	0.9224	-0.0422	0.468	0.413	1	
OPW	-0.020	-0.0141	0.0027	0.3018	-0.0246	-0.0189	-0.0063	1

Data Source: Census of Industrial Production 1991-2000.

Chapter 6: Conclusion

The motivation for this thesis has been to contribute to the discussion on the role of foreign labour and foreign firms in the Irish economy during the recent 'Celtic Tiger' phase of the country's economic history. Never has it been more relevant to focus upon the contributions of foreign capital and in particular foreign labour to the Irish economy, as for the first time in Irish history emigrants found Ireland to be an attractive location for employment. Chapter 2 outlines the factors that created the economic transformation of an Irish economy founded upon protectionist philosophies and dominated by policies aimed at agriculture and self-sufficiency, to a hub for FDI and migrant workers. This economic transformation has given rise to the need for the analysis that is presented in the empirical chapters of this thesis.

Chapter 3 examines the occupational outcomes for workers in the Irish labour market, with particular focus placed upon occupational attainment of foreign workers. An occupational attainment model was estimated using a multinomial logit model. The QNHS data set between 1991 and 2004 was used which provided 236,601 observations. This occupational attainment study of the Irish labour market offers deeper analysis than the earlier work of Barrett et al. (2006) who use a probit model and in so doing only allow for two occupational categories. Three varying measures of nationality (nationality, country of birth and duration of residency in Ireland) were modelled, while estimates were provided for all workers, manufacturing workers only, female workers only and male workers only. The relationships between key variables were in general as expected, with males more likely to be engaged in professional roles than females and the probability of obtaining one of the higher skilled posts increased if the worker was located in the Dublin region. Higher skilled occupations were positively linked with higher levels of educational attainment and workers with greater labour market experience were more likely to gain employment in a professional post. Workers with young children (under five years old) tended to hold professional posts, which raises questions in relation to child care costs and labour market participation for workers on the margin of entry and exit from the labour market.

With respect to the key element of the study, nationality, Irish workers in the sample were found to be the most likely cohort (relative to all other nationalities controlled for) to gain employment in a professional post. The results for workers from the UK may possibly indicate that language barriers for workers from non-English speaking EU countries may exist. UK workers were likely to work in associate management and professional roles, while other EU workers, who are similar to UK nationals in not requiring a work permit to work in Ireland but who may not speak English, are less likely to gain employment in either of these categories. Foreign born workers who reside in Ireland for more than ten years are likely to be employed in associate professional posts, while those foreign born workers with less than ten years of residency in Ireland were found to be more likely working in lower skilled occupations such as sales and security. However, when years of residency is examined for the female workers only it was found that those foreign born female workers with more than ten years of experience were most likely to be employed in a clerical post. The empirical analysis outlined in Chapter 3 could be improved upon with more detailed information in relation to the location of workers and country of origin of the immigrant workers sampled. Also, information on the native language spoken would allow for firmer comments to be made in relation to potential language barriers faced by some immigrant workers in the Irish labour market.

A Mincerian wage study based upon the Irish labour market is presented in Chapter 4, with particular focus placed upon differences in earnings between indigenous and foreign born workers. The LII data set from 1995 to 2001 comprising of 18,349 observations was utilised in this study and in so doing extends some previous Irish wage studies such as Barrett and McCarthy (2007a), Barrett and McCarthy (2007b) and Barrett et al. (2008) who all used just one year of data in their respective studies. Unlike the empirical work in this study, it also appears to be the case that the three Irish wage studies mentioned above do not control for possible sample selection bias in their wage estimations. An Oaxaca decomposition was also presented in Chapter 4. In keeping with Chapter 3, nationality is modelled in more than one way, with both country of birth citizenship included in separate models. The latter measure of nationality allows for unique comment (in the context of Irish

labour market studies) to be made in relation to the potential impact of foreign born workers taking out Irish citizenship upon their earnings.

Results were very much as anticipated, with males earning a 15% premium relative to females and with one extra year of experience translating into an extra 2% more per hour, in terms of earnings. Married workers were reported to earn 16% more than similar workers who were not married, while professional workers were found to earn 33% more than unskilled workers. With respect to sectors, workers in the agricultural sector earned the least of all sectors, with workers in the education sector earning the most, 40% more than workers in the agricultural sector. Workers in the public sector were found to earn 11% more per hour than equivalent workers in the private sector, while workers with pension schemes earned 18% more than those workers not contributing towards a pension.

The results for education suggest that education does have a positive and significant impact upon earnings and that the returns to education rise with the educational level attained by the worker. The highest levels of educational attainment of degree and higher degree, earned workers the highest wage premiums, with an extra 11% and 14% earned respectively, relative to those workers without a junior certificate level of education. With respect to the location of workers, as anticipated workers located in the Dublin region earned more than workers located in any of the other regions in Ireland, with such workers earning 13% more than similar workers in either the south eastern or border regions. The region closest to Dublin, the eastern region, was found to have closest earnings potential to Dublin, with the differential between the two regions being 3%.

The focus of Chapter 4 was the earnings differential between foreign born and indigenous workers in the Irish labour market and when the earnings model estimated included country of birth as an explanatory variable it was found that Irish born workers earned 5% less per hour than their foreign born counterparts. It was postulated that this differential could potentially be the result of foreign firms transferring foreign born labour from abroad to their Irish plants in order to manage the Irish operations and to train and transfer their skills to the indigenous workers. The impact for foreign born males was found to be 8%, while the impact of being a

foreign born female upon earnings was found to be insignificant. When citizenship was included as an independent variable it was found to have an insignificant effect upon earnings in the Irish labour market. However, foreign born workers who took up Irish citizenship did receive a benefit, with such a worker earning a premium of 6% relative to a foreign born worker without Irish citizenship. This unique finding in the context of Irish labour market studies may simply be the result of foreign born workers of Irish parentage who grew up in Ireland (and are so in effect 'Irish' in the sense of education and labour market experience) taking out Irish citizenship. Foreign born males who took up Irish citizenship earned an extra 8% per hour relative to foreign born males without Irish citizenship, while the equivalent effect for foreign born females was found to be 5%.

The outcome from the Oaxaca decomposition suggests that there are relatively small differentials in earnings between foreign born and indigenous workers, but that the majority of the differential was the result of discrimination and that it favoured the foreign born workers. It is felt that this study could be improved upon with access to some extra explanatory variables including trade union membership, the language spoken by the respondent and further disaggregation of country of birth would enable further comment to be made upon earnings differentials in the Irish labour market.

Emphasis was placed in Chapter 5 upon the differentials between foreign and Irish firms in the Irish manufacturing sector. A Cobb-Douglas production function was used to examine the impact of capital, labour and nationality upon output (gross value added). The CIP data set between 1991 and 2000 comprising in total 33,373 observations was used, while four estimation techniques (OLS, within, GMM and System GMM) were applied to both the balanced and unbalanced panel of data. It was noted that direct comparisons between indigenous firms and MNC's are difficult to make, as MNC's will often be multi-located operations with turnovers comparable with the GDP of some nations, while indigenous firms may actually be on the margin of entry and exit to the sector. Only the OLS estimates found a significant relationship between output and nationality, and this finding was discounted on the basis that historically OLS estimates of production functions have tended to yield biased results. The most striking result from the unbalanced panel

of firms was the difference between Irish and foreign firms in terms of their relative dependencies upon family labour and outside piece workers in the production process. There was no relationship found between these two labour inputs and output for foreign firms, but a positive and significant relationship was found in the case of Irish firms. Interestingly, when the balanced panel of data was examined Irish firms still had links with outside piece workers, but that no relationship existed between their output and the number of family members employed. The view was taken that Irish firms that were in the balanced panel of data would be by definition more established and may have had time to adjust to more efficient practices.

With respect to the estimators used, the system GMM estimators were found in the majority of cases to be coupled with invalid instrumental variables, while there was also evidence that the GMM estimator tended to produce low and, in some cases, statistically insignificant capital coefficients. It should also be noted that in many cases the GMM coefficients were found to be estimated with valid instrumental variables. With respect to the unbalanced panel, the system GMM estimates of the capital coefficient tended to increase relative to the equivalent GMM estimate. However, when the balanced panel was examined, the System GMM estimates of the capital coefficient were often found to be as low as or lower than the elasticity of capital produced by the GMM estimator. This outcome may possibly be the result of the consistent rejection of the instruments used by the system GMM model. Finally, the within estimates of the capital coefficient were consistently found to be relatively low, while the constant returns to scale hypothesis was rejected in the majority of the GMM and system GMM estimations.

The availability of further details on firm nationality and the types of manufacturing engaged in would help improve upon the analysis provided in this chapter. Overall, the study contained in Chapter 5 has extended the empirical work on production functions for Ireland by firstly, highlighting the links between the output of Irish manufacturing firms and two types of labour, family members and outside piece workers, a relationship that was found to be insignificant for foreign firms in the Irish manufacturing sector and secondly, by demonstrating the insignificance of the nationality of ownership in relation to gross value added in the Irish manufacturing sector.

In conclusion, this thesis has presented both labour market outcomes for foreign workers in the Irish labour market and productivity analysis for foreign firms in the Irish manufacturing sector. In doing so it is evident that foreign workers are possibly underrepresented in the higher skilled occupations in the Irish labour market, but do receive higher levels of pay relative to their indigenous colleagues. With respect to foreign firms operating in the Irish manufacturing sector, it is apparent that these firms are less dependent upon outside piece workers and family members as labour inputs, relative to Irish firms in the sector, while firm nationality does not appear to be a relevant factor in determining output.

References

Abowd, J., F. Kramarz and D. Margolis (1999) "High Wage Workers and High Wage Firms", Econometrica, Vol. 67, No. 2, pp. 251-334.

Abraham, K. and H. Farber (1987) "Job Durations, Seniority, and Earnings", American Economic Review, Vol. 77, No. 3, pp. 278-297.

Ackerberg, D. and K. Caves (2003) "Structural Identification of Production Functions", Mimeo, University College of Los Angeles.

Alonso-Borrego, C. and R. Sánchez-Mangas (2001) "GMM Estimation of a Production Function with Panel Data: An Application to Spanish Manufacturing Firms", Universidad Carlos III de Madrid Statistics and Econometrics Series 27, Working Paper 01-55.

Altonji, J. and R. Shakotko (1987) "Do Wages Rise With Job Seniority?", Review of Economic Studies, Vol. 54, No. 3, pp. 437-459.

Anderson, S. and R. Newell (2003) "Simplified Marginal Effects in Discrete Choice Models", Economics Letters, Vol. 81, No. 3, pp. 321-326.

Antecol, H. and K. Bedard, (2004) "The Racial Wage Gap: The Importance of Labour Force Attachment Differences across Black, Mexican and White Men", Journal of Human Resources, Vol. 41, No. 2, pp. 564-583.

Arellano, M., and S. Bond (1991) "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations", Review of Economic Studies, Vol. 58, No. 2, pp. 277-297.

Arellano, M. and O. Bover (1995) "Another Look at the Instrumental-Variable Estimation of Error-Components Models", Journal of Econometrics, Vol. 68, No. 1, pp. 29-51.

Atkinson, A., A. Maynard and C. Trinder (1983) "Parents and Children", London, Heinemann.

Baltagi, B. (2008) "Econometric Analysis of Panel Data", Chichester, John Wiley and Sons.

Bar-Or, Y., J. Burbidge, L. Magee and A. Robb (1995) "The Wage Premium to a University Education in Canada, 1971-1991", Journal of Labor Economics, Vol. 13, No. 4, pp. 762-794.

Barrett, A., A. Bergin and D. Duffy (2006) "The Labour Market Characteristics and Labour Market Impacts of Immigrants in Ireland", The Economic and Social Review, Vol. 37, No. 1, pp. 1-26.

Barrett, A and D. Duffy (2008) "Are Ireland's Immigrants Integrating into its Labour Market?", International Migration Review, Vol. 42, No. 3, pp. 597-619.

Barrett, A., J. Fitzgerald and B. Nolan, (2002) "Earnings Inequality, Returns to Education and Immigration into Ireland", Labour Economics, Vol. 9, No. 5, pp. 665-680.

Barrett, A. and Y. McCarthy (2007a) "Immigrants in a Booming Economy: Analysing their Earnings and Welfare Dependence", Labour, Vol. 21, No. 4, pp. 789-808.

Barrett, A. and Y. McCarthy (2007b) "The Earnings of Immigrants in Ireland: Results from the 2005 EU Survey of Income and Living Conditions", Quarterly Economic Commentary: Special Article, Vol. 2007, Issue 4-Winter, pp. 42-62.

Barrett A., S. McGuiness and M. O'Brien (2008) "The Immigrant Earnings Disadvantage across the Earnings and Skills Distributions: The Case of Immigrants from the EU's New Member States in Ireland", The Institute for the Study of Labor, Working Paper No. 3479.

Barrett, A. and F. Trace (1998) "Who is Coming Back? The Educational Profile of Returning Migrants in the 1990's", Irish Banking Review, Summer, pp. 38-52.

Barrios, S., H. Görg and E. Strobl (2005) "Foreign Direct Investment, Competition and Industrial Development in the Host Country", European Economic Review, Vol. 49, No. 7, pp. 1761-1784.

Barro, R. (1991) "Economic Growth in a Cross Section of Countries", Quarterly Journal of Economics, Vol. 106, No. 2, pp. 407-443.

Barro, R. and X. Sala-i-Martin (2004) "Economic Growth", New York: W. W. Norton and Company Inc.

Barry, Frank (1996) "Peripherality in Economic Geography and Modern Growth Theory: Evidence from Ireland's Adjustment to Free Trade". World Economy, Vol. 19, No. 3, pp. 345-365.

Barry, F. (1999) "Understanding Ireland's Economic Growth", London, Macmillan.

Barry, F. (2000) "Convergence is not Automatic: Lessons from Central and Eastern Europe", World Economy Vol. 23, 10, pp. 1379-1394.

Barry, F. (2002) "The Celtic Tiger Era: Delayed Convergence or Regional Boom?", The Economic and Social Research Institute, Quarterly Economic Commentary, July, pp. 84-91.

Barry, F., J. Bradley and A. Hannan (2001) "The Single Market, the Structural Funds and Ireland's Recent Economic Growth", Journal of Common Market Studies, Vol. 39, No. 3, pp. 537-552.

Barry, F. and N. Crafts (1999) "Some Comparative Aspects of Ireland's Economic Transformation", Irish Banking Review, Autumn, pp. 39-44.

Barry, F., and M. Devereux (1995) “The Expansionary Fiscal Contraction Hypothesis: A Neo-Keynesian Analysis”, Oxford Economic Papers, Vol. 47, No. 2, pp. 249-264.

Barry, F., A. Hannan and E. Strobl (1999) “The Real Convergence of the Irish Economy and the Sectoral Distribution of Employment Growth”, in F. Barry, (ed.) *Understanding Ireland’s Economic Growth*, London, Macmillan.

Bauer, T. and K. Zimmermann (1999) “Occupational Mobility of Ethnic Migrants”, The Institute for the Study of Labor, Discussion Paper No. 58.

Beach, C. and C. Worswick (1993) “Is there a Double-Negative Effect on the Earnings of Immigrant Women?”, Canadian Public Policy, Vol. 19, No. 1, pp. 36-53.

Becker, G. (1964) “Human Capital”, New York, Columbia University Press.

Becker, G. (1967) “Human Capital and the Personal Distribution of Income”, Ann Arbor, University of Michigan Press.

Becker, G. (1981) “A Treatise on the Family”, Cambridge Massachusetts, Harvard University Press.

Becker, G. (1985) “Human Capital, Effort and the Sexual Division of Labour”, Journal of Labor Economics, Vol. 3, No. 1, pp. S33-S58.

Behan, J., B. Comerford, J. McNaboe, V. Patterson and A. Hogan (2005) “National Skills Bulletin”, Dublin, FÁS.

Behan, J., N. Condon, J. McNaboe, I. Milicevic and V. Rodríguez (2007) “National Skills Bulletin”, Dublin, FÁS.

Behan, J., N. Condon, J. McGrath, I. Milicevic and C. Shally (2008) “National Skills Bulletin”, Dublin, FÁS.

Behan, J., N. Condon, A. Hogan, J. McGrath, J. McNaboe, I. Milicevic and C. Shally (2009) "National Skills Bulletin", Dublin, FÁS.

Behrman, J. and P. Taubman (1976) "The Intergenerational Correlation Between Children's Adult Earnings and Their Parents' Income: Result from the Michigan Panel Survey of Income Dynamics", Review of Income and Wealth, Vol. 36, No. 2, pp. 115-127.

Behrman, J. and P. Taubman (1990) "The Intergenerational Correlation Between Children's Adult Earnings and Their Parents' Income: Result from the Michigan Panel Survey of Income Dynamics", Review of Income and Wealth, Vol. 36, No. 2, pp. 115-127.

Behrman, J. and B. Wolfe (1984) "The Socioeconomic Impact of Schooling in a Developing Country", Review of Economics and Statistics, Vol. 66, No. 2, pp. 296-303.

Bell, B. (1997) "The Performance of Immigrants in the United Kingdom: Evidence from the GHS", The Economic Journal, Vol. 107, No. 441, pp. 333-344.

Benkard, C. (2000) "Learning and Forgetting: The Dynamics of Commercial Aircraft Production", American Economic Review, Vol. 90, No. 4, pp. 1034-1054.

Ben-Porath, Y. (1967) "The Production of Human Capital and the Life Cycle of Earnings", Journal of Political Economy, Vol. 75, No. 4, pp. 352-365.

Bentolila, S., C. Michelacci and J. Suarez (2010) "Social Contacts and Occupational Choice", Economica, Vol. 77, No. 305, pp. 20-45.

Bhanumurthy, K. (2002) "Arguing a Case for the Cobb-Douglas Production Function", Review of Commerce Studies, Vol. 20-21, No.1, pp. 75-91.

Black, S., P. Devereux and K. Salvanes (2005) "Why the Apple Doesn't Fall Far: Understanding Intergenerational Transmission of Human Capital", American Economic Review, Vol. 95, No. 1, pp. 437-449.

Blackaby, D., K. Clark, D. Leslie and P. Murphy (1994) "Black-White Male Earnings and Employment Prospects in the 1970's and 1980's: Evidence for Britain", Economics Letters, Vol. 46, No. 3, pp. 273-280.

Blackburn, M. and D. Bloom (1993) "The Distribution of Family Income: Measuring and Explaining Changes in the 1980's for Canada and the United States", in R. Freeman and D. Card (eds.) *Small Differences that Matter,* National Bureau of Economic Research Comparative Labour Market Series, Vol. 1, Chicago, University of Chicago Press.

Blackburn, M., D. Bloom and R. Freeman (1990) "The Declining Economic Position of Less Skilled American Men", in G. Burtless (ed.) *In a Future of Lousy Jobs,* Washington, Brookings Institution.

Blau, P., J. Gustad, R., Jessor, H. Parnes and R. Wilcock (1956) "Occupational Choice: A Conceptual Framework", Industrial and Labor Relations Review, Vol. 9, No. 4, pp. 531-543.

Blinder, A. (1973) "Wage Discrimination: Reduced Form and Structural Estimates", The Journal of Human Resources, Vol. 8, No. 4, pp. 436-455.

Blundell, R. and S. Bond (1998) "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models", Journal of Econometrics, Vol. 87, No. 1, pp. 115-143.

Blundell, R. and S. Bond (2000) "GMM Estimation with Persistent Panel Data: An Application to Production Functions", Econometric Reviews, Vol. 19, No. 3, pp. 321-340.

Blundell, R., S. Bond and F. Windmeijer (2000) “Estimation in Dynamic Panel Data Models: Improving on the Performance of the Standard GMM Estimators”, The Institute for Fiscal Studies, Working Paper No. W00/12.

Bond, S. (2002) “Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice”, Portuguese Economic Journal, Vol. 1. No. 2, pp. 141-162.

Bond, S., A. Hoeffler and J. Temple (2001) “GMM Estimation of Empirical Growth Models”, The Centre for Economic Policy Research, Discussion Paper No. 3048.

Bond, S., D. Harhoff and J. Van Reenen (2003a) “Corporate R&D and Productivity in Germany and the United Kingdom”, The Centre for Economic Performance, Discussion Paper No. CEPDP0599.

Bond, S., D. Harhoff and J. Van Reenen (2003b) “Investment, R&D and Financial Constraints in Britain and Germany”, The Centre for Economic performance, Discussion Paper No. dp95/05.

Booth, A., M. Francesconi and G. Zoega (2003) “Unions, Work-Related Training, and Wages: Evidence for British Men”, Industrial and Labor Relations Review, Vol. 57, No. 1, pp. 68-91.

Borjas, G. (1987) “Self-Selection and the Earnings of Immigrants”, American Economic Review, Vol. 77, No. 4, pp. 531-553.

Borooah, V. (2002) “Logit and Probit: Ordered and Multinomial Models”, SAGE University Press Series on Quantitative Applications in the Social Sciences, Series No. 07-138.

Boskin, M. (1974) “A Conditional Logit Model of Occupational Choice”, Journal of Political Economy, Vol. 82, No. 2, pp. 389-398.

Bradley, H. (1996) “Fractured Identities: Changing Patterns of Inequality”, Cambridge, Polity Press.

Bronars, S. and M. Famulari (1997) “Wage, Tenure and Wage Growth Variation Within and Across Establishments”, Journal of Labor Economics, Vol. 15, No. 2, pp. 285-317.

Brown, R., M. Moon and B. Zoloth (1980) “Incorporating Occupational Attainment in Studies of Male-Female Earnings Differentials”, The Journal of Human Resources, Vol. 15, No. 1, pp. 3-28.

Brown, S., T. Fry and M. Harris (2008) “Untangling Supply and Demand in Occupational Choice”, Economics Letters, Vol. 99, No. 2, pp. 414−417.

Butcher, K. (1994) “Black Immigrants in the United States: A Comparison with Native Blacks and Other Immigrants”, Industrial and Labor Relations Review, Vol. 47, No. 2, pp. 265-284.

Butcher, K. and J. Dinardo (2002) “The Immigrant and Native-Born Wage Distributions: Evidence from United States Censuses”, Industrial and Labor Relations Review, Vol. 56, No. 1, pp. 97-121.

Callan, T. and B. Reilly (1993) “Unions and the Wage Distribution in Ireland”, The Economic and Social Review, Vol. 24, No. 4, pp. 297-312.

Callan, T. and A. Wren (1994) “Male-Female Wage Differentials: Analysis and Policy Issues”, The Economics and Social Research Institute, General Research Series, No. 163.

Cameron, C. and P. Trivedi (2005) “Microeconometrics: Methods and Applications”, New York, Cambridge University Press.

Campbell III, C. (1993) “Do Firms Pay Efficiency Wages? Evidence with Data at the Firm Level, Journal of Labor Economics, Vol. 11., No. 3, pp. 442-470.

Card, D., T. Lemieux and C. Riddell (2004) "Unions and Wage Inequality", Journal of Labor Research, Vol. 25, No. 4, pp. 519-562.

Carmichael, F. and R. Woods (2000) "Ethnic Penalties in Unemployment and Occupational Attainment: Evidence for Britain", International Review of Applied Economics, Vol. 14, No. 1, pp. 71-98.

Chabanet, D. and F. Royall (2009) "Economic Recession and the Mobilisation of the Unemployed: France and Ireland Compared", French Politics, Vol. 7, No. 3, pp. 268-293.

Chamberlin, G. (1982) "Multivariate Regression Models for Panel Data", Journal of Econometrics, Vol. 18, No. 1, pp. 5-46.

Chiswick, B. (1978a) "A Longitudinal Analysis of Occupational Mobility of Immigrants", in B. Dennis (ed.) *Proceedings of the 30th Annual Industrial Relations Research Association Meeting,* Madison, University of Wisconsin Press.

Chiswick, B. (1978b) "The Effect of Americanisation on the Earnings of Foreign-Born Men", The Journal of Political Economy, Vol. 86, No. 5, pp. 897-921.

Chiswick, B. (1980) "The Earnings of White and Coloured Male Immigrants in Britain", Econometrica, Vol. 47, No. 185, pp. 81-87.

Chiswick, B. and P. Miller (2002) "Immigrant Earnings: Language Skills, Linguistic Concentrations and the Business Cycle", Journal of Population Economics, Vol. 15, No. 1, pp. 31-57.

Chiswick, B., Y. Liang Lee and P. Miller (2003) "Patterns of Immigrant Occupational Attainment in a Longitudinal Survey", International Migration, Vol. 41, No. 4, pp. 47-68.

Clark, R. and N. Ogawa (1992a) “The Effect of Mandatory Retirement on Earnings Profiles in Japan”, Industrial and Labor Relations Review, Vol. 45, No. 2, pp. 258-266.

Clark, R. and N. Ogawa (1992b) “Employment Tenure and Earnings Profiles in Japan and the United States: Comment”, The American Economic Review, Vol. 82, No. 1, pp. 336-345.

Clinch, P., F. Convery and B. Walsh (2002) “After the Celtic Tiger Challenges Ahead”, Dublin, The O’Brien Press.

Cobb, C. and P. Douglas (1928) “A Theory of Production”, American Economic Review, Vol. 18, No. 1, pp. 139-172.

Coelli, T., D. Prasada Rao and G. Barrese (2003) “An Introduction to Efficiency and Productivity Analysis”, The Netherlands, Kluwer Academic Publishers Group.

Connelly, R. (1989) “Occupational Choice under Uncertainty: When Experience is a Determinant of Earnings”, Econometrica, Vol. 57, No. 5, pp. 1215-1219.

Connolly, S., J. Micklewright and S. Nickell (1992) “The Occupational Success of Young Men Who Left School at Sixteen”, Oxford Economic Papers, Vol. 44, No. 3, pp. 460-479.

Considine, J. and E. O’Leary (1999) “The Growth Performance of Northern Ireland and the Republic of Ireland, 1960 to 1995”, in N. Collins (ed.) *Political Issues in Ireland Today*, New York, Manchester University Press.

Constant, A. and K. Zimmermann (2003) “Occupational Choice across Generations”, The Institute for the Study of Labor, Discussion Paper No. 975.

Corcoran, M. and P. Courant (1987) “Sex-Role Socialisation and Occupational Segregation: An Exploratory Investigation”, Journal of Post-Keynesian Economics, Vol. 9, No. 3, pp. 330-346.

Corcoran, M., L. Datcher and G. Duncan (1980) "Information and Influence Networks in Labour Markets", in G. Duncan and J. Morgan (eds.) *Five Thousand American Families: Patterns of Economic Progress, Vol. 8,* Ann Arbour, Michigan, Institute for Social Research.

Couch, K. and T. Dunn (1997) "Intergenerational Correlations in Labour Market Status: A Comparison of the United States and Germany", The Journal of Human Resources, Vol. 32, No. 4, pp. 210-232.

Crépon, B. and E. Duguet (1997) "Estimation of a Production Function of Innovation", Journal of Applied Econometrics, Vol. 12, No. 3, pp. 243-263.

Dascher, K., (2000) "Trade, FDI and Congestion: The Small and Very Open Economy", Centre for Economic Policy Research, Working Paper No. 2526.

Darity, W., D. Guilkey and W. Winfrey (1995) "Ethnicity, Race and Earnings", Economics Letters, Vol. 47, No. 3-4, pp. 401-408.

DeLong, J. and L. Summers, (1991) "Equipment Investment and Economic Growth", Quarterly Journal of Economics, Vol. 106, No. 2, pp. 445-502.

Dolton, P. (1990) "The Economics of UK Teacher Supply: The Graduate's Decision", Economic Journal, Vol. 86, No. 400, Conference Papers, pp. 729-745.

Dolton, P., G. Makepeace and W. van der Klaauw (1989) "Occupational Choice and Earnings Determination: The Role of Sample Selection and Non-Pecuniary Factors", Oxford Economic Papers, New Series, Vol. 41, No. 3, pp. 573-594.

Dolton, P. and K. Mavromaras (1994) "Intergenerational Occupational Choice Comparisons: The Case of Teachers", The Economic Journal, Vol. 104, No. 425, pp. 841-863.

Dooley, M. (1986) “The Overeducated Canadian? Changes in the Relationship among Earnings, Education and Age for Canadian Men: 1971-1981”, Canadian Journal of Economics, Vol. 19, No. 1, pp. 142-159.

Duleep, H. and D. Dowhan (2002) “Revisiting the Family Investment Model with Longitudinal Data: The Earnings Growth of Immigrant and US-Born Women”, The Institute for the Study of Labor, Discussion Paper No. 568.

Duncan, K. (1996) “Gender Differences in the Effect of Education on the Slope of Experience-Earnings Profiles: National Longitudinal Survey of Youth, 1979-1988”, American Journal of Economics and Sociology, Vol. 55, No. 4, pp. 457-471.

Dustmann, C. and F. Fabbri (2003) “Language Proficiency and the Labour Market performance of Immigrants in the UK”, Economic Journal, Vol. 113, No. 489, pp. 695-717.

Egerton, M. (2001a) “Mature Graduates I: Occupational Attainment and the Effects of Labour Market Duration”, Oxford Review of Education, Vol. 27, No. 1, pp. 135-150.

Egerton, M. (2001b) “Mature Graduates II: Occupational Attainment and the Effects of Social Class”, Oxford Review of Education, Vol. 27, No. 2, pp. 271-286.

Elliot, R. and J. Lindley (2008) “Immigration Wage Differentials, Ethnicity and Occupational Segregation”, Journal of the Royal Statistical Society: Series A (Statistics in Society), Vol. 171, No. 3, pp. 645-671.

Enterprise Ireland (2007) “Ireland Economic Profile”, Dublin, Enterprise Ireland.

Epstein, G. and T. Lecker (2001) “Multi-Generation Model of Immigrant Earnings: Theory and Applications”, The Institute for the Study of Labor, Discussion Paper No. 275.

Ermisch, J. and M. Francesconi (2000) "The Effect of Parents' Employment on Children's Educational Attainment", The Institute for the Study of Labor, Discussion Paper No. 215.

Figini P. and H. Görg (1999) "Multinational Companies and Wage Inequality in the Host Country: The case of Ireland", Review of World Economics, Vol. 135, No. 4, pp. 594-612.

FitzGerald, G. (2009) "Reintroduction of Third-Level Fees May Hinder Social Progress", The Irish Times, Saturday March 28th 2009.

Fitzgerald, J. (1999) "Understanding Ireland's Economic Success", The Economic and Social Research Institute, Working Paper No. 111.

Fitzgerald, J. And O. Keegan (1993) "The Community Support Framework 1989-1993: Evaluation and Recommendations for the 1994-1997 Framework", Dublin, Stationary Office.

Flabbi, L. and A. Ichino, (2001) "Productivity, Seniority and Wages: New Evidence from Personnel Data", Labour Economics, Vol. 8, No. 3, pp. 359-387.

Flynn, S. (2009) "Education Funding Cut by 5%", The Irish Times, Wednesday, December 9th 2009.

Forest, J. and R. Johnston (2000) "The Occupational Attainment of Immigrant Groups in Australia", International Migration, Vol. 38, No. 2, pp. 269-296.

Fortin, P. (2002) "The Irish Economic Boom: Facts, Causes and Lessons", Industry Canada, Discussion Paper No. 12.

Freeman, R. (1971) "The Market for College Trained Manpower", Cambridge, Massachusetts, Harvard University Press.

Freeman, R. (1975a) “Legal Cobwebs: The Changing Market for Lawyers”, Review of Economics and Statistics, Vol. 57, No. 2, pp. 171-179.

Freeman, R. (1975b) “Supply and Salary Adjustments to the Changing Science Manpower Market: Physics 1948-1973”, American Economic Review Proceedings, Vol. 65, No. 1, pp. 2-39.

Freeman, R. (1976) “The Overeducated American”, Orlando, Academic Press.

Fuchs, V. (1988) “Women’s Quest for Equality”, Cambridge Massachusetts, Harvard University Press.

Gabriel, P. and S. Schmitz (2005) “A Note on Occupational Variations in the Returns to Education in the US Labour Market”, International Journal of Manpower, Vol. 26, No. 5, pp. 450-456.

Gang, I. and K. Zimmermann (2000) “Is Child Like Parent? Educational Attainment and Ethnic Origin”, Journal of Human Resources, Vol. 35, No. 3, pp. 550-569.

Gaudry, M. and M. Dagenais (1979) “The Dogit Model”, Transportation Research – Part B, Vol. 13B, pp.105-112.

Giavazzi, F., and M. Pagano (1990) “Can Severe Contractions Be Expansionary? A Tale of Two Small Economies”, National Bureau of Economic Research, Working Paper No. 3372.

Ginther, D. and R. Pollak (2003) “Does Family Structure Affect Children’s Educational Outcomes?”, National Bureau of Economic Research, Working Paper No. 9628.

Girma, S. and H. Görg (2004) “Outsourcing, Foreign Ownership and Productivity: Evidence from UK Establishment-Level Data”, Review of International Economics, Vol. 12, No. 5, pp. 817-832.

Goldin, C. and S. Polachek (1987) “Residual Differences by Sex: Perspectives on the Gender Gap in Earnings”, American Economic Review, Vol. 77, No. 2, pp. 143-151.

Görg, H. and A. Hanley (2005) “International Outsourcing and Productivity: Evidence from the Irish Electronics Industry”, North American Journal of Economics and Finance, Vol. 16, No. 2, pp. 255-269.

Görg, H., A. Hanley and E. Strobl (2008) “Productivity Effects of International Outsourcing: Evidence from Plant-Level Data”, Canadian Journal of Economics and Finance, Vol. 41, No. 2, pp. 670-688.

Görg, H. and F. Ruane (2000) “European Integration and Peripherality: Lessons from the Irish Experience”, The World Economy, Vol. 23, No. 3, pp. 405-421.

Görg, H., and E. Strobl (2005) “Spillovers from Foreign Firms through Worker Mobility: An Empirical Investigation”, Scandinavian Journal of Economics and Finance, Vol. 107, No. 4, pp. 693-709.

Granovetter, M. (1974) “Getting a Job”, Cambridge, Massachusetts, Harvard University Press.

Greene, W. (2003) “Econometric Analysis”, New Jersey, Pearson Education.

Greenhalgh, C. (1980) “Male-Female Wage Differentials in Great Britain: Is Marriage an Equal Opportunity?”, Economic Journal, Vol. 90, No. 360, pp. 751-775.

Greenhalgh, C. and M. Stewart (1985) “The Occupational Status and Mobility of British Men and Women”, Oxford Economic Papers, Vol. 37, No. 1, pp. 40-71.

Griffith, R. (1999) “Productivity and Foreign Ownership in the UK Car Industry”, The Institute for Fiscal Studies, Working Paper Series No. 99/11.

Grilliches, Z. and J. Mairesse (1995) “Production Functions: The Search for Identification”, National Bureau of Economic Research, Working Paper No. 5067.

Grilliches, Z. and J. Mairesse (1997) “Production Functions: The search for Identification”, in S. Strom (ed.), *Essays in Honour of Ragnar Frisch,* Cambridge, Cambridge University Press.

Gujarati, D. and D. Porter (2009) “Basic Econometrics”, Singapore, McGraw-Hill.

Hall, R. (1988) “The Relation between Price and Marginal Cost in U.S. Industry”, Journal of Political Economy, Vol. 96, No. 5, pp. 921-947.

Hall, R. and R. Kasten (1973) “The Relative Occupational Success of Blacks and Whites” Brookings Papers on Economic Activity, pp. 781-795.

Hamilton, B. (2000) “Does Entrepreneurship Pay? An Empirical Analysis of the Returns of Self-Employment”, The Journal of Political Economy, Vol. 108, No. 3, pp. 604-631.

Hansen, L. (1982) “Large Sample properties of Generalised Method of Moments Estimators”, Econometrica, Vol. 50, No. 4, pp. 34-53.

Harper, B., and M. Haq (1997) “Occupational Attainment of Men in Britain”, Oxford Economic Papers, Vol. 49, No. 4, pp. 638-650.

Harris, R., D. Siegel and M. Wright (2005) “Assessing the Impact of Management Buyouts on Economic Efficiency: Plant-Level Evidence from the United Kingdom”, The Review of Economics and Statistics, Vol. 87, No. 1, pp. 148-153.

Hashimoto, M. and J. Raisian (1985) “Employment Tenure and Earnings Profiles in Japan and the United States”, American Economic Review, Vol. 75, No. 4, pp. 721-735.

Hashimoto, M. and J. Raisian (1992) “Employment Tenure and Earnings Profiles in Japan and the United States: Reply”, American Economic Review, Vol. 82, No. 1, pp. 346-354.

Hause, J. (1972) “Earnings Profile: Ability and Schooling”, The Journal of Political Economy, Vol. 80, No. 3, pp. S108-S138.

Hause, J. (1980) “The Fine Structure of Earnings and On-the-Job Training Hypothesis”, Econometrica, Vol. 48, No. 4, pp. 1013-1029.

Heady, E. and J. Dillon (1961) “Agricultural Production Functions, Aces, Iowa”, Iowa State University Press.

Heath, A. and D. McMahon (1995) “Education and Occupational Attainments: The Impact of Ethnic Origins”, Centre for Research into Elections and Social Trends, Paper No. 34.

Heckman, J. (1979) “Sample Selection Bias as a Specification Error”, Econometrica, Vol. 47, No. 1, pp. 153-161.

Heckman, J. and J. Hotz (1986) “An Investigation of the Labour Market Earnings of Panamanian Males: Evaluating the Sources of Inequality”, The Journal of Human Resources, Vol. 21 No. 4, pp. 507-542.

Heckman, J., L. Lochner and P. Todd (2006) “Earnings Functions, Rates of Return and Treatment Effects: The Mincer Equation and Beyond”, in E. Hanushek and F. Welch (eds.) *Handbook of the Economics of Education, Vol. 1,* Amsterdam, Elsevier.

Hersch, J. (1991) “Male-Female Differences in Hourly Wages: The Role of Human Capital, Working Conditions, and Housework”, Industrial and Labor Relations Review, Vol. 44, No. 4, pp. 746-759.

Hill, M. (1979) “The Wage Effects of Marital Status and Children”, Journal of Human Resources, Vol. 14, No. 4, pp. 579-594.

Hoch, I. (1955) “Estimation of Production Function Parameters and Testing for Efficiency”, Econometrica, Vol. 23, No. 3, pp. 325-326.

Hoch, I. (1962) “Estimation of Production Function Parameters Combining Time-Series and Cross-Section Data”, Econometrica, Vol. 30, No. 1, pp. 34-53.

Holzer, H. (1988) “Search Method Use by Unemployed Youth”, Journal of Labor Economics, Vol. 6, No. 1, pp. 1-20.

Hout, M. and H. Rosen (1999) “Self-Employment, Family Background, and Race”, National Bureau of Economic Research, Working Paper No. W7344.

Huang, T. (1999) “The Impact of Education and Seniority on the Male-Female Wage Gap: is More Education the Answer?”, International Journal of Manpower, Vol. 20, No. 6, pp. 361-374.

Iannelli, C. (2002) “Parental Education and Young People’s Educational and Labour Market Outcomes: A Comparison across Europe”, Mannheim Centre for European Social Research, Working Paper No. 45.

International Monetary Fund (2009) “Ireland: 2009 Article IV Consultation – Staff Report; and Public Information Notice on the Executive Board Discussion”, International Monetary Fund Country Report No. 09/195.

Irish Independent (2003) Dublin, April 10th.

Jasso, G. and M. Rosenzweig (1990) “Self-Selection and the Earnings of Immigrants: Comment”, American Economic Review, Vol. 80, No. 1, pp. 298-304.

Jeon, B. and W. Simmons (1998) “Reward for Being an Immigrant: Earnings Gap between Immigrant and Native-Born West Indians”, Atlantic Economic Journal, Vol. 26, No. 3, pp. 309-316.

Katz, L. and K. Murphy (1992) “Changes in Relative Wages, 1963-1987: Supply and Demand Factors”, Quarterly Journal of Economics, Vol. 107, No. 1, pp. 35-78.

Keane, M. and D. Runkle (1992) “On the Estimation of Panel-Data Models with Serial Correlation when Instruments are not Strictly Exogenous”, Journal of Business and Economic Statistics, Vol. 10, No. 1, pp. 1-14.

Kee, P. (1995) “Native-Immigrant Wage Differentials in the Netherlands: Discrimination?”, Oxford Economic Papers, Vol. 47, No. 2, pp. 302-317.

Kidd, M. (1993) “Immigrant Wage Differentials and the Role of Self-Employment in Australia”, Australian Economic Papers, Vol. 32, No. 60, pp. 92-115.

Klette, T. (1994) “Estimating-Cost Margins and Scale Economies from a Panel of Microdata”, Statistics Norway Research Department, Discussion Paper No. 130.

Klette, T. and Z. Grilliches (1994) “The Inconsistency of Common Scale Estimators when Output Prices are Unobserved and Endogenous”, Journal of Applied Econometrics, Vol. 11, No. 4, pp. 343-361.

Kennedy, E. (2008) “Child Care Costs on the Rise”, The Sunday Business Post, Sunday March 2nd 2008.

Koeber, C. and D. Wright (2001) “W/age Bias in Worker Displacement: how Industrial Structure Shapes the Job Loss and Earnings Decline of Older American Workers”, Journal of Socio-Economics, Vol. 30, No. 4, pp. 343-352.

Koman, J. and D. Marin (1997) “Human Capital and Macroeconomic Growth: Austria and Germany, 1960-1992”, Centre for Economic Policy Research, Working Paper No. 1551.

Korenman, S. and D. Neumark (1991) “Does Marriage Really Make Men More Productive?”, The Journal of Human Resources, Vol. 26, No. 2, pp. 282-307.

Krugman, P., (1997) “Good News from Ireland: A Geographical Perspective”, in A. Gray (ed.), *International Perspective on the Irish Economy*, Dublin, Indecon.

Kugler, A. (2002) “Employee Referrals and the Inter-Industry Wage Structure”, Mimeo, Universitat Pompeu Fabra.

Lazear, E. (1976) “Age, Experience and Wage Growth”, The American Economic Review, Vol. 66, No. 4, pp. 548-558.

Lazear, E. (1979) “The Narrowing of Black-White Wage Differential is Illusory”, The American Economic Review, Vol. 69, No. 4, pp. 553-564.

Lazear, E. (1981) “Agency, Earnings Profiles and Hours Restrictions”, The American Economic Review, Vol. 71, No. 4, pp. 606-620.

Lazear, E. and S. Rosen (1990) “Male-Female Wage Differentials in Job Ladders”, Journal of Labor Economics, Vol. 8, No. 1, pp. S106-S123.

Leddin, A. and B. Walsh (1998) “The Macroeconomy of Ireland”, Dublin, Gill and Macmillan.

Levinsohn, J. and A. Petrin (2000) “Estimating Production Functions Using Inputs to Control for Unobservables”, National Bureau of Economic Research, Working Paper No. 7819.

Lichtenberg, F. and D. Siegel (1990) “The Effect of Leveraged Buyouts on Productivity and Related Aspects of Firm Behaviour”, Journal of Financial Economics, Vol. 27, No. 1, pp. 165-194.

Lindley, J. (2009) "The Over-Education of UK Immigrants and Minority Ethnic Groups: Evidence from the Labour Force Survey", Economics of Education Review, Vol. 28, No. 1, pp. 80-89.

Long, J. (1980) "The Effect of Americanization on Earnings: Some Evidence for Women", The Journal of Political Economy, Vol. 88, No. 3, pp. 620-629.

Loureiro, P. F. Carneiro and A. Sachsida (2004) "Race and Gender Discrimination in the Labour Market: an Urban and Rural Sector Analysis for Brazil", Journal of Economic Studies, Vol. 31, No. 2, pp. 129-143.

Luce, R. (1959) "Individual Choice Behaviour: A Theoretical Analysis", New York, John Wiley.

Maddala, G. (2001) "Introduction to Econometrics", West Sussex, England: Wiley.

Mairesse, J. (1975) "Comparison of Production Function Estimates on the French and Norwegian Census of Manufacturing Industries" in F. Altmann et al. (eds.), *On the Measurement of Factor Productivities*, Gottingen, Vendenbeck and Ruprecht.

Mairesse, J. and B. Hall (1993) "Comparing the Productivity of R&D in French and U.S. Manufacturing Firms: An Exploration of Simultaneity Issues with GMM Methods", in Wagner, K. and B. Van Ark (eds.), *International Productivity Differences and their Explanations*, New York, Elsevier Science.

Mairesse, J. and B. Hall (1996) "Comparing the Productivity of R&D in French and U.S. Manufacturing Firms", Paper Delivered at the Conference on International Productivity Differences and their Explanations, Wissenschaftszentrum, Berlin, November 26-27.

Mansfield, E. (1999) "Managerial Economics Theory, Applications and Cases", New York, W.W. Norton and Company.

Manski, C. (1985) “Semiparametric Analysis of Discrete Response: Asymptotic Properties of the Maximum Score Indicator”, Journal of Econometrics, Vol. 27, No. 3, pp. 313-333.

Marini, M. (1989) “Sex Differences in Earnings in the United States”, Annual Review of Sociology, Vol. 15, No. 1, pp. 343-380.

Martins, P. and P. Pereira (2004) “Does Education Reduce Wage Inequality? Quantile Regression Evidence from 16 Countries”, Labour Economics, Vol. 11, No. 3, pp. 355-371.

Marschak, J. and W. Andrews (1944) “Random Simultaneous Equations and the Theory of Production”, Econometrica, Vol. 12, No. 3-4, pp. 143-205.

Mátyás, L. (1999) “Generalised Method of Moments Estimation”, Cambridge University Press.

Mayhew, K. and B. Rosewell (1981) “Occupational Mobility in Britain”, Oxford Bulletin of Economics and Statistics, Vol. 43, No. 1, pp. 225-255.

McDonald. J. and C. Worswick (1988) “The Earnings of immigrant Men in Canada: Job Tenure, Cohort and Macroeconomic Conditions”, Industrial and Labor Relations Review, Vol. 51, No. 3, pp. 465-482.

McNabb, R. and G. Psacharopoulos (1981) “Racial Earnings Differentials in the UK”, Oxford Economic Papers, Vol. 33, No. 3, pp. 413-425.

McQuinn, K. (2003) “Alternative Models of the Irish Supply Side”, Central Bank of Ireland, Technical Paper No. RT/2/03.

Mendershausen, H. (1938) “On the Significance of Professor Douglas’ Production Function”, Econometrica, Vol. 6, No. 2, pp. 143-153.

Miller, P. and P. Volker (1985) "Economic Progress in Australia: An Analysis of Occupational Mobility", Economic Record, Vol. 61, No. 172, pp. 463-475.

Miller, P. and L. Neo (1997) "Immigrant Unemployment: The Australian Experience", International Migration, Vol. 35, No. 2, pp. 155-183.

Mincer, J. (1974) "Schooling Experience and Earnings", New York, Columbia University Press.

Mincer, J. and S. Polachek (1974) "Family Investments in Human Capital: Earnings of Women", Journal of Political Economy, Vol. 82, No. 2, S76-S108.

Minns, C. (2005) "How Skilled are Irish Emigrants? Evidence and Implications", Institution for International Integration Studies, Discussion Paper No. 68.

Molony, S. (2006) "Cowen Set to Boost Support for Child Care Despite IMF", The Irish Independent, Monday August 21st 2006.

Montgomery, J. (1991) "Social Networks and Labour-Market Outcomes: Toward an Economic Analysis", American Economic Review, Vol. 81, No. 5, pp. 1408-1418.

Muendler, M. (2004) "Estimating Production Functions when Productivity Change is Endogenous", Centre for Economic Studies/Institute for Economic Research, Working Paper No. 1643.

Munasinghe, L and K. Sigman (2004) "A Hobo Syndrome? Mobility, Wages, and Job Turnover", Labour Economics, Vol. 11, No. 2, pp. 191-218.

Mundlak Y. (1961) "Empirical Production Function Free of Management Bias", Journal of Farm Economics, Vol. 43, No. 1, pp. 44-56.

Mundlak, Y. and I. Hoch (1965) "Consequences of Alternative Specifications of Cobb-Douglas Production Functions", Econometrica, Vol. 33, No. 4, pp. 814-828.

Nadiri, M. and I. Prucha (1997) “Estimation of the Depreciation Rate of Physical and R&D Capital in the U.S. Total Manufacturing Sector”, National Bureau of Economic Research, Working Paper No. 4591.

Neuman, S. and R. Oaxaca (2005) “Wage Differentials in the 1990’s: Endowments, Discrimination and Selectivity”, International Journal of Manpower, Vol. 26, No. 3, pp. 217-236.

Nickell, S. (1982) “The Determinants of Occupational Success in Britain”, Review of Economic Studies, Vol. 49, No. 1, pp. 43-53.

Nielsen, H., M. Rosholm, N. Smith and L. Husted (2004) “Qualifications, Discrimination, or Assimilation? An Extended Framework for Analysing Immigrant Wage Gaps”, Empirical Economics, Vol. 29, No. 4, pp. 855-883.

Oaxaca, R. (1973) “Male-Female Wage Differences in Urban Labour Markets”, International Economic Review, Vol. 14, No. 3, pp. 693-709.

Ó’Gráda, C., (2002) “Is the Celtic Tiger a Paper Tiger?”, University College Dublin, Working Paper No. WP02/02.

Ó’Gráda C. and K. O’Rourke (1996) “Irish Economic Growth, 1945-1988”, in N. Crafts and G. Toniolo (eds.), *Economic Growth in Europe Since 1945*, Cambridge, Cambridge University Press.

Olley, S. and A. Pakes (1992) “The Dynamics of Productivity in the Telecommunications Equipment Industry”, National Bureau of Economic Research, Working Paper No. 3977.

Olley, S. and A. Pakes (1996) “The Dynamics of Productivity in the Telecommunications Equipment Industry”, Econometrica, Vol. 64, No. 6, pp. 1263-1297.

O'Neill, J. (1985) "The Trend in the Male-Female Wage Gap in the United States", Journal of Labor Economics, Vol. 11, No. 1, pp. 91-116.

O'Neill, J. and S. Polachek (1993) "Why the Gender Gap in Wages Narrowed in the 1980's", Journal of Labor Economics, Vol. 11, No. 1, pp. 205-228.

O'Neill, D. O. Sweetman and D. Van de gaer, D (2006) "The Impact of Cognitive Skills on the Distribution of the Black-White Wage Gap", Labour Economics, Vol. 13, No. 3, pp. 343-356.

Osterman, P. (1980) "Getting Started", Boston, Massachusetts Institute of Technology.

Pashigian, P. (1977) "The Market for Lawyers: The Determinants of the Demand and for and the Supply of Lawyers", Journal of Law and Economics, Vol. 20, pp. 53-85.

Phillips B. and W. Griffiths (2004) "Female Earnings and Divorce Rates: Some Australian Evidence", Australian Economic Review, Vol. 37, No. 2, pp. 139-152.

Pillinger, J. (2006) "An Introduction to the Situation and Experience of Women Migrant Workers in Ireland", Dublin, The Equality Authority.

Pistaferri, L. (1999) "Informal Networks in the Italian Labour Market", Giornale degli Economisti, Vol. 58, pp. 355-375.

Powell, B. (2003) "Economic Freedom and Growth: The Case of the Celtic Tiger", Cato Journal, Vol. 22, No. 3, pp. 431-448.

Polachek, S. (1987) "Occupational Segregation and the Gender Wage Gap", Population Research and Policy Review, Vol. 6, No. 1, pp. 47-67.

Reed, R. and K. Harford (1989) "The Marriage Premium and Compensating Wage Differentials", Journal of Population Economics, Vol. 2, No. 4, pp. 237-265.

Reimers, C. (1983) “Labour Market Discrimination against Hispanic and Black Men”, The Review of Economics and Statistics, Vol. 65, No. 4, pp. 570-579.

Reskin, B. and P. Roos (1990) “Job Queues, Gender Queues”, Philadelphia, Temple University Press.

Ringstad, V. (1971) “Estimation Production Functions and Technical Change from Micro Data”, Central Bureau of Statistics of Norway, Economic Studies No. 21.

Robertson, D. and J. Symons (1990) “The Occupational Choice of British Children”, Economic Journal, Vol. 100, No. 402, pp. 828-841.

Rosen, S. (1969) “Trade Union Power, Threat Effects, and the Extent of Organisation”, Review of Economic Studies, Vol. 36, No. 106, pp. 185-196.

Rosen, S. (1977) “Human Capital: A Survey of Empirical Research”, in R. Ehrenberg (ed.) *Research in Labour Economics,* Greenwich, Connecticut, JAI Press.

Rosholm, M., L. Husted and H. Skyt Nielsen (2002) “Integration across Generations? The Education of Second Generation Immigrants, Nationalokonomisk Tidsskrift, Vol. 140, No. 1, pp. 35-58.

Ross, A. (1948) “Trade Union Wage Policy”, Berkeley, University of California Press.

Ruhs, M. (2005) “Managing the Immigration and Employment of Non-EU Nationals in Ireland”, The Policy Institute Trinity College Dublin Paper No. 19.

Sacco, P. and C. Scarpa (2000) “Critical Mass Effect and Restructuring in the Transition Towards a Market Economy”, European Economic Review, Vol. 44, No. 3, pp. 587-608.

Sachs, J., and A. Warner (1995) “Economic Reform and the Process of Global Integration”, Brookings Papers, Vol. 26, No. 1, pp. 1-118.

Sadeg, M. (1996) “A Production Function Explanation of Irish Economic Growth 1951 – 1984”, Trinity College Dublin, Technical Paper Series No. 96/2.

Schmidt, P. and R. Strauss (1975) “The Prediction of Occupation Using Multiple Logit Models”, International Economic Review, Vol. 16, No. 2, pp. 471-486.

Sexton, J. and P. O’Connell (1997) “Labour Market Studies: Ireland”, Brussels, European Commission.

Shamsuddin, A. (1998) “The Double-Negative Effect on the Earnings of Foreign-Born Females in Canada”, Applied Economics Vol. 30, No. 9, pp. 1187-1201.

Simon, C. and J. Warner (1992) “Matchmaker, Matchmaker: The Effect of Old Boy Networks on Job Match Quality, Earnings and Tenure”, Journal of Labor Economics, Vol. 10, No. 3, pp. 306-330.

Siow, A. (1984) “Occupational Choice under Uncertainty”, Econometrica, Vol. 52, No. 3, pp. 631-646.

Sjögren, A. (2000) “Occupational Choice and Incentives: The Role of Family Background”, The Research Institute of Industrial Economics, Working Paper No. 539.

Slevin, G. (2001) “Potential Output and the Output Gap in Ireland”, Central Bank of Ireland, Technical Paper No. RT/5/01.

Small, K. (1987) “A Discrete Choice Model for Altered Alternatives”, Econometrica, Vol. 55, No. 2, pp. 409-424.

Smarzynska-Javorcik, B. (2004) “Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages”, American Economic Review, Vol. 94, No. 3, pp. 605-627.

Smith, A. (1938) “An Inquiry into the Nature and Causes of the Wealth of Nations”, New York, Random House.

Smith, J. and M. Ward (1989) “Women in the Labour Market and in the Family”, The Journal of Economic Perspectives, Vol. 3, No. 1, pp. 9-24.

Smith, J. and F. Welch (1978) “Race Differences in Earnings: A Survey and New Evidence”, Santa Monica, Rand Corporation R-2295-NSF.

Smith, J. and F. Welch (1989) “Black Economic Progress after Myrdal”, Journal of Economic Literature, Vol. 27, No. 2, pp. 519-564.

Solon, G. (1992) “Intergenerational Income Mobility in the United States”, American Economic Review, Vol. 82, No. 3, pp. 393-408.

Solon, G., M. Corcoran, R. Gordon and D. Laren (1991) “A Longitudinal Analysis of Sibling Correlations in Economic Status”, Journal of Human Resources, Vol. 26, No. 3, pp. 471-486.

Solow, R. (1957) “Technical Change and the Aggregate Production Function”, The Review of Economics and Statistics, Vol. 39, No. 3, pp. 312-320.

Stewart, N. (1947) “A.G.C.T. Scores of Army Personnel Grouped by Occupations”, Occupations, Vol. 26, pp. 5-41.

Stewart, M. (1983) “Racial Discrimination and Occupational Attainment in Britain”, The Economic Journal, Vol. 93, No. 371, pp. 521-541.

Stigler, S. (1981) “Gauss and the Invention of Least Squares”, The Annals of Statistics, Vol. 9, No. 3, pp. 465-474.

Strong, E. (1935) “Predictive Value of the Vocational Interest Test”, Journal of Educational Psychology, Vol. 26, No. 5, pp. 331-349.

Super, D. and R. Wright (1940) “From School to Work in the Depression Years”, School Review, Vol. 49, No. 2, pp. 123-130.

Sutherland, A. (1997) “Fiscal Crisis and Aggregate Demand: Can High Public Debt Reverse the Effects of Fiscal Policy?”, Journal of Public Economics, Vol. 65, No. 2, pp. 147-162.

Teixeira, P. (2007) “Jacob Mincer A Founding Father of Modern Labour Economics”, Oxford, Oxford University Press.

Temin, P. (2002) “The Golden Age of European Growth Reconsidered”, European Review of Economic History, Vol. 6, No. 1, pp. 3-22.

Ten, R. and T. Wolff (2001) “Outsourcing of Services and the Productivity Recovery in US Manufacturing in the 1980s and 1990s”, Journal of Productivity Analysis, Vol. 16, No. 2, pp. 149-165.

The Economist (2000) “Guide to Economic Indicators”, London, Profile Books Ltd.

Thomas, T. (1994) “Graduate Recruitment in a Changing Labour Market”, in National Commission on Education (ed.) *Insights in Education and Training*, London, Heinemann.

Tintner, G. (1944) “A Note on the Derivation of Production Functions from Farm Records”, Econometrica, Vol. 12, No. 1, pp. 26-34.

Tobin, J. (1958) “Estimation of Relationships for Limited Dependent Variables”, Econometrica, Vol. 26, No. 1, pp. 24-36.

Trejo, S. (1997) “Why do Mexican Americans Earn Low Wages?”, The Journal of Political Economy, Vol. 105, No. 6, pp. 1235-1268.

Van Biesebroeck, J. (2003) “Productivity Dynamics with Technology Choice: An Application to Automobile Assembly”, Review of Economic Studies, Vol. 70, No. 1, pp. 167-198.

Vaughan, G. (1992) “Census 86 – Birthplace Differences in Occupational Attainments”, Canberra, Australian Bureau of Statistics.

Vera-Toscano, E., E. Phimister and A. Weersink (2004) “Panel Estimates of the Canadian Rural-Urban Women’s Wage Gap”, American Journal of Agricultural Economics, Vol. 86, No. 4, pp. 1138-1151.

Verbeek, M. (2008) “A Guide to Modern Econometrics”, Chichester, John Wiley and Sons.

Walsh, B. and B. Whelan (1976) “A Micro-Economic Study of Earnings in Ireland”, Economic and Social Review, Vol. 7, No. 2, pp. 199-207.

White, H. (1980) “A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity”, Econometrica, Vol. 48, No. 4, pp. 817-830.

Wills, R. and S. Rosen (1979) “Education and Self-Selection”, Journal of Political Economy, Vol. 87, No. 5, Part 2: Education and Income Distribution, pp. S7-S36.

Wood. R., M. Corcoran and P. Courant (1993) “Pay Differences among the Highly Paid: The Male-Female Earnings Gap in Lawyers’ Salaries”, Journal of Labor Economics, Vol. 11, No. 3, pp. 417-441.

Wooden, M. (1994) “The Labour Market Experience of Immigrants”, in M. Wooden, R. Holton, G. Hugo and J. Sloan (eds.) *Australian Immigration: A Survey of the Issues,* Canberra, Australian Government Publishing Services, Bureau of Immigration Research.

Yuengert, A. (1994) “Immigrant Earnings, Relative to What? The Importance of Earnings Function Specification and Comparison Points”, Journal of Applied Econometrics, Vol. 9, No. 1, pp. 71-90.

Zalokar, N. (1988) “Male-Female Differences in Occupational Choice and the Demand for General and Occupation-Specific Human Capital” Economic Inquiry, Vol. 26, No. 1, pp. 59-74.

Zarkin, G. (1985) “Occupational Choice: An Application to the Market for Public School Teachers”, Quarterly Journal of Economics, Vol. 100, No. 2, pp. 409-446.

Zellner, A., J. Kmenta and J. Dreze (1966) “Specification and Estimation of Cobb-Douglas Production Function Models”, Econometrica, Vol. 34, No. 4, pp. 784-795.

Zellner, A. and N. Revankar (1969) “Generalised Production Functions”, Review of Economic Studies, Vol. 36, No. 106, pp. 241-250.

Zimmermann, K. (1992) “Regression Toward Mediocrity in Economic Stature”, American Economic Review, Vol. 82, No. 3, pp. 409-429.