An Empirical Study of Firm Efficiency: New Evidence using Cross Industry and Country Data

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The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

For my grandfather, David.

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Chapter 1

Introduction

At the most individual level, those operating within firms have a shared interest - the want to improve. Since the foundational ideas of Adam Smith and the division of labour, economists have taken an interest in attempting to understand what the firm does and how exactly it operates. The pioneering work of Coase (1937) explored the nature of the firm and the economic understanding of exactly why individuals choose to form firms to undertake business, rather than conducting market operations on an individual contractual basis. This marked the beginning of what was and has become a broad and diverse area of the literature. While the notion may have been hinted at and mentioned implicitly, the term transaction costs, coined by and developed by Williamson (1979) and Williamson (1981) made apparent the costs associated with initial contracts with suppliers and the importance of relational and ownership implications over time between buyer and seller. More generally, in the area of contract theory, theoretical applications of the principal-agent problem, in

relation to the firm, have considered the design of contracts that maximise incentives on behalf of the worker, as well as considering the moral hazard that presents when information asymmetries are present (Hölmstrom, 1979; Grossman and Hart, 1983).

In the advent of novel econometric techniques in the 1970s, such as stochastic frontier (Battese and Corra, 1977) and data envelopment analysis Charnes et al. (1978), made possible empirical studies of firm performance, namely efficiency in cost and production. While at the start of this literature, such techniques were solely used as a means to evaluate a numerical measure of efficiency and rank the observed individual units, more recent methodological advances have allowed an additional dimension of performance and efficiency studied. Using either a two or one-stage estimation method (Kumbhakar and Lovell, 2003), empirical researchers are able to use the efficiency estimates, attained from either the cost or production function, as a measure that could be explained by other explanatory covariates. This development was critical as it allowed the economist, policy maker and firms themselves, an insight into exact what attributes of the firm and the business environment either improve or hinder their performance. Aside from individual desires to make profit, the importance of understanding firm efficiency and its determinants has much wider implications. Given that small and medium-sized enterprise dominate the composition of firms within the private sector, particularly in developing countries; in combination with the fact that research has indicated that higher levels of GDP per capita in countries with larger numbers of SMEs (Beck et al., 2005; Ayyagari et al., 2007), there is a larger importance to understanding how we can encourage efficiency and performance.

Moreover, despite the advent of new techniques, firm-level data that can be employed in this framework have been relatively limited. While the applied SFA literature has been primarily concerned with the measure measurement of efficiency within utilities and agriculture, some firm or industry-level studies have emerged. That being said, those that do exists lack a expansive coverage of countries at different stages of economic and institutional development, as such, the application of policy recommendations are particularly constrained.

1.1 Contribution of the thesis

This thesis attempts to fill a number of gaps within the existing body of literature in a number of ways. Firstly, we employ the use of a novel and comprehensive dataset. The World Bank Enterprise Survey (WBES) has an extensive coverage 139 countries, at differing stages of economics and institutional development and transition from 2006-2016. The pooled cross-sectional dataset is multifaceted, in that, it includes a range of accounting and production measures, as well as a number of typical and atypical firm characteristics. Most notable, the survey ask firm managers about their perception to a range of obstacles to firm performance, including corruption, access to finance, the informal economy and business licensing. To our knowledge, this particular insight is unique within the data available on firms at any level of coverage.

Secondly, in previous studies of corruption more generally, the established measures of corruption are usually at the country-level in the form of indices, namely the

Corruption Perceptions Index or International Country Risk measure. In this thesis, not only do we have information about the level of corruption at the level of the firm but we also know what the perceived level of corruption that firm has experience. Similarly, with respect to financial constraints, while the availability of data measuring access to finance at the firm-level is more prevalent, disaggregation by severity is less so. Moreover, the characteristics of the firm included in the data set, go far beyond usual variables such as age and size. Information on tax inspections, time spent on regulatory matters, use of IT communication in client dealings and external audits are provided, that allow far more a detail analysis of the determination of firm efficiency that has also been observed in the literature thus far.

In the first of three studies in this thesis, we employ a one-stage SFA approach to both calculate and subsequently attempt to understand the role of corruption and financial constraints in the variation amongst firms in productive efficiency. In doing so, we test our hypotheses. Based on a survey of the literature, we formulate two hypotheses; the severity of both corruption and constraints to finance will reduce firm efficiency. The results of our empirical analysis find that while higher levels of severity in financial constraints reduce the level of efficiency, we find evidence to the contrary for the minor levels of perceived corruption. While the former result is in agreement with the established literature, our result regarding corruption is in line with the 'grease money' hypothesis.

In lieu of the negative effects on efficiency found in chapter two, in chapter three, we endevour to understand what determines the severity to financial constraints the firm faces, particularly different information types, soft and hard. Based on the

work of Beck et al. (2006), we employ a generealised ordered probit methodology to assess the marginal effects of different information types. In contrast with Beck et al. (2006), we find evidence against using the ordered probit over the generealised model, allowing a relaxing of the parallel lines assumption. In essence we find that, despite a documented over-reliance of hard information used in the consideration of loan applications Cole et al. (2004), soft information has important implications which are otherwise disregarded in the decision-making process. For completeness, we create two scales that assess the total number of problems firm report to face, as well as their aggregate severity. Just as is the case in considering only access to finance, we find that both information types are important to both severity and number of obstacles to operation that firms must endure.

Following from this, in chapter four we employ two novel approaches to construct a index measures of obstacles that firms face. By using these approachs, namely generalised structural equation modelling (GSEM), empirical Bayes prediction and polychoric principal component analysis, we construct two measure of firm obstacles that are manifested within the 15 perceived obstacles measures that the survey measures, given the oversimplification that simpler arithmetic measures embody. In the construction of these measures, we find the perceived obstacles with the largest weighting are corruption, courts and business licensing, in line with some theoretical predictions made in the corruption and bribery literature (Guriev, 2004). Once constructed, we use these measures, as well as a number of other firm characteristic to assess the effect on firm performance, namely firm sales. Initially, we find that the polychoric principal component measure to be statistically preferred to the empirical

bayes prediction. For the sample as a whole, we find a negative significant negative linear relation between the firm's placement on the scale and the level of firm sales. This persists also above the 40th percentile of firm sales, as well as in particular regions, sectors and firm sizes. Finally, chapter five will summarise the thesis.

Chapter 2

Corruption, Finance and Firm Efficiency: A Stochastic Frontier Analysis Approach

2.1 Introduction

Corruption continues to plague and infect the morals which individuals choose to abide by in making decisions on a day–to–day basis. From commerce and industry to government and the legal system, the incentives and rewards for engaging in corrupt activities still remain lucrative enough for those with the respective attitude to risk. Evidence of widespread corruption on a global scale can been seen in the 2013 Corruption Perceptions Index, carried out by Transparency International (2013), in which they find that 69 percent of countries included in the report, achieve a score less

that 50, indicative of 'a serious corruption problem'. Furthermore, in both Eastern Europe and Central Asia, and Sub–Saharan Africa, 95 percent and 90 percent of countries in these regions respectively have scores less than 50, revealing that it is predominately developing and transition countries that pertain to the most severe level of corruption internationally.

Since the seminal paper by Rose-Ackerman (1975), the study of corruption has not only expanded from fields such as sociology and politics previously to business, economics, finance and law, but has evolved from theoretical to empirical study. The latter class of literature has witnessed a large contribution by authors considering the association of corruption with various factors, including: competition (Emerson, 2006; Campos et al., 2010; Alexeev and Song, 2013), economic growth (Mauro, 1995, 1997; Leite and Weidmann, 1999; Mo, 2001; Paldam, 2002), investment (Hines Jr, 1995; Wei, 1997; Smarzynska and Wei, 2000; Hakkala et al., 2008) and regulation (Treisman, 2000; Heckelman and Powell, 2010; Johnson et al., 2014). In spite of this flourishing development of work in past few decades, relatively little has been done to empirically test the efficiency effects of corruption at any level but especially so at the industry or firm level. Those that do attempt to do so, tend to focus on either a particular industry (Dal Bó and Rossi, 2007; Yan and Oum, 2011; Castro et al., 2014), or a particular continent or region (Gaviria, 2002; Teal and McArthur, 2002; Athanasouli et al., 2012).

Furthermore, it is well–established that access to financial markets and financial development are integral to the promotion of economic growth (Levine, 1997), as well as the encouraging the development of firms, particularly small and medium–

sized enterprises (SMEs). With regard to the latter, it has been recognised that, particularly in the context of developing countries where they dominate in number with regards to private sector composition (Ayyagari et al., 2007, 2011), small–sized firms are amongst the those that face the highest constraints to growth, and as such, face greater difficulty in accessing external financing (Beck et al., 2005; Beck and Demirguc-Kunt, 2006; Aghion et al., 2007). While this is a known quantity, there is a significant gap in the literature which attempts to quantify the importance of financial access to firms, particularity with the emphasis on firm efficiency. Moreover, to our knowledge, there are no previous studies that have attempted to study the efficiency effects of either corruption and finance access, in a way which allows the model to account of differing levels of severity that the firm faces.

Given this, we attempt to bridge the gap between these two classes of literature, using the World Bank's Enterprise Survey (WBES) dataset. We look at firm–level data across 139 countries, at differing stages of development, to test the efficiency implications of corruption and access to firm financing. Adopting the productivity approach of Saliola and Seker (2011, 2012), we specify a model comprised of a translog production function using a range of factor inputs, as well as a vector of independent variables to endeavour to explain differences in efficiency. Estimation is performed by utilising a one–stage stochastic frontier analysis (SFA) approach. Unlike other studies considering the efficiency effects of corruption and finance, we use measures that disaggregates the level of severity into four distinct categories: minor, moderate, major and severe. This will allow us to test whether or not these factors in and of themselves have an absolute effect or whether the implications for efficiency are

dependent on their magnitude.

The results of our empirical undertaking show that regardless of the output measure that is employed, firms that report corruption to be a minor obstacle to operation are associated with higher levels of technical efficiency, whilst those firm that report their ability to access financial markets as either major or severe are associated with low levels of technical efficiency. These results are found to be persistent after conducting robustness measures.

The remainder of this chapter is organised as follows. The next section consists of a review of the existing literature in order to develop testable hypotheses. The third section discusses the data being used in empirical testing and section four outlining the methodology will proceed this. Finally, sections five and six will present the estimation results and the conclusion respectively.

2.2 Hypothesis Development

2.2.1 Corruption

Authors have faced great difficulty in attempting to formulate a precisie definition of corruption, in fact Jain (2002, p.73) expresses similar sentiments on this issue but ultimately concedes to a consensus view that, 'corruption refers to acts in which the power of public office is used for personal gain in a manner that contravenes the rules of the game'. Furthermore, Rose-Ackerman (1975, p.187) highlights that while corruption may occur in a variety of situations, 'its essential aspect is an illegal or unauthorized transfer of money or an in–kind substitute'. The distinction that is

made is absolutely fundamental, as all too frequently the definition of corruption is oversimplified only to explicitly state the necessary payment of a bribe within a *quid pro quo* rather than elucidate the contents of the bribe. As such, we adopt this definition when making reference to corruption in this chapter.

The 'grease money' or 'efficient grease' hypothesis asserts bribery could 'grease' the otherwise friction–filled environment in which business and exchange occurs by reducing the amount of effective red tape an individual agent would have to endure. Moreover, Méon and Sekkat (2005) notes that, 'The ill functioning of the bureaucracy is considered as the most prominent inefficiency that corruption could grease'. Indeed, before the advent of any models to substantiate such a hypothesis, Kaufmann and Wei (1999) credits both Huntington (1968) and Leff (1964) of noting the potential that bribery may possess, in it's ability to improve efficiency by reducing the amount of red tape. By building on the work of Kleinrock (1967), Lui (1985) constructs a queuing model to theoretically assess the efficiency effects of corruption by analysing the size of the bribe made by an agent and the respective time spent in a queue. In equilibrium, the results derived illustrate that bribery will serve to reduce the time a given individual will queue for depending on the magnitude of the bribe. The underlying rational for this result being that the bribe acts as an incentive for the issuer of red tape to 'grease the wheels' of a bureaucratic process, in contrast with the case where bribery does not occur. Moreover, Fredriksson (2014) in analysing the time taken to obtain licences, corroborates the finding that bribing bureaucrats would reduce waiting times in contrast to attempting to obtain a licence legitimately; while the use of an intermediate party to interact with the bureaucrats in order to

reduce waiting times creates incentives on the part of the bureaucrat to create more red tape and further obfuscate the process.

Additionally, Guriev (2004) creates a framework that directly analyses the relationship between red tape and corruption, which considers a three–way hierarchical relationship between a principal, bureaucrat and agent. Despite finding that while bribery may reduce the amount of red tape, the model derives an equilibrium in which the amount of red tape that is prevalent is above that which is socially optimal. Conceptually, the knowledge that bureaucrats are able to extort bribes from agents in order to reduce the amount of effective red tape, creates an incentive on the part of the bureaucrat to create more red tape in order to maximise their bribe income. Myrdal (1968, p.171) acknowledges this very practice whilst studying the causes and consequences of corruption in Asia noting, 'The usual way to make money by corrupt practices is to threaten obstruction and delay in official function. This causes a slowing down of the wheels of administration in South Asia to a damaging degree'.

Limited empirical work has been done to directly test the theory of 'grease money', particularly at the micro level. However there has been a significant literature testing the association between corruption and economic growth in which a consensus has prevailed, *viz.* corruption is negatively associated with growth, typically by means of decreased investment (Mauro, 1995; Kaufmann and Wei, 1999; Del Monte and Papagni, 2001; Mo, 2001). Despite this, Méon and Sekkat (2005) note that this evidence is not inconsistent with the 'grease money' hypothesis, given that corruption may indeed be favourable in areas where effectiveness of governance is particularly

poor but increasingly less so where a country is in later stages of development and therefore, embodies a bureaucracy with higher levels of effectiveness. As such, the authors use macro level data to perform a cross–country analysis in order to test the 'grease money' hypothesis, finding evidence against the hypothesis and moreover supporting what they call the 'sand the wheels' hypothesis, in line with their postulations concerning the resultant effects of corruption depending on governance effectiveness. Furthermore, Méon and Weill (2010) carry out additional investigations with regards to the 'grease money' hypothesis, using a panel of 69 countries and find evidence to corroborate the importance of effective institutions and governance when assessing the effects of corruption, however in those countries with particularly inefficient governance systems, there is evidence to show that the 'grease money' hypothesis holds true.

A number of macro–level studies have been implemented concerning the relationship between corruption, various institutional attributes and country–level total factor productivity (TFP), the latter computed using a variety of methods including two–step ordinary least squares (OLS) estimation (Olson Jr. et al., 2000) and SFA (Adkins et al., 2002). Despite the differences in method, ultimately the goal is the same; by calculating TFP measures, authors subsequently utilise a number of corruption and institutional variables in an attempt to explain the variation in productivity within or across countries. Until very recently, data availability has made it considerably difficult to study the effect of corruption at the firm level, given that the predominant measures used are at the country–level. Although over the last decade, the advent of novel firm–level survey data has provided researchers a unique insight

into how corruption is perceived by those in a particular business environment. In considering the theoretical underpinning underlying the relationship between corruption and firm efficiency, much is dependent on how we discern the effects of corrupt acts upon a firm's ability to operate and be productive. Pertaining to bribery, if we are to consult the 'efficient grease' literature and related evidence, on the whole it would seems that corruption does more to cause friction within enterprise than it does to smooth the transactions necessary to carry out business, the extent of which depends on the institutional setup.

Teal and McArthur (2002) use firm–level survey data of 27 African economies across several industries to examine this very relationship using what they term, both 'local' and 'global' corruption measures; the former is a composite measure which constitutes various survey answers from the 2001 African Competitiveness Report particular to the firm, whereas the latter relates to responses to questions concerning the perception of corruption at the country level. The conclusions drawn from the results are striking; the authors find that at the firm level, those firms that engage in bribery result in an output 20 per cent lower per worker than that of firms that does not and furthermore, firms that operate in countries where corruption is widespread are around 70 per cent less efficient than those who operate in countries where corruption is not prevalent. De Rosa et al. (2010) employ firm–level data supplied by the 2009 wave of the Business Environment and Enterprise Performance Survey (BEEPS), using a one–step approach estimated by OLS, the authors use two measures of corruption, a 'bribe tax' and 'time tax' to not only assess the effects of corruption by traditional means of bribery exclusively but to also test the

'efficient grease' hypothesis by examining the interaction between them. They find that the isolated effects of the corruption are distinct; whilst bribery was found to negatively affect the productivity of the firm, the 'time tax' measure is found to have no significant effect across the sample as a whole but displays a negative effect when the sample is disaggregated to include only countries within the European Union. In addition, the interaction between both bribe and time tax measures provide no evidence in support of the 'efficient grease' hypothesis.

Dal Bó and Rossi (2007) make use of an unique dataset containing firm–level data of firms solely within the electric supply industry across 13 Latin American countries. Whilst the study is able take advantage of output, capital and labour measures at the firm level; the corruption measures are only available at the country level, namely the Transparency International (TI) and International Country Risk Guide (ICRG) indices. Despite this limitation, after applying a number of robustness measures, the authors are able to conclude that countries with higher levels of corruption are associated with firms that attain higher levels of inefficiency. In an attempt to elucidate the forces behind Africa's pre–crisis growth levels, Harrison et al. (2014) use firm–level data from the WBES, focusing primarily on firms within manufacturing, they use a variety of measures including bribery, in conjunction with a number of firm characteristics; geographical, political and institutional parameters, as well as other aspects of the business environment. The authors conclude that while corruption is only negatively associated with sales growth of the firm, the most significant determinant to firm productivity, growth and sales, is the tenure of the the ruling political party, that is to say, the longer the rule by a single party, the

larger the detrimental effect is to the firm's performance. In a study carried out by Hanousek et al. (2016), the only study which attempts to look at corruption with a methodology akin to the one used in this chapter, use firm-level panel data from the World Bank Business Environment and Enterprise Performance Survey (BEEPS) to empirically assess the relationship between variation in corruption perception at the firm-level and firm efficiency. While their findings suggest that higher levels of corruption are negatively related to firm efficieny, their firm sample is limited to only private firms within the 14 Central and Eastern European countries captured by the survey.

Hypothesis 1: Corruption is negatively associated with firm efficiency and as such, will act as a detrimental force to productivity.

2.2.2 Access to finance

As well as briefly analysing what bearing institutions have in determining the performance of growth at both the firm and country level, another aspect worthy of consideration is the role financial intermediaries play insofar as determining the access to finance firms are able to obtain. While there has been a considerable volume of literature recognising the importance of financial intermediaries in the determination of economic growth (King and Levine, 1993; Rajan and Zingales, 1998; McCaig and Stengos, 2005), naturally the focus of such studies have narrowed to assess the effect of financial intermediaries at higher levels of disaggregation, namely firm performance. The long–standing hypothesis put forward argues a firm's access to finance may effect their performance by means of restricting technical innovation

(Schumpeter, 1934), which, from a more pragmatic standpoint, raises implications of paramount importance for small and medium enterprise (SMEs), as they dominate the composition of firms in the private sector, particularly in developing countries. As such, attempts have been made in the empirical literature to test the validity of such a postulate.

At the advent of large datasets providing elucidation as to the impact of SMEs to the economy, simple correlation computations of cross–country statistics pointed to higher levels of GDP per capita in countries with larger numbers of SMEs (Ayyagari et al., 2007), moreover this association is reaffirmed when utilising econometric analysis (Beck et al., 2005). Moving forward, the question transforms from 'do SMEs encourage economic growth?' to 'what influences economic growth that is associated with SMEs?' One such influence that has been explored by scholars has been the credit constraints that firms face, particularly small firms, given that collateral requirements necessary to acquire funds crucial for the start–up and early growth phases of operation can be hard to attain, in the absence of microfinancing or government spending programmes to ease such constraints. Intuitively, anything which acts as an obstacle to the SMEs' operations and productivity is not likely just to negatively affect its established association with economic growth but potentially the growth of the firm itself.

Beck et al. (2000) investigates the development of financial intermediaries with respect to total factor productivity (TFP) growth and economic growth in a cross–country sample of 63 countries and find strong evidence between the development of financial intermediaries and higher levels of TFP and in turn, GDP growth, albeit at

the country level. In contrast with other such studies that present findings in terms of associations or likelihood, Butler and Cornaggia (2011) utilise US agricultural crop data, corn farming specifically, to not only assess the relationship between access to finance and productivity but to investigate the existence of a causal link between the two aspects. Using a differences–in–differences–in–differences (DIDID) approach, the authors take advantage of an exogenous shift in demand for corn that ensued in response to a new US policy calling for an increase in the amount of renewable fuel additives to be used, of which corn is the primary ingredient. In doing so, they find significant evidence that as a result of this shift in demand, increases in production are higher in areas of the US where access to finance is greater.

Concentrating attention to the firm, Musso and Schiavo (2008) use a panel across the period 1996–2004 to investigate the effect of constraints to finance on the development of French firms, solely in the manufacturing sector. Analysis of this data does not only affirm the hypothesis that access to finance increases the growth of these manufacturing firms but moreover, they find evidence of a positive association between financial constraints and productivity in the short run. Beck et al. (2008) investigate the level of financial development with respect to the level of firm growth using both cross–industry and country data and show that the growth of small firms industries is disproportionally large in countries where the stages of financial development are further advanced. Furthermore, Fafchamps and Schündeln (2013) tests similar hypothesis using data on Moroccan manufacturing firms and finds results concurrent with comparable studies, specifically, access to finance in the form of bank availability is associated with faster rates of growth for SMEs, more significantly for

medium–sized firms.

Whilst the findings of country–specific studies do seem to arrive at the same outcome in verifying the negative effect financial constraints place upon the firm growth; the number of studies analysing firms across both countries and industry, looking at the efficiency implications of financial constraints are notably fewer. In one such study, Sena (2006) analyses the impact of financial constraints on the technical efficiency of Italian firms within the manufacturing sector using SFA, estimating by means of ML, and finds evidence in support of the notion that firms can be more efficient in the face of financial constraints; later corroborated by Musso and Schiavo (2008) albeit only for the short run. Kuntchev et al. (2013), like previous authors, endeavour to assess the effect of credit constraints on firm efficiency and productivity, however with access to a unique form of data at the firm level, the authors decide to compile a new measure to categorise the extent to which firms have access to credit. Four categories are devised to disaggregate the firms based on the severity of credit constraints, such levels of severity are chosen based on responses given by each firm when asked questions based on their use of external financing, for example, if the firm had applied for a loan in the last fiscal year or if they indeed had a loan outstanding at the time of the survey. Their empirical analysis affirm that SMEs are the parties which are most likely to succumb to and experience credit constraints, furthermore, firms that carry higher levels of productivity are less likely to face such constraints.

Dabla-Norris et al. (2012) makes use of the same source of data as we intend to use from the WBES, only however, across the period 2005–2007. The authors utilise the firm–level manufacturing data across 63 countries, both developed and

developing, to attempt to investigate how innovation affects the level of firm productivity and exactly what role, if any, does access to finance play in this association. By calculating TFP by estimating a Cobb–Douglas production function and using the Solow residual of the first stage estimation results, the TFP measure is then explained in a second stage regression using other factors such as innovation, various constraints to business, as well as particular firm characteristics. The findings of the analysis show that indeed innovation has a positive effect on firm productivity, moreover, they find this effect is larger in countries where the financial markets have attained a higher level of development.

Hypothesis 2: Constraints to finance will adversely affect firm efficiency.

2.2.3 Firm Ownership

While there is a well-established literature with regards to the relationship between firm ownership structures and performance, this is not such the case in relation to firm efficiency - specifically technical efficiency. Early work concerning the theory of the firm saw the advent of the agency cost literature working in parallel with finance and property right theory (Jensen and Meckling, 1976; Fama and Jensen, 1983) to advance a theory of firm ownership structure. Central to the debate over ownership is the divergent interests of both managers and shareholders. For the latter group, the incentives are such that the priority is to maximise the value of the firm; whereas for the former - at least in the Principal-Agent framework - seeks to maximise utility. The agency problem in this setting arises due to the fact that those who invest into the firm, themselves cannot alone produce a rate of return without the assistance of

an individual - in this setting, termed the manager - with a particular endowment of human capital which can be utilised to generate a rate of return on shareholder investment.

An aside from initial incentive differences, when investors and managers endeavour to work together, optimally they would agree on terms - primarily on the side of the manager - as to exactly how the individual would employ these finances to generate a return on investment, as well as an agreement on division on profit. In other words, create and sign a complete contract. However, it is intuitive to conceive of the notion that not all eventualities between two individuals can be included, not much less agreed upon, given the vast number of possible eventualities and moreover, the uncertainty of future events. Consequently, what is termed in the literature as incomplete contracts (Grossman and Hart, 1986), which accepts this eventually but from this arises the problem of what should happen in the event of a scenario that arises within firm operation that is not accounted for by said contract. Noted by Williamson (1975) and eventually coined as the hold-up problem, incomplete contracts can have the effect of preventing two parties that are keen to enter into a contractual agreement but are hesitant to, owing to what Hart and Moore (1990) term residual control rights, that is, the rights to decisions made on those eventualities omitted from the agreed contract.

While residual control rights are not, in and of themselves, problematic - indirectly, one or both of the parties face an uncertainty as to whether or not the other party would be given an advantage in residual decision-making, in which, the other party does not have the appropriate set of human capital to participate. This is

exactly the case observed between shareholders and managers. Shareholders entrust, under this incomplete contract, residual control rights to managers, for decision-making in the face of eventualities unaccounted for by the incomplete contract, for which shareholders do not have the human capital sufficient to do so by themselves. However, returning to this mismatch in incentives between both parties, giving residual control rights to managers in this situation may not be beneficial to the shareholders, given that the manager may take action which does not necessarily maximise firm value but instead acts out of self-interest to maximise their individual utility - indirectly, income. The emerging theoretical literature proposed the use of incentive contracts (Jensen and Meckling, 1976; Holmstrom, 1982; Fama and Jensen, 1983) to circumvent the moral hazard that arises between principal and agent.

With regard to the empirical literature, while we could focus on the bridge between ownership types and firm performance, the difference between performance and technical efficiency is non-trivial. Despite the latter class of literature being relatively sparse in size, we will continue by outlining the existing literature pertaining to efficiency. Servin et al. (2012), with focus on Latin America, analyse the technical efficiency of microfinance institutions using a one-step SFA and find that those microfinance firms that are classed as non-governmental or cooperative have lower technical efficiency than non-bank financial intermediaries. Roy and Yvrande-Billon (2007), again using a SFA approach, look to measure the technical efficiency of urban public transport in France and find evidence to suggest that private transport operators consistent outperform their public counterparts between the period of 1995-2002, across 135 urban transport networks. In the sphere of hospital own-

ership, Ozcan et al. (1992) in a less recent study, analyse the technical efficiency of both for-profit and government hospitals, using data envelopment analysis (DEA), using the 1987 American Hospital Association annual survey and find that for-profit hospital are less technically efficient with respect to the use of their capital but more efficient in the use of service and labour inputs. Note, that in the time since this paper, a number of studies have been performed to show the relative weaknesses of DEA to outliers within collected data due to the non-parametric nature of the technique. Goldar et al. (2004) find for Indian engineering firms between the years of 1990-91 and 1999-2000, while there is no statistically significant difference between the technical efficiency of private and public ownership of those firms that are classed as domestically-owned; foreign-owned firms are operating at a higher level of technical efficiency than those that are domestically-owned. Liu (2001) in calculating the technical efficiency of 23 airlines of different ownership types between 1973-1983, again find that state-owned airlines are less technically efficient than those that are privately owned. In a study of 461 nursing homes in the US, Rosko et al. (1995) corroborate these findings, finding private ownership associated with higher levels of technical efficiency.

2.3 Data

In this study, we use data from the WBES, which provides a comprehensive and unique insight into the operation of firms across a number of both developing and transition countries, collecting survey data from both business owners and managers.

The survey is designed as such to cover topics including corruption, crime, finance, performance and trade. The survey follows a global methodology, as such, this ensures that a high levels of consistency between firm responses across countries, which is vital considering we intend to use this data in order to perform cross–country analysis. Our pooled sample is comprised of 139 countries within the period 2006–2016, across 56,507 firms; however as will be discussed within the variables section, the under–reporting of some variables reduces the overall sample size considerably in some cases. Table 2.1 present the sample countries included within the dataset.

2.3.1 Perception bias

A point of concern that has been raised in the literature in using survey data is the possibility of the existence of perception bias. De Rosa et al. (2010) in using the Business Environment and Enterprise Performance Survey (BEEPS) 2009 data notes that perception bias could arise given particular political and social aspects within the country that firm respondents originate. In light of this, the author cites work done by Fries et al. (2003) who using 2002 BEEPS data, realises the potential of such bias and as such, tests for its presence by comparing qualitative measures to their related objective measures statistically and does not find any evidence of such biases in their data. Given this is the case and that BEEPS and WBES, both carried out by the World Bank, have almost identical questionnaires and methods, we shall do as De Rosa et al. (2010) have done and assume the same with our data but also employ both industry and country fixed effects in our analysis to control for such a possibility.

Table 2.1: List of regions and countries

Region	Countries
Africa	Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Congo, Cote d'Ivoire, DRC, Eritrea, Ethiopia, Gabon, Gambia, Guinea, Guinea Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, South Sudan, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe
East Asia and Pacific	Cambodia, China, Fiji, Indonesia, Lao PDR, Malaysia, Micronesia, Mongolia, Myanmar, Papua New Guinea, Philippines, Samoa, Solomon Islands, Thailand, Timor Leste, Tonga, Vanuatu, Vietnam.
Europe and Central Asia	Afghanistan, Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, FYR Macedonia, Georgia, Hungary, Kazakhstan, Kosovo, Kyrgyz Republic, Latvia, Lithuania, Moldova, Mongolia, Montenegro, Poland, Romania, Russia, Serbia, Slovak Republic, Slovenia, Sweden, Tajikistan, Turkey, Ukraine, Uzbekistan.
Latin America and the Caribbean	Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, St Kitts and Nevis, St Lucia, St Vincent and Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela.
Middle East and North Africa	Djibouti, Egypt, Iraq, Israel, Jordan, Lebanon, Morocco, Tunisia, West Bank And Gaza, Yemen.
South Asia	Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka.

More generally, Macher and Mayo (2015, p.8) notes of the potential for perception bias within the same WBES data that we utilise in this paper. In lieu of this, the authors give four reasons to diminish such a concern and justify the use of perception responses within empirical study. The first reason they give is that the responses given are perceptions and not predictions of behavioural responses to particular stimuli. The second and third highlight the integrity and completeness of the survey design, such that, respondents are given anonymity in an attempt to reduce the extent to which cultural or private pressures coerce the individual to give an inaccurate response; as well as not offering the respondents any benefits to complete the survey, in order to limit incentives towards giving any particular response than that of the true perception. Finally, albeit with respect to the variables used in their study but no less relevant for our purposes, the authors point out that measures of perception offer as plausible a measure than other indirect measures offered from other data sources.

2.3.2 Dependent variables

Tables 2.2 and 2.3 provides definitions of the variables used in this study and associated summary statistics, respectively. In computing efficiency scores, we require suitable dependent variables that are able to capture the performance of the firm. Two offered options within the WBES dataset are the firm's total sales in the last fiscal year (Sales) and the level of the firm's value added (Value added). The former is offered directly by the dataset while the latter must be computed using other available information given from the firm's survey answers. To do so, we subtract

the total sales accrued in the last year from the total cost; total cost computed by summing together all the firm costs provided by the survey.[1] In their original form, both sales and value added are reported in local currency units, hence using data from the World Bank's World Development Indices, we convert monetary values into U.S. dollars and deflate using a GDP deflator.

2.3.3 Independent variables

In testing the two formulated hypotheses, we utilise unique measures given by the data in order to proceed with estimation. Concerning our conjectures with regard to corruption and finance, we have access to such measures. The first is a measure that originally asks the firm, 'How much of an obstacle to the firm does corruption acts to current operations?', which allows the respondent to reply by choosing from no obstacle, minor obstacle, moderate obstacle, major obstacle or very severe obstacle, represented as a scale from 0 to 4. There is the option to reply with the option, 'do not know/apply' however we have excluded these responses from our study. In order to be able to test the effect of different levels of reported corruption, we create four binary variables derived from this measure, namely Corruption: Severe, Corruption: Major, Corruption: Moderate and Corruption: Minor but excluding the option where corruption is no obstacle as a baseline case, to avoid issues arising from multicollinearity. Equally, there is a measure that asks the exact same question but with regards to access to finance, as such we transform this variable in the precisely the same fashion, thereby generating four binary variables that disaggregate the mea-

[1]The costs included are as follows: labour, electricity, communication, raw materials, fuel, transportation, water, security and the cost of rent, land and equipment.

Table 2.2: Variable definitions

Variable	Definition
Value added	Adjusted Value added of the firm, calculated by subtracting last year's total sales from total cost.
Sales	Adjusted total firm sales last year.
Labour cost	Adjusted total annual cost of labour (including wages, salaries, bonuses, social payments)
Capital	Firm's adjusted total cost of capital, computed by summing the net book value of machinery, vehicles, equipment, land and buildings.
Energy cost	Firm's adjusted total cost of energy computed by summing the firm's electricity and fuel costs.
Raw material cost	Firm's adjusted total cost of raw materials.
Size: Medium	Binary variable equal to one if the firm has between 20 and 99 employees, zero otherwise.
Size: Large	Binary variable equal to one if the firm has over 100 employees, zero otherwise.
Age	Firm age.
Domestic	Percentage of the firm owned by private domestic individuals, companies or organisations.
Foreign	Percentage of the firm owned by private foreign individuals, companies or organisations.
Other	Percentage of the firm owned by means excluding state, private domestic and private foreign ownership.
Corruption: Severe	Binary variable signifying corruption is a very severe obstacle to the firm, zero otherwise.
Corruption: Major	Binary variable signifying corruption is a major obstacle to the firm, zero otherwise.
Corruption: Moderate	Binary variable signifying corruption is a moderate obstacle to the firm, zero otherwise.
Corruption: Minor	Binary variable signifying corruption is a minor obstacle to the firm, zero otherwise.
Finance: Severe	Binary variable equal to one if access to finance is a very severe obstacle to the firm, zero otherwise.
Finance: Major	Binary variable equal to one if access to finance is a major obstacle to the firm, zero otherwise.
Finance: Moderate	Binary variable equal to one if access to finance is a moderate obstacle to the firm, zero otherwise.
Finance: Minor	Binary variable equal to one if access to finance is a minor obstacle to the firm, zero otherwise.
Labour	The extent that labour regulations are an obstacle to firm operation on a scale from 0-4, increasing with severity.
Black market	The extent that the informal economy is an obstacle to firm operation on a scale from 0-4, increasing with severity.
Tax	The extent that tax administration is an obstacle to firm operation on a scale from 0-4, increasing with severity.

Table 2.3: Summary statistics

Variable	**Mean**	**Standard Deviation**	**N**
Value added	553996.502	92365966.277	52978
Sales	820751.91	91448018.503	52978
Labour cost	29687.78	1494808.42	52680
Capital	19309.621	1004445.068	27537
Energy cost	157426.741	7334508.616	30881
Raw material cost	383363.036	14409611.41	22968
Size: Small	0.449	0.497	56507
Size: Medium	0.352	0.477	56507
Size: Large	0.199	0.399	56507
Age	18.662	15.539	56507
Other	1.600563	11.34703	55761
Foreign	8.287	25.645	55763
State	0.767	7.025	55770
Corruption: Minor	0.167	0.373	56477
Corruption: Moderate	0.169	0.375	56477
Corruption: Major	0.187	0.39	56477
Corruption: Severe	0.159	0.366	56477
Finance: Minor	0.214	0.41	54506
Finance: Moderate	0.221	0.415	54506
Finance: Major	0.158	0.365	54506
Finance: Severe	0.09	0.285	54506
Labour	1.487	1.356	56018
Black market	1.394	1.239	56057
Tax	1.016	1.132	56039

sure of the constraint to financial access: Finance: Severe, Finance: Major, Finance: Moderate and Finance: Minor.

In addition to these variables, we do also have data on a range of firm inputs, namely labour costs (Labour cost), the value of the firm's capital stock (Capital), energy costs (Energy cost) and raw material costs (Raw material cost). While the measures of labour and raw material costs are given directly by the respondent, the others have been computed given other responses. Firstly, the measure of capital is calculated by summing the net book value of machinery, vehicles, and equipment and net book value of land and buildings; while the firm's energy cost is given by the sum of electricity costs and fuel costs. Unfortunately, other than labour cost, the other aforementioned factors of production are reported to a far lesser extent. The reasons for under-reporting may include poor accounting, given the developing nature of a large number of countries in the sample or unwillingness to disclose such information. However, such attempts to explain is pure conjecture. Nonetheless, the resultant sample size is still sufficient to perform suitable empirical analysis.

2.3.4 Control variables

In addition to those parameters that we are using to directly test the hypothesis we have formulated, it is imperative that we include other relevant factors which are available in our data that have the ability to effect the efficiency of the firm's operation, in order to offer an adequate explanation. Considering our first group of control variables, we include two parameters to account for heterogeneity between two fundamental firm aspects, firm size (Size) and firm age (Age). The survey

characterises firm size by the number employees employed by the firm and as such we create individual dummies to represent each of three levels represented and use small firms as the benchmark, whilst using both medium and large–sized firms within our analysis. The use of this characteristic is important for our analysis as it allows us to control for the fact that as firm become larger they are able to take advantage of particular scale and scope economies that lend themselves to increasing efficiency. Table 2.4 reports the observations by firm size. Furthermore, firm age is another key factor to include as there is thought to be an experience effect, that is, 'learning by doing' that comes with the increasing age of the firm that could also contribute to efficiency gains.

Furthermore, to mitigate for the effect of the composition of firm ownership on efficiency, we use responses to the survey question, 'What percent of this firm is owned by each of the following?'. In response to this question, the participants are presented with the following ownership modes and as such act as our variables for such a measure: domestic private (Domestic), foreign private (Foreign), government/state (State) or other. We use the 'State' option of ownership as a benchmark as well as avoiding associated multicollinearity issues. In testing the corruption hypothesis, whilst we enlist the use of a comprehensive measure for corruption within a particular business environment, there is an underlying concern that this measure would wrongly be associated with changes to efficiency that are in fact attributed to related factors, in other words, introducing omitted variable bias into our estimation. As such, we make use of another obstacle to firm operation that is included in the survey that may wrongly be attributed to corruption - practices of competitors in

Table 2.4: Composition of firm sample

	Small		**Medium**		**Large**	
Region	Services	Manufacturing	Services	Manufacturing	Services	Manufacturing
Africa	3,015	4,961	1,915	1,717	937	450
East Asia and Pacific	1,413	1,624	2,030	1,126	1,880	513
Europe and Central Asia	1,376	3,134	1,716	1,845	1,148	829
Latin America and the Carribbean	2,946	2,015	3,145	1,682	2,019	964
Middle East and North Africa	734	803	671	412	386	149
South Asia	2,230	1,136	2,788	824	1,689	285
Total	11,714	13,673	12,265	7,606	8,059	3,190

the informal sector (Black market).

In relation to our second hypothesis, our survey of the literature found that SMEs were most affected by credit constraints and access to finance. As such, another related aspect to firm finance could pertain to the taxation implications growing firms face. It could be argued that countries encourage the growth of SMEs, by means of easing regulatory burden, financial or otherwise, as smaller–sized are not as adequately equipped to devote independent resources to oversee the firm's accordance and adherence to evolving regulatory frameworks, implemented by government or other such bodies, than that of larger–sized firms. We therefore use a variable to account for varying extents of regulatory burden to the firms operation, namely tax administration (Tax) and labour regulation (Labour).

2.4 Methodology

2.4.1 Background

In attempting to both estimate the level of technical efficiency of firm production as well as going towards attempting to explain the reasons for variation and disparity of such measure, we will be using an stochastic frontier analysis (SFA) approach. The birth of this method can be found in the works of Aigner et al. (1977), Battese and Corra (1977) and Meeusen and van den Broeck (1977), initially used to assess the efficiency of the agricultural sector, SFA has increasingly become the preferred procedure in studies that involve either efficiency or cost analysis. In outlining the methodology adopted in this study, we use the notation proposed by Kumbhakar

and Lovell (2003). In the initial studies in which this method finds its origins, the SFA is typically performed by estimating a model as shown by equation 2.1 in its general form; where y is the output vector, x is a matrix of inputs and β is a vector of technology parameters.

$$y = f(x;\beta).exp\{v - u\} \tag{2.1}$$

Unlike typical regression models, the SFA model estimated by maximum likelihood (ML), has a composite error term comprised of two separate elements; the first component of the error term v contains the two–sided statistical noise of the estimation, while the second error term u is the element of note, as it is the proportion of the model which is intended to capture the technical inefficiency effects. One integral feature of u is a necessary non–negativity constraint ($u \geq 0$), which conceptually is a sensible one, such that for a given production frontier, the producer must be either producing at a point on the frontier ($u = 0$), where there is no technical inefficiency or underneath ($0 > u \leq 1$) with some degree of technical inefficiency.

2.4.2 Distributional choice

An important aspect to consider with respect to estimating this type of model is the choice of distribution we assume the error terms to follow. First considering v, while non–trivial, is generally considered to follow the normal distribution as well as being independent and identically distributed, that is, $v \sim \mathcal{N}(0, \sigma_v^2)$ and by construction does not have the non–negativity constraint of the technical inefficiency term u. Conversely, the crux of the issue lies with the distributional assumptions

made about the counterpart term within the composite error, u. In older studies adopting SFA methodology, quite often, this issue is sparsely discussed, if at all, as u is assumed the follow a half–normal distribution, the justification being that such convention is often assumed or followed in previous such studies.

While this may have been acceptable during the SFA method's inception, since this time, much has been considered and investigated regarding such choice. In addition to the half–normal distribution, practitioners have also considered the technical inefficiency term to follow exponential, gamma and truncated normal distributions. This presents a considerable challenge for the researcher. In order to overcome such obstacle, a sensible place to start would be in the surrounding technical literature. Kumbhakar and Lovell (2003, p.90) contribute to this discussion by providing a small number of notable results found by others testing the properties of the aforementioned distribution options. The authors calculate rank correlations of sample mean efficiencies attained by Greene (1990) in estimating cost frontiers of US electric utilities using half–normal, truncated normal, gamma and exponential distributions and find that while the lowest correlation is between gamma and truncated normal of 0.7467, the highest is found to be between half–normal and exponential of 0.9803. With the proviso of this relation generally yielding true, the authors point out that this result will provide support to work done by Ritter and Simar (1997a,b) who suggest the use of simpler distributional choices such as half–normal and exponential over other more flexible choices.

Moreover, Coelli et al. (2005, p.253) make a very important distinction when it comes to the computation of efficiency scores using different distributional choices.

While it is true that the choice of distribution that u is assumed to follow will have ramifications on the predicted level of technical efficiency, the ranking of entities for which technical efficiencies have been calculated, is often robust to the choice of distribution. Furthermore, they state that in such cases, that simpler distributions such as half–normal and exponential should be preferred. As such, we will proceed our empirical analysis by assuming u to follow the half–normal distribution.[2]

2.4.3 One–step versus two–step estimation

Following the estimation of the equation 2.1 and computation of technical inefficiency values, previously the second stage of a two–step method is executed, in which a variety of explanatory parameters are regressed on the technical inefficiency values obtained in the first stage, as in equation 2.2, where $E(-u_i|v_i - u_i)$ is the estimated technical inefficiency values, z_i is a vector of explanatory variables and their associated parameter estimates, γ, as well as an error term e_i.[3]

$$E(-u_i|v_i - u_i) = g(\gamma z_i) + \epsilon_i \tag{2.2}$$

While this model may be technically feasible, it has been suggested by Greene (2008, p.155) that by not including variables which are considered important in explaining the efficiency of production in the first stage and using the very same derived

[2]In order to estimate our models, we utilise the *frontier* routine in Stata. Use of the gamma distribution is not available and additionally use of the truncated normal does not allow the use of the composite error structure, crucial for our analysis. As a result, we only have half–normal and exponential at our disposal. Unfortunately, the initial values used in estimating our empirical models are not feasible using the exponential distribution, hence we proceed using half–normal.

[3]For completeness, note that it is assumed $e_i \sim iid\,(0, \sigma_e^2)$.

estimates in the second stage would lead to the introduction of a 'persistent bias' to the estimation of the model in the second stage of the SFA method. Given such potentially critical failings of the two–stage estimation of technical efficiency, we adopt the one–stage approach as specified by Kumbhakar et al. (1991), as characterised by equations 2.3 and 2.4.

$$ln\, y_i = ln\, f(x_i; \beta) + v_i - u_i \tag{2.3}$$

$$u_i = \gamma' z_i + \epsilon_i \tag{2.4}$$

It follows from equations 2.3 and 2.4:

$$ln\, y_i = ln\, f(x_i; \beta) + v_i - \{\gamma' z_i + \epsilon_i\} \tag{2.5}$$

2.4.4 Empirical model

In using 2.5, we are able to both estimate the production frontier and in doing so, simultaneously explain technical efficiency with the chosen set of explanatory variables, whilst addressing the aforementioned bias resulting in the two–stage method of estimation. Within the model adopted by this study, we will model the firm's production function using both Cobb–Douglas and translog specifications as in equations 2.6 and 2.7, in doing so, we can directly test for the preferred specification given that the Cobb–Douglas model is nested within the Translog specification. To do so, we will jointly test the significance of the additional terms within Translog model, in order to avoid any bias associated with model misspecification.

$$ln\, y_i = ln\ A + \sum_{i=1}^{n} \beta_i ln\ (x_i) + v_i - \{\sum_{i=1}^{n} \gamma_i' z_i + \epsilon_i\} \tag{2.6}$$

$$ln\, y_i = ln\ A + \sum_{i=1}^{n} \alpha_i ln\ (x_i) + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \beta_{ij} ln\ (x_i)\ ln\ (x_j) + v_i - \{\sum_{i=1}^{n} \gamma_i' z_i + \epsilon_i\} \tag{2.7}$$

Furthermore, post-estimation we will be able to attain the values of technical efficiency estimates as suggested by Jondrow et al. (1982):

$$TE_i = E(u_i|\epsilon_i) = \mu_{*i} + \sigma_* \left[\frac{\phi(-\mu_{*i}/\sigma_*)}{1 - \Phi(-\mu_{*i}/\sigma_*)} \right]^{4} \tag{2.8}$$

$$\text{where } \mu_* = -\epsilon \frac{\sigma_u^2}{\sigma^2} \text{ and } \sigma_*^2 = \sigma_u^2 \frac{\sigma_v^2}{\sigma^2}$$

and proceeding to take the mean of this measure to present estimates of technical efficiency for further comparison and consideration.

2.5 Estimation

2.5.1 Primary estimation results

Table 2.7 presents the primary estimation results of the empirical analysis. As in Saliola and Seker (2011) and Saliola and Seker (2012), we employ firm sales as the primary output variable in this study, however in the interest of completeness and robustness, we also perform additional computations using firm value added as an

[4]Where $\Phi(.)$ and $\phi(.)$ are the standard normal cumulative distribution and density functions, respectively. σ_*^2 is reparameterisation of the variances of both parts of the composite error.

alternative output measure. In both estimations, we carried out estimation of our model on a variety of factor inputs and by means of an F–test, we find that the use of all available factor inputs is preferred (F=594.87, p=0.000, F=670.59, p=0.000). Moreover, we perform a log–likelihood ratio test on both Cobb–Douglas and translog specification of production and find that translog is preferred in both cases (χ^2 =1300.30, p=0.000, χ^2=3482.78, p=0.000). Additionally, to account for heterogeneity and the possibility of perception bias across our sample, we employ the use of country, industry–level and year effects in all estimations performed.

Table 2.5: Specification Tests: Total Sales

	Log-Likelihood			Choice of Factors	
Factor Specification	**Cobb-Douglas**	**Translog**	**F-Test**	**LK vs LKE**	**LKE vs LKEM**
LK	-29064.298	-28871.116	108.92 (0.000)	–	–
LKE	-26500.407	-26161.067	99.23 (0.000)	5420.10 (0.000)	–
LKEM	-22777.171	-21035.643	670.17 (0.000)	–	10250.85 (0.000)

Table 2.6: Specification Tests: Value Added

	Log-Likelihood			Choice of Factors	
Factor Specification	**Cobb-Douglas**	**Translog**	**F-Test**	**LK vs LKE**	**LKE vs LKEM**
LK	-31542.262	-31367.269	194.34 (0.000)	–	–
LKE	-29616.102	-29364.507	120.74 (0.000)	4005.52 (0.000)	–
LKEM[a]	-28759.965	-28109.746	594.99 (0.000)	–	2509.52 (0.000)

[a] Where L is labour, K is capital, E is electricity and M is raw materials input, respectively.

Table 2.7: Stochastic Frontier Estiamtes

Variable	(1) Value added	(2) Sales	(3) Value added	(4) Sales
Panel A: Production function				
ln(Labour cost)	0.0117 (0.838)	0.185 (0.000)	-0.0431 (0.486)	0.101 (0.030)
	(0.0571)	(0.0402)	(0.0619)	(0.0464)
ln(Capital)	-0.0569 (0.150)	-0.0145 (0.559)	-0.0628 (0.175)	-0.0529 (0.104)
	(0.0395)	(0.0249)	(0.0463)	(0.0325)
ln(Energy cost)	0.360 (0.000)	0.315 (0.000)	0.376 (0.000)	0.335 (0.000)
	(0.0541)	(0.0333)	(0.0514)	(0.0326)
ln(Raw material cost)	0.179 (0.000)	0.223 (0.000)	0.172 (0.000)	0.221 (0.000)
	(0.0357)	(0.0255)	(0.0390)	(0.0237)
$0.5\ln(\text{Labour cost})^2$	0.183 (0.000)	0.113 (0.000)	0.196 (0.000)	0.165 (0.000)
	(0.0154)	(0.0129)	(0.0155)	(0.0116)
$0.5\ln(\text{Capital})^2$	0.0135 (0.000)	0.00615 (0.000)	0.0132 (0.000)	0.00850 (0.000)
	(0.00198)	(0.00123)	(0.00228)	(0.00142)
$0.5\ln(\text{Energy cost})^2$	0.0776 (0.000)	0.0385 (0.001)	0.0954 (0.000)	0.0870 (0.000)
	(0.0165)	(0.0120)	(0.0121)	(0.00733)
$0.5\ln(\text{Raw material cost})^2$	0.144 (0.000)	0.135 (0.000)	0.140 (0.000)	0.155 (0.000)
	(0.00790)	(0.00676)	(0.00840)	(0.00622)
ln(Labour cost) x ln(Capital)	-0.00785 (0.307)	-0.000379 (0.958)	-0.00363 (0.641)	-0.00150 (0.766)
	(0.00768)	(0.00744)	(0.00779)	(0.00506)
ln(Labour cost) x ln(Raw material cost)	-0.0889 (0.000)	-0.0793 (0.000)	-0.0874 (0.000)	-0.0906 (0.000)
	(0.00801)	(0.00895)	(0.00825)	(0.00589)
ln(Capital) x ln(Raw material cost)	-0.00912 (0.095)	-0.00479 (0.282)	-0.00800 (0.175)	-0.00701 (0.040)
	(0.00547)	(0.00446)	(0.00590)	(0.00340)
ln(Labour cost) x ln(Energy cost)	-0.0460 (0.000)	-0.0110 (0.387)	-0.0623 (0.000)	-0.0443 (0.000)
	(0.0131)	(0.0127)	(0.0112)	(0.00746)
ln(Capital) x ln(Energy cost)	0.00737 (0.280)	-0.00278 (0.755)	0.00337 (0.588)	0.00257 (0.472)
	(0.00682)	(0.00889)	(0.00622)	(0.00357)
ln(Energy cost) x ln(Raw material cost)	-0.0475 (0.000)	-0.0378 (0.000)	-0.0445 (0.000)	-0.0484 (0.000)
	(0.00760)	(0.00800)	(0.00812)	(0.00484)
Constant	7.002 (0.000)	5.873 (0.000)	7.520 (0.000)	6.178 (0.000)
	(0.309)	(0.179)	(0.491)	(0.279)
Panel B: Idiosyncratic error component				
Size: Medium	0.00758 (0.909)	-0.273 (0.005)	0.0770 (0.166)	-0.218 (0.021)
	(0.0663)	(0.0981)	(0.0556)	(0.0949)

Continued on next page

Table 2.7 – continued from previous page

Size: Large	0.261 (0.000)	0.364 (0.003)	0.303 (0.000)	0.270 (0.023)
	(0.0746)	(0.122)	(0.0764)	(0.119)
Constant	0.513 (0.000)	-0.620 (0.000)	0.422 (0.000)	-0.840 (0.000)
	(0.0530)	(0.0841)	(0.0550)	(0.0735)
Panel C: Technical inefficiency component				
Size: Medium	-1.131 (0.002)	-1.759 (0.000)	-1.138 (0.004)	-2.160 (0.000)
	(0.364)	(0.207)	(0.391)	(0.274)
Size: Large	-3.944 (0.001)	-29.47 (0.000)	-4.092 (0.026)	-29.50 (0.000)
	(1.149)	(0.464)	(1.854)	(0.459)
Age	0.0103 (0.604)	0.00679 (0.102)	0.00658 (0.614)	0.00641 (0.068)
	(0.0198)	(0.00415)	(0.0131)	(0.00351)
Other	0.0173 (0.150)	0.00922 (0.437)	0.0141 (0.130)	-0.00345 (0.694)
	(0.0120)	(0.0119)	(0.00933)	(0.00874)
Foreign	-0.167 (0.608)	-0.0176 (0.152)	-0.0041 (0.673)	-0.0330 (0.012)
	(0.325)	(0.0122)	(0.00973)	(0.0130)
Domestic	0.0152 (0.151)	-0.00154 (0.888)	0.0124 (0.121)	-0.00854 (0.214)
	(0.0106)	(0.0109)	(0.00797)	(0.00688)
Black market	0.0126 (0.876)	0.0428 (0.345)	0.0152 (0.791)	0.0192 (0.600)
	(0.0803)	(0.0454)	(0.0574)	(0.0367)
Tax	0.104 (0.390)	0.0952 (0.092)	0.0778 (0.247)	0.0525 (0.281)
	(0.121)	(0.0565)	(0.0672)	(0.0487)
Labour	-0.0633 (0.611)	-0.123 (0.028)	-0.0757 (0.382)	-0.121 (0.032)
	(0.124)	(0.0564)	(0.0867)	(0.0563)
Corruption: Minor	-0.455 (0.052)	-0.499 (0.005)	-0.360 (0.035)	-0.582 (0.002)
	(0.234)	(0.176)	(0.171)	(0.185)
Corruption: Moderate	-0.150 (0.576)	-0.251 (0.148)	-0.132 (0.419)	-0.107 (0.530)
	(0.268)	(0.173)	(0.163)	(0.171)
Corruption: Major	-0.293 (0.287)	-0.337 (0.069)	-0.258 (0.269)	-0.358 (0.030)
	(0.275)	(0.185)	(0.233)	(0.165)
Corruption: Severe	-0.616 (0.189)	-0.353 (0.232)	-0.460 (0.075)	-0.775 (0.000)
	(0.470)	(0.295)	(0.259)	(0.209)
Finance: Minor	0.170 (0.408)	0.123 (0.541)	0.171 (0.321)	0.146 (0.401)
	(0.206)	(0.203)	(0.173)	(0.173)
Finance: Moderate	0.149 (0.479)	0.361 (0.103)	0.181 (0.265)	0.367 (0.023)
	(0.210)	(0.222)	(0.162)	(0.162)
Finance: Major	0.627 (0.035)	0.386 (0.037)	0.541 (0.002)	0.658 (0.000)
	(0.297)	(0.186)	(0.176)	(0.164)

Continued on next page

Table 2.7 – continued from previous page

Finance: Severe	1.067 (0.000)	0.577 (0.004)	0.976 (0.000)	0.900 (0.000)
	(0.259)	(0.199)	(0.270)	(0.167)
Constant	-2.46 (0.046)	-2.320 (0.003)	-1.750 (0.027)	-1.965 (0.003)
	(1.234)	(1.079)	(0.790)	(0.671)
N	16167	18838	15208	15208
Country, industry and year fixed effects	Yes	Yes	Yes	Yes
Log-likelihood	-28108.21	-21034.588	-26188.415	-15127.573
F-test for factors of production χ^2_{10}	594.87 (0.000)	670.59 (0.000)	564.73 (0.000)	1166.43 (0.000)
Likelihood ratio test for production function specification χ^2_8	1300.30 (0.000)	3482.78 (0.000)	962.11 (0.000)	3659.22 (0.000)

P-values are reported besides coefficients in parentheses, standard errors underneath.

Panels A and B of Table 2.7 presents the production function and idiosyncratic error components of the model respectively, which are included for completeness. However Panel C provides the estimates for the attributed efficiency effects of each of the included explanatory parameters. In interpreting these particular coefficients, two things must be kept in mind. Firstly, due to composite nature of the error terms, negative coefficients reflect increases in efficiency, while positive estimates point to increases in inefficiency. Secondly, with regard to the disaggregate measures, we have omitted the case where the a given obstacle is not recognised as an obstacle to a given firm, to avoid multicollinearity issues, as such, is the benchmark with which we can compare other measures of severity included in the model. Moreover, the size of the effect, in and of itself, is not of particular interest but useful relative to other estimated coefficients, in understanding which factor has a greater effect on firm in/efficiency.

Model one, which concerns the firm's value added as an output measure, provides evidence in support of Hypothesis 2, which conjectures that obstacles to firm financing would be associated with higher levels of firm efficiency. Specifically, firms that reported their ability accessing financial markets either as a major or severe

obstacle to firm operation, were found to be associated with higher levels of technical inefficiency relative to those firms that did not report financing as an obstacle. Moreover, analysing the estimated coefficients further, we find that the attributed increase in firm inefficiency between reporting the finance access as major to severe is 70.8 percent[5]. Moreover, Model 2, which takes firm sales as the output measure, reaffirms the agreement with Hypothesis 2 found in Model 1, again with regard to both major and severe measures. However, despite the agreement of point estimates across models, the difference in magnitude across the output measures is notable, 78.6 percent and 46 percent for major and severe, respectively.

In contrast, our other formulated premise, Hypothesis 1, which stated corruption will be negatively associated with firm efficiency, is found to be in contravention with the outcome of our empirical analysis. Both Models 1 and 2 find evidence to the contrary of Hypothesis 1, specifically in the case of firms reporting corruption as a minor obstacle to operation, there is an association of higher levels of technical efficiency. Interestingly, while there is relatively large variation between coefficients found between both models, in the case of finance, the measure of corruption as a minor obstacle to firm operation is far less output-dependant, with a difference of around 9.6 percent between model coefficients. In the only other paper that exists in the firm efficiency literature employing a similar methodlogy (Hanousek et al., 2016), the empirical anlysis of this chapter are in contradiction, as they find that corruption perception is negative related to the efficiency of the firm, where the output of the firm is measured as firm sales. The primary reason for this could be

[5]Calculated as the percentage change between estimated coefficients for major and severe levels of severity

due to the differences in the countries captured in the dataset. While Hanousek et al. (2016) use the BEEPS dataset, comprising of only 14 Central and Eastern Eurpean Countries; we use the WBES dataset comprising of 139 countries across Africa and Asia, as well as Europe. The inclusion of these countries that are in a relatively earlier stage of developments, which on average, will have institutions and rule of law that are less effective and advanced than those considered in the BEEPS. Consistent with the work of Huntington (1968) and Leff (1964), where red tape can be reduced to increase efficiency, corruption acts as the effective 'grease', given institutions are weaker and allow for such behaviour (Méon and Sekkat, 2005).

Moreover, while we find that while technical efficiency increases with firm size, regardless of output measure, the size of the effect across models is far less consistent; while the technical efficiency for medium firms, relative to small firms, is 55.4 percent higher when sales is the output measure, firm efficiency for large firms is over seven times larger than when value added is the output measure. Furthermore, we find that the various controls that we have included to capture differing aspects of firm heterogeneity, over and above corruption and finance, show no evidence of any relationship between any covariate and firm efficiency when we consider value added. However in Model 2, when we consider firm sales, we do find that several of these parameters, namely levels of domestic and foreign ownership, as well as tax administration and labour regulation, are important determinants to the level of firm efficiency.

In particular, we find in Model One, relative to state-owned firms, private domestic firms are less efficient, whereas foreign-owned private firm are more efficient,

however the latter is statistically insignificant. Whereas, in the case of Model Two, while the other ownership category of firms are again less efficient, relative to state-owned firm, both private foreign and domestic-owned firms are significantly more efficient in production. The latter finding is consistent with the typical convention put foward in the literature with respect to the difference in property rights between public and private ownership; as described by Yu (2013), due to clearer definition of property rights within privately-owned firms, incentives for seeking profits by owners of privately-owned firms results in a more effective method of monitoring management performance.

2.5.2 Robustness testing

Again, following the treatment of the production data in use when estimating the production function, we follow the methodology of Saliola and Seker (2011) and re–estimate Models 1 and 2 using observations that are within three standard deviations from the mean, in order to ascertain whether the results found previously, are robust in the presence and absence of outliers. Models 3 and 4 present the estimates of the reduced data sample, again with two differing output measures. Comparing Models 1 and 3, we find that our results are still in support of Hypothesis 2, although the attributed effect on firm inefficiency for both major and severe financing obstacle are reduced by 13.6 and 8.7 percent, respectively. Additionally, when we estimate the Model 2 with the refined sample, we find evidence that moderate finance obstacles are increased levels of inefficiency in production, in addition to the major and severe measures, their coefficients increasing with the levels of severity.

The unconformity of our results with Hypothesis 1 also persists across both Models 3 and 4, as firms that report corruption as a minor obstacle are found the be associated with higher levels of technical efficiency. Although we do note that the difference in the reported coefficient across output measure is greater in the augmented sample that the full sample ($\Delta_{full} = 0.044, \Delta_{robust} = 0.222$). While not the case with Models 1–3, Model 4 provides further evidence contrary to Hypothesis 1, in addition to minor severity, we find evidence of the same association, in terms of both major and severe reported levels, although, unlike financial obstacles, there does not appear to be a clear relation between obstacle severity and estimate size.

Finally, with regard to other firm characteristics, they are on balance robust to sample changes, in the sense that the direction of the effect is analogous but rather the strength differs to an extent. Three primary differences do arise; firstly, relative to state ownership, all types of ownership have a statistically significant effect on firm efficiency, irrespective of the output measure. Secondly, where sales is the dependent variable, all three forms of firm ownership are associated with firm efficiency, again relative to the base case. In addition, when firm sales is considered as the output measure, we find evidence that firm age is negatively related with firm efficiency, however the size of the effect is relatively limited ($\beta = 0.00641$).

2.5.3 Calculated efficiency scores

While the one-step SFA framework allows for firm efficiency to be estimated and then explained by a set of explanatory covariates, we are also able to extract from the estimated models, efficiency scores that can be aggregated by different criteria.

Although they are not, in and of themselves, necessary for the testing of hypotheses formulated in this chapter, it would still be interesting nonetheless to analyse these to ascertain whether or not they provide any additional insight. Tables 2.8 and 2.9, as well as figures 2.1 and 2.2 present the efficiency scores for the SFA models for both output types, by year and sector respectively.

In either case, while the technical efficiency attained from the sales frontier is higher in every year than that of the frontier estimated from the value added measure of output, the two measures are highly correlated ($\rho = 0.9066$ ($p<0.0000$)), perhaps not unexpected but of significance. Graphically, this is also made evident by observing figure 2.1, where both series follow similar trajectories but separated by a persistent level difference. In explaining the latter, it is likely that firms natively seek to maximise sales subject to constraints on the production process, hence attaining high levels of technical efficiency relative to a more indirect measure, which is calculated by using other variables reported in the dataset. Moreover, value added can vary widely depending on the intensity of a particular market, where competitive pricing strategies may be utilised.

Table 2.8: Mean Technical Efficiency by Year

Year	Sales	Value Added
2006	0.871	0.736
2007	0.899	0.778
2008	0.912	0.788
2009	0.901	0.786
2010	0.904	0.780
2011	0.838	0.675
2012	0.925	0.815
2013	0.892	0.763
2014	0.896	0.757
2015	0.901	0.788
All	0.894	0.768

Table 2.9: Annual Mean Technical Efficiency by Sector

Year	Sector	Sales	Value Added
2006	Manufacturing	0.871	0.736
2007	Manufacturing	0.899	0.778
2007	Services	0.812	0.660
2008	Manufacturing	0.912	0.788
2008	Services	0.905	0.771
2009	Manufacturing	0.904	0.789
2009	Services	0.853	0.734
2010	Manufacturing	0.904	0.780
2010	Services	0.889	0.760
2011	Manufacturing	0.837	0.674
2011	Services	0.894	0.773
2012	Manufacturing	0.925	0.815
2012	Services	0.888	0.775
2013	Manufacturing	0.893	0.764
2013	Services	0.872	0.739
2014	Manufacturing	0.896	0.757
2014	Services	0.859	0.725
2015	Manufacturing	0.901	0.788
2015	Services	0.897	0.809
All	Manufacturing	0.895	0.769
All	Services	0.866	0.740

Another point of note, would be the considerable fall of technical efficiency in 2011, with the sales and value added measures falling by around 0.065 and 0.104 respectively, from the previous year. Given the vast number of countries within the dataset, the primary reasons for this which accounts for the interconnectedness of the global economy, would be the negative shock that stock markets experience within the US, Europe, Asia and the Middle East, arising from the European debt crisis, as well as the downgrading of credit ratings in France and the US. This uncertainty is likely to create macroeconomic conditions which are less favorable to those engaging within the international, as opposed to the domestic business environment.

Moreover, if we consider the resultant currency fluctuations of macroeconomic instability within those countries that are primarily involved, namely developed countries, weaker terms of trade relative to developing countries that we have analyzed in this data, could translate to lower sales for these firms. Additionally, firms within this analysis that relied on imported raw materials to manufacture their products, may see a fall in technical efficiency, as measured as a function of value added, if unfavorable currency fluctuations ultimately increase the cost of production, ceteris paribus. The conjecture is given some weight after analysing figure 2.2, once we disaggregate technical efficiency by sector.

Again, we observe the same level differences throughout the series between the sales and value added measures but there is a distinct difference when comparing sectoral efficiency. While cross-country efficiency within the manufacturing sector is akin to that of the combined measure; the service sector efficiency during 2011, does not experience the same decline. In fact, the resilience is such that from 2010-2011,

Figure 2.1: Mean Technical Efficiency by Year

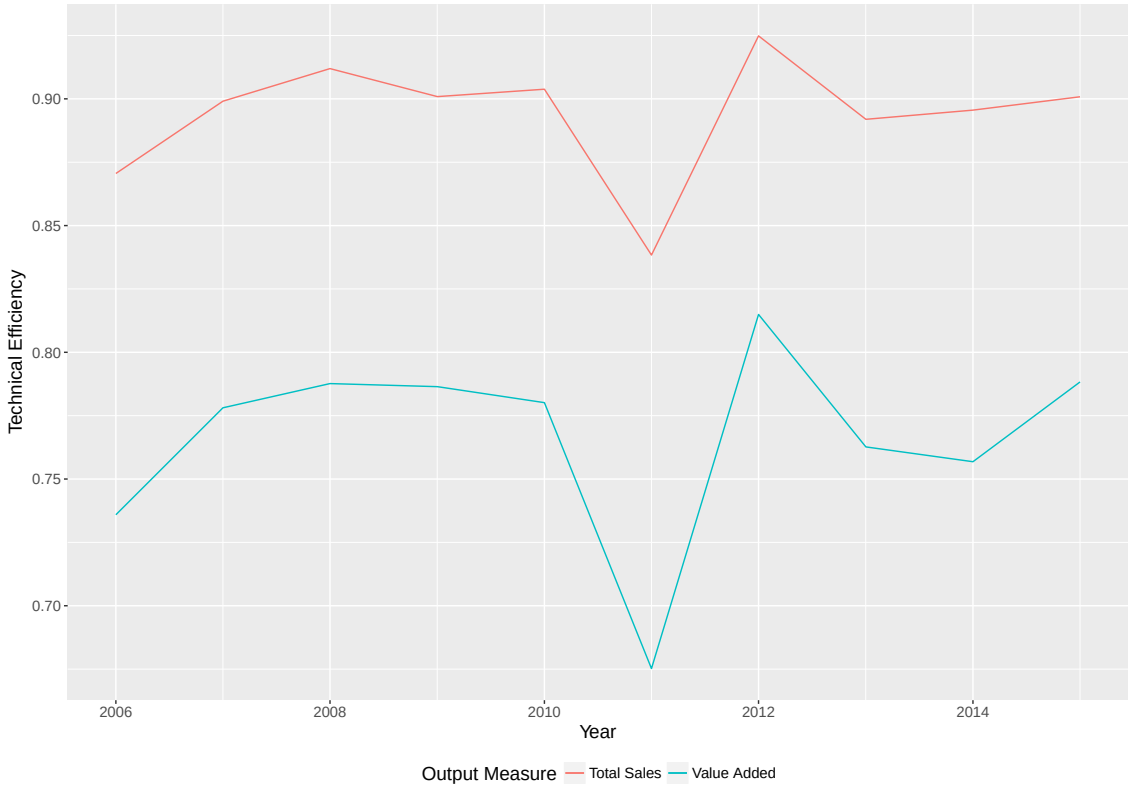
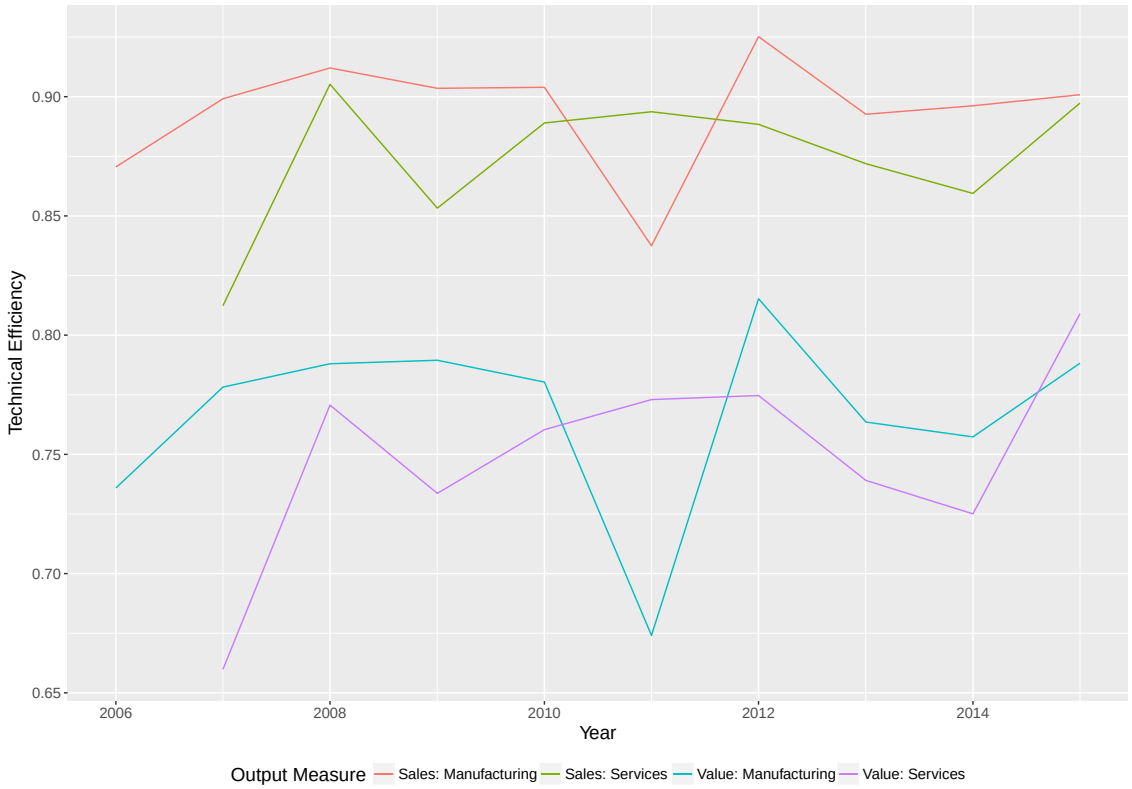


Figure 2.2: Annual Mean Technical Efficiency by Sector



the mean technical efficiency increases. The justification for this may lie simply in the characteristic differences in what constitutes both sectors; manufacturing relies on raw materials, imported or domestically harvested, to produce a product, whereas services are principally involve the use of labour. That is not to say that there is not other components to the process, however the relative differences, it could be argued, acts as a safeguard against such volatile circumstances.

2.6 Discussion and Conclusion

Previously, there has been a large volume of work undertaken within the finance literature investigating the implications of financial constraints with respect to the development of SMEs (Beck et al., 2005; Beck and Demirguc-Kunt, 2006; Aghion et al., 2007). Comparatively, the corruption literature has developed a body of work investigating its effects, that pervades through a plethora of subjects but most relevant to this study, efficiency effects at either the continent/regional (Gaviria, 2002; Teal and McArthur, 2002; Athanasouli et al., 2012) or industry (Dal Bó and Rossi, 2007; Yan and Oum, 2011; Castro et al., 2014) level. Given the two sets of literature, we recognise that there is a considerable gap that considers both efficiency effects of both corruption and financial constraints at the firm level. To our knowledge, our attempt to assess the the effect of financing obstacles or corruption on the efficiency effects of firm, using the dimension of severity, is the first to do so within the related literature.

In this paper, the main contributions of our empirical analysis are twofold. In gen-

eral, our findings highlight the prominent role that differing levels of both obstacles, constraints to financial access and corruption, play in the efficiency of firm production, providing a unique insight and extension to the existing literature. Firstly, our analysis finds evidence consistent with previous literature, in relation to the detrimental effect of restriction to financial markets on the development of the firm. Specifically, we show that firms that communicate that they experience accessing finance as an obstacle to production, particularly of higher degrees of severity, are operating at a lower level of efficiency, relative to those firms who report encountering no such constraint.

It is important to note the importance of these findings; the composition of countries in the tested sample is predominantly those that are earlier stage of development and moreover, the composition of firms by size in our study mirrors that which is found in most countries, in that SMEs make up the majority of firms in the private sector. The two preceding points in combination, therefore highlight the importance of reducing factors that act to inhibit future avenues for growth for SMEs. As such, one established restriction that has been identified in the empirical literature as disproportionally affecting SMEs relative to larger firms is their difficulty in accessing finance (Ayyagari et al., 2007; Beck et al., 2005).

Furthermore, the outcome of our empirical analysis suggests that those firms that acknowledge corruption as a minor obstacle to operation are associated with higher levels of technical efficiency, in comparison with firms who do not report corruption as a obstacle at any severity. Implicitly, this is consistent with the 'grease money' hypothesis and while not in support of our formulated hypothesis, consid-

ering the varying state of development that the sample countries are situated, this result is not as unexpected as was first the case. As is discussed and analysed by Méon and Sekkat (2005) and Méon and Weill (2010), in countries that are situated in relatively early stages of development, the advancement of various political and economic institutional frameworks, such as the rule of law and governance structures, are comparably embryonic. As such, corruption may act as an efficacious apparatus to facilitate transactions and agreements between parties, in lieu of a matured underlying formal due process and effective bureaucratic mechanisms.

In addition to the two hypotheses tested in this paper, we find amongst the additional measures of firm characteristics that firm increase their technical efficiency as their size increase, providing affirmation to the theoretical scale economies albeit with respect to efficiency in production, as opposed to cost. While in this paper we have not directly investigated the mechanism of this effect, previous empirical works have shown a positive relationship between firm size and research and development expenditure, although in a review of all the empirical literature, there is no consensus as to the particular threshold of firm size, after which this positive relationship occurs (see Symeonidis (1996)). Moreover, this particular finding does not necessarily hold across industries, particularly in high–tech areas where in fact, smaller firms are engaging with research and innovation–related activities. While this may seem to contradict what has been established previously regarding financial constraints on small firms, it could be suggested that in this particular industry, smaller firms are more likely to receive funding for innovative activities, in contrast to other low–tech industries (Hall et al., 2009).

This outcomes of this paper have important implications for policy makers to consider, particularly with reference to those countries considering policies of transition, in order to support and encourage the growth and prosperity SMEs. Firstly, given the private sector reliance on SMEs and the disproportional effect of financial constraints on smaller–sized firms, both governments and development institutions should endeavour to alleviate such obstacle through targeting such firms with grants, subsidies or other similar strategies. Furthermore, while corruption may, in the presence of a weak institutional framework, encourage efficiency in transactional and other business-related activities, ensuring in the process of transition, a policy programme which prescribes the advancement of a rigorous and adherent rule of law and legal framework, as well as an effective governmental system is imperative. By constructing measures to combat corruption with consideration to the business environment, society and other such spheres, over time, the objective will be to attempt to remould individual incentives behind the decision-making process. As such, that efficiency gain that was once attainable by corrupt practices is less prevalent due to a reduced number of parties that will engage with such behaviour, diverting efforts to more legitimate means of achieving improvements in efficiency, such as innovation.

In conclusion, our study of firm efficiency has yielded two outcomes. We find strong support to the hypothesis that constraints to financial access is detrimental to the efficiency of firm production, increasingly so with the severity experienced by the firm. Additionally, in contradiction to our own formulated hypothesis, we find evidence in support to the 'grease money' thesis, that is, firms that express corruption as a minor obstacle to operation are more efficient to those who report

the contrary. These results persist across different measures of output and are robust to restrictions to the distribution of the sample.

Chapter 3

Access to Finance and Obstacles to Firm Operation: The Role of Information

3.1 Introduction

Since the early path-breaking theoretical work highlighting the important role of information and lack thereof (Vickrey, 1961; Akerlof, 1970; Mirrlees, 1971) plays in the competitive market, there have been subsequent studies focusing on the possibility of alternative equilibriums under information asymmetries (Rothschild and Stiglitz, 1976; Wilson, 1977; Riley, 1979) as well as other mechanisms such as signalling theory (Spence, 1973) that allow individual agents to broadcast otherwise unobserved characteristics to whom they are of interest. In parallel, the embryonic body of re-

search concerning the role of financial intermediaries have posited that not all but part of their role can be attributed to easing information asymmetries (Diamond, 1984; Ramakrishnan and Thakor, 1984; Fama, 1985) and consequently alleviating associated transaction and agency costs. Moreover, with the developing literatures and refined definitions of information types emerging (Goddard et al., 1999; Liberti, 2003; Petersen, 2004), questions have been put forward that look to investigate how, and indeed why, availability of these different information types have an effect on the firm's ability to access external finance and terms which borrowing is agreed upon (Boot and Thakor, 1994; Petersen and Rajan, 1994; Berger and Udell, 1995; Blackwell and Winters, 1997).

In this chapter, using novel firm-level survey data from the World Bank Enterprise Survey, extending the work done by Beck et al. (2006), we use a scale which reports how difficult firm's currently find accessing external finance to investigate how a range soft and hard information measures facilitate or inhibit a firm's ability to borrow. In the sample as a whole, we find that older firms are less likely to face severe obstacles to financing and rather are more likely to either face minor or no obstacles to borrowing at all, a result that is inconsistent with the theoretical predictions made by Greenbaum et al. (1989) and Sharpe (1990). This is also found to be the case irrespective of firm size. Moreover, we find that as firm sales increases, the likelihood of facing no obstacle to borrowing increases, the converse is true with respect to moderate, major and severe classes of severity. We find that no one legal status is likely to be associated with having no obstacles and indeed we find significant evidence that a firm with a given legal status is either likely to face minor or major

obstacles to borrowing. Those firms that have faced tax inspection or have acquired a loan or credit line in the last 12 months are most likely to face no obstacle to finance, whilst it is conversely the case for firms have an overdraft facility.

In the section that immediately follows this, we will survey the literature surrounding information asymmetries, the information classification body of work, as well as attempting to understand exactly how heterogenous information types are important as a determinant of lending decisions made by financial intermediaries on firm funding applications. Section 3.3 discusses the data sample used in the empirical analysis of this chapter, as well as outlining the methodology and empirical models in section 3.4. After reviewing the calculated regression estimates in section 3.5, we end by concluding in section 3.6.

3.2 Literature Review

3.2.1 Origins of hard and soft information

In order to allow an in-depth analysis of the literature surrounding information types and their interaction with the firm's ability to access financial markets, it seems appropriate to survey the literature from which the importance of information between two parties has been made apparent. This will begin with a brief overview of both the asymmetric information and signaling theory bodies of work, continuing to explore how signaling and information asymmetries have been considered both theoretically and empirically in the theory and practice of contracts. Once completed, only then will we address the question of exactly what is understood to be defined as soft and

hard information and review how information types are utilised by financial intermediaries and a given firm's access to financial markets is either impeded or facilitated conditional on being able to provide such information.

Asymmetric information

The role of information, in and of itself, has been of primary interest to economists, given it's integral role within individual decision making. Arguably born out of an objection to one of the central assumptions underpinning neoclassical theory, namely that individuals possess and act on perfect information on quantity, price, utility and other facets of the transactions decision-making process in the market. The alternative posited, asymmetric information, emerged from the path-breaking work of Vickrey (1961) where, in addition to the contribution to auction theory while in its infancy, explored the notion of pre-transaction (*a priori*) information asymmetries on the side of the bidder. In what may be considered simplistic in current thinking, Vickrey demonstrates that under such conditions, the resultant outcome is atypical and provides a distinct but nontrivial result, relative to the full information case, that provides incentives for the bidder to change their (market) behavior.

Moreover, Mirrlees (1971), not explicitly under the auspice of asymmetric information — as Sandmo (1999, p.170) notes, the word 'asymmetric' is not actually used in the paper itself but the interpretation developed later by Mirrlees and other authors — explores the optimum taxation on individual income. In his mathematical treatment, individuals know their wage rate and hours worked but the State is only able to observe the overall income of each individual. The informational asymmetry

here lies in the fact that the branch of Government responsible for collecting tax revenue is not able to see each individual wage rate, which in a perfectly competitive market is the direct indicator of a worker's marginal revenue product of labour. As such, Government instead uses gross income received from an individual's labour as a proxy for worker effort. Under such conditions, it was shown that due to the underlying asymmetries, setting an income tax regime without full knowledge of an individual's working hours poses significant challenges for an individual's incentives to work, better known as efficiency, as well as equity.

In the seminar work of Akerlof (1970), asymmetry of information here pertains to the uncertainty of quality in the market for used cars. In what has coined 'the market for lemons', central is the idea that buyers have incomplete information as to the quality of cars in the used market; they cannot distinguish between cars of good (peaches) and bad (lemons) quality. Consequently, buyers are only willing to pay the cost for a given car that is an average between the price of a peach and a lemon. The seller on the other hand is able to discern the quality of the car they are trying to sell. When both parties interact in the marketplace, due to the price buyers are willing to pay, sellers will only sell lemons, as the average will always be lower than the price of a peach but higher than that of a lemon. As soon as sellers are left with only cars of a better quality, they will exit the market, leaving only sellers of poorer quality cars in the market. Ultimately, this experiment demonstrates the failure of a market due to adverse selection.

Furthermore, using the market for insurance policies, both Rothschild and Stiglitz (1976) and Wilson (1977) show how crucial the role of information plays in estab-

lishing a stable equilibrium within a competitive market. In doing so, they show that in such a market, in the absence of perfect information about the risk profile of each individual, it be the case that either no equilibrium state (in a game-theoretic sense) exists or if under a certain set of assumptions, one may exist but would exhibit non-standard properties. Wilson (1977) along with Riley (1979) do not only demonstrate the difficulties of establishing stable equilibrium in the case of information asymmetries but both propose alternative equilibrium under these existing market conditions. In the former case, the expectations on the part of the firm are augmented to align with obscured individual risk, while in the latter, a different non-cooperative equilibrium is established that is coined as reactive, to the difficulties posed in an imperfectly competitive marketplace.

Signaling theory

While still related to the then emerging literature on asymmetric information, Spence (1973) focuses on the issue that employers face when hiring, in that, from a pool of prospective candidates applying for a particular position, they are unable to ascertain the innate abilities of an individual and thus their marginal product of labour, prior to taking the position at the firm. It is from this initial dilemma that signaling, in the sphere of economics and market analysis, is coined. A distinction is made at the outset between different forms of observable individual characteristics, signals and indices, where the former refers to those attributes that are readily modified by the individual and the latter, traits that are inalterable such as ethnicity, height and gender. By their nature of their permanence in this exposition, naturally the focal

point is centered instead on signals.

On the side of the employer, it is assumed that they employ people using these signals and indices, based on previous experience of hiring in the labour market, which over time, has been attained and refined, to form what is thought to be a probability density function conditioned on both of these types of observables and the realised productivity once an individual has been hired. Moreover, such beliefs are implied to suggest that the employer considers signals that indicate the quality of the candidate to be positively related to their innate productivity and crucially, signals such as education would only be attainable by those candidates who are inherently able to do so, in contrast with candidates with such signals. While perhaps a relatively straightforward intuition, significant game-theoretic continuations of this work has been derived (Cho and Kreps, 1987; Noldeke and Van Damme, 1990; Swinkels, 1999) as well as empirical modeling of screening types and returns to education (Riley, 1979; Psacharopoulos, 1979; Hartog, 1983).

While the origins of the signaling literature is of importance, the ramifications of signaling in other economic domains pertinent to the chapter matter should been considered, namely financial markets and intermediaries. Therefore, we will depart from here and give more attention to this work, which will more directly inform our hypothesis development. In doing so, will we first survey the literature around soft and hard information and then progress to discover how information types and availability affect lending to firms.

3.2.2 Classifying information types

Given the recent advances of technological development, particularly computing and networking, the ability to access information has become far more straightforward. The implications for this are extensive, given that information in the digital age is arguably more important a facilitator of everyday decision-making, than any other persuasive medium, be that financial currency or otherwise. Furthermore, whilst we consider the advances in technology, while data and other information is now readily accessible, either at zero cost or behind some virtual pay or security wall; another powerful aspect of this progress is the instantaneous nature by which data can be sent and received from one party to another. Before allowing this discussion to pervade into an examination more generally, it may be pertinent at this juncture to self-inflict the constraint of further discourse, to the impact of information on the firm's operation and closely-related spheres. However, before doing so, a very important distinction has to be made; what exactly do mean when we talk about information?

The ambiguity of the term arises due to a disjunction between two types of information that disaggregates the unified set into two subsets, soft and hard. From the offset, it should be made clear that we do not endeavour to further the definition of these information types, nor to challenge current thinking surrounding this. This undertaking aspires to plainly explore and contrast the minutia of interpretations found within the literature. For the sake of grounding the discussion, we will state a very over-simplified and infant definition of both types of information and begin to build and refine from this primitive ground. Petersen (2004) conducts an expansive

and comprehensive review on the very matter of soft and hard information, in which is presented, a self-confessed simplistic contrast between both forms. While hard information is usually considered to be in a stored or collected in a quantitative format; soft information is classified as information that is difficult to consolidate into a quantitative measure and is consequently stored as qualitative data. Indeed, this is used by other authors, as a naive but nonetheless stable foundation, on which the definition of information types can be refined (Goddard et al., 1999).

Another important aspect to the differentiation between soft and hard, pertains to the verifiability of the information being communicated. (Liberti, 2003, p.7) makes the distinction that not only is hard information instantly verifiable but is attainable at zero or low cost. Conversely, soft information is not as easily verified by the other party and is done so at a high cost, although the author does not state if that cost is purely monetary or is inclusive of time and other associated non-monetary costs. As a small aside, nonetheless relevant to this notion of verifiability, it is interesting to note that in a work wholly dedicated to drawing a distinction between hard and soft information, Petersen (2004) makes an important parallel from the contract literature on the criteria to be met to class a signal as verifiable. The author points to the work of Hart (1995), in which a verifiable signal is one where it can be observed by both parties (labelled as insiders and outsiders) and the signal is interpreted by both - as well as any additional third party necessary to enforce a contract - as having the same meaning, implicitly defining a form of hard information.

As well as establishing both types of information, some attention in the literature has been given to the notion that information types need not be permanent. What

has been coined 'information hardening' is the notion that information originally thought of as soft could be transformed into hard, allowing information to evolve in some sense, where previously the classification remained immobile to change. While this concept is occasionally but erroneously attributed to advances in technology, as Petersen (2004) highlights, the origins of information hardening are found in the formation of credit rating agencies within in United States in the 19th century, where previously, lenders operated on a relationship-based system, in which they would record different types of soft informations over time after a number of interactions with a given individual.

While this acts as a functional model within smaller communities, as transportation methods advanced, with the development of the steam-powered rail and eventually aircraft, this opened up the ability for individuals to conduct business on a far greater scale, geographically. It is the establishment of an international market which saw this traditional model of credit-worthiness fail, as clearly without this previous record of soft transactional data and no established method for two distant parties to gauge the prospective risk profile of an individual, *ex-ante*. This saw the the creation of what we know today as credit rating agencies. Based in cities, these firms would collect the amassed soft information from the various parties that have established credit to other individuals and construct ratings that assessed the wealth and credit-worthiness of a prospective borrower.

Undoubtedly an early facilitator of international trade, the ability to consolidate what is typically verbose and unstandardised information into a form which is understood with ease by any party in any geographic location is greatly advantageous,

however consider the trade-off of informational hardening, between what we could know, compared to what needs to be known. In the case of credit rating agencies and the formulation of a credit score, typically the case today would be that the agency will have a pre-formulated set of criteria which an individual will be rated on. This may in part, be achieved by using hard information from externally-audited balance sheet data or other verifiable data from other credible third parties but also forms of soft information that could include public information such as news, attributes of executive staff or other market commentary.

Natively hard information is typically uncontroversial in what is being expressed, soft information cannot claim to be so for a number of reasons. Firstly, subjectivity is often thought of as an attribute of soft information which lends primarily to the difficulty in its verification but more so, the need to use language beyond using a set of numeric integers implies that there are elements of information that cannot be captured by a standardised scale. However, despite the knowledge that the process of hardening can lead to discarding potentially useful information, in the case where only hard information or that information that is easily verifiable is only of use, organisations are ironically omitting information about that party from their consideration in order to amass an opinion or rating that is supposedly objective. This over-reliance of hard information is indeed considered by Rajan et al. (2015); in their work assessing the inaccuracy of models to forecast default risk, empirical analysis show that where there is a greater dependence on hard information, the larger the deviation between the predicted default risk compared to the actual observed risk. Furthermore, Berg et al. (2013) corroborate these findings and also in an analysis

of a large dataset of loan applications, concludes that when there is an incentive on behalf of the individual approving loans to maximise the number of loans, reliance on hard information alone results in higher rates of default.

Conversely, in the absence of issues that arise by misaligned incentives, hardening soft information does present a number of advantages. While the process of hardening may remove subtleties that language can convey, rather than take a nihilistic opinion of the procedure, it seems uncontroversial to condone amassing some information against the alternative of none at all. Moreover, the ability to convey individual experience or thoughts on a particular situation, with the use of a Likert scale, allows some level of standardisation across responses, compared the the infinite unique possibilities that natural language permits. Finally, while it may be argued that even in the form of a Likert-style measure, from the respondent's side, there may be a differing meaning between two individuals as what a certain point on the scale actually expresses but for the analyst, the interpretation of the scale is far less ambiguous compared to narrated accounts.

The literature appears primarily to focus on the role of soft and hard information with respect to financial intermediaries and firm access to liquidity markets, of which a survey will follow. However, before moving on, it is important to consider that when we define what soft and hard information, one pre-established criterion which we go by is verifiability. It is for this reason that it is difficult to apply this definition across the literature more generally, as a given party's ability to verify data from a firm is not equal. It may hold with respect to looking at determinants of obstacles to firm financing but when we are considering other obstacles to firm operation, the

third parties whom are responsible for verifying information, it does not. Hence, the type of information we are trying to classify is, what we will call form-dependent, on the third party's capability to verify information communicated to them, by what available methods they have at their disposal.

To give a simple but informative example of what is meant by information being form-dependent, consider the following. In the case of a financial intermediary deciding on a loan application for a firm, they may want to know if that applicant has an account with that bank as well as any previous unauthorised overdraft facility. In the case that the firm has an account with the same financial institution, the verification of information given by the firm regarding accounts and overdrafts are easily verified and zero marginal cost. Even in the case where the firm is applying to a financial institution where their banking services are provided by another intermediary, electronic communication between banks would still provide a means of verification that is relatively expeditious and at negligible cost. In this instance, this could be thought of as a form of hard information. Consider now, a prospective seller that wants to sell a large amount of a given good to a firm on the basis of credit, to be paid 60 days from receipt. The seller wants to know, as an indicator of the buyer's credit-worthiness, if they have any previous unauthorised use of an overdraft facility. As the verifying party in the instance, the seller is not as easily able to verify the information that the buyer gives regarding the overdraft and as an outsider requesting the information from the financial intermediary, it is unlikely to be without cost, monetary or otherwise. In this case, the information would fail to be classed as hard in type.

Given the implications of form-dependence, we need to consider the process of verification as part of the criteria that classifies whether or not informational variables we utilise in our analysis are soft or hard. This is because, if we were to class hard information purely by the initial definition given by Petersen (2004) as quantitative, the credibility of that information would not matter, which due to the added condition of verifiability given in the literature, is not the case. Additionally, this notion of form-dependence is important as the informational variable may be classified as one information type given a particular third party in one sense - that is, the financial intermediary in a decision to lend - while classed as another given a different consideration, as will be the case in our analysis. By extension, this is primarily an issue in classifying only hard information, with soft information implicitly serving as the default state, given that all information must serve to be processed as being verifiable. Additionally, it is also sensible to assume as this point that information of any type cannot be without classification.

Hence, before we begin our analysis, it should be made clear that in this study, information types will be decided by considering the cost - both monetary and otherwise - of verification, the way in which the data is stored, quantitatively or qualitatively, electronically or otherwise, as well as how quickly the information can be verified. Moreover, the overarching deliberation that will help us identify the preceding guidelines, will be the party examining the information.

3.2.3 Information and access to financial markets

As can be observed with relatively little effort, the literature surrounding information types and their effect on financial aspects of the firm are plentiful and well-developed, the same cannot be said with regards to the other types of obstacles to the firm that this paper attempts to examine. Nonetheless, it would seem appropriate to survey the former class of literature, as it may provide elucidation to such matters that are given less theoretical and empirical treatment. Despite this inequality, it is perhaps understandable, given the long-established and evolving role information assumes in the lending relationship between financial intermediaries and the firm. The early theoretical literature is explicitly clear of the importance that information availability has in determining a firm's ability to acquire external capital.

As a direct descendent of the asymmetric information and signaling literature, Brealey et al. (1977) derives a model that involves lenders and entrepreneurs which, analogous to the treatment of Spence (1973), assumes that the lender is not able to observe the the full set of information that indicates the quality of the project the entrepreneur requires financing for. The necessary concomitant to this asymmetry assumes that signaling is the mechanism crucial to alleviating any information asymmetry. Specifically, the signal requires that the entrepreneur can credibly communicate a willingness to invest in their own project as a proxy for investment quality. More than this, the authors attempt to justify the existence of financial intermediaries, which they claim the literature on financial markets fail to do until this point in time. They posit, in the absence of markets with perfect information, a market for information has - in an of itself - potential issues of adverse selection.

Just as it was demonstrated by Akerlof (1970), in the market for information where lenders cannot distinguish between differing qualities of information sources, there is the risk that lenders are only willing to pay the average of the two prices (assuming there are only two types of homogenous firms offering information), leaving the market with those firms offering only poor quality information. Ruling out the possibility of private individual lenders amassing their own information about borrows, as the associated monitoring costs would make it too costly to do so, the authors show that financial intermediaries can provide this information to lenders at a lower cost and additionally overcome the adverse selection issue, given that the intermediary will use this information they are willing to sell, to buy assets for their own portfolio. Hence the quality of the information is related to the return of the portfolio. Although, work done by Campbel and Kracaw (1980) to examine the aforementioned thesis put forward by Brealey et al. (1977), rejects that the existence of financial intermediaries cannot be sufficiently justified solely by acting as a producer of information but acts as only a part of a set of viable explanations.

In addition to the other literature which analyses the role of financial intermediates in easing information asymmetries and subsequently lowering associated transactional and agency costs (Diamond, 1984; Ramakrishnan and Thakor, 1984; Fama, 1985), consideration should also be given to the lender-borrower relationship and the role of information. Naturally, the consideration of soft information has concentrated around relationship banking models, where the bank is able to assimilate the borrower's risk profile based on previous dealings and personal rapport that has been established over time, that cannot necessarily be quantified easily or without

significant costs. This is made clear by the definition of relationship banking given by Boot (2000, p.10) as financial intermediaries providing financial services that both 'invests in obtaining customer-specific information, often proprietary in nature' and 'evaluates the profitability of these investments through multiple interactions with the same customer over time and/or across products'.

One assumption that could be made then, is that the amount of soft information a lender has accumulated increases with strength and duration of the relationship between lender-borrower. This seems a reasonable assumption to make given all hard information is provided by the borrower from the outset and as the relationship develops, the borrower's idiosyncrasies will regards to communication, borrowing behaviour and traits that are otherwise opaque at the offset of the relationship are revealed. However the question arise, how does relationship strength affect the terms the borrower will be offered? The theoretical literature appears divided. Lending terms may become more favourable as the relationship strengthens, either in terms of rate of interest (Petersen and Rajan, 1995) or collateral requirements (Boot and Thakor, 1994). Whereas others have argued that stronger lender-borrower relationships will result in higher rates of interest over the course of the term, as a result of competition and the need to encourage credit applications from younger borrowers (Greenbaum et al., 1989; Sharpe, 1990).

The empirical strand of literature is seemingly more united on this. Using a cross-section of US firm data, Berger and Udell (1995) directly test and find support for the theoretical conjectures of Boot and Thakor (1994) and Petersen and Rajan (1995), that is, an inverse relationship between relationship strength and both, inter-

est rates and collateral requirements. Blackwell and Winters (1997), considering the closeness of banking relationship - that is, the frequency of loan monitoring - using US banking records, find the same inverse relation with respect to offered rates of interest. Petersen and Rajan (1994) also produces consistent findings but ultimately finds that the relationship is statistically insignificant.

In addition to the terms of lending, considerable attention has been given to how availability of finance is affected within relationship banking models. Berger et al. (1999) makes the argument based on organisational theory, namely Williamson (1967), that larger banks may face diseconomies of scope in providing financial services which requires knowledge of smaller borrowers, where credit decisions are based on aspects of their borrowing and the market they serve, that cannot be acquired without significant time investment, relative to smaller, independent financial intermediaries. Moreover, given the pre-existing organisational structure of larger lending institutions, even if they were to acquire soft information from smaller intermediaries, it may be inefficient for the larger bank to process and analyse soft information.

Aside from studies of availability of finance to lenders more generally, attempts have also been made to investigate if firm and bank size has any implications to approved lending. Cole et al. (2004), in considering the 'cookie-cutter and character' approaches, find that large banks tend to use type of hard information in an loan approval process which allows for standardisation of the process, whereas smaller banks are more heavily reliant on the use of soft information regarding the borrower; consistent with the findings of Berger et al. (2005), that smaller banks are more able to collect and utilise soft information than larger banking institutions. Indeed, it

follows that firms that are at the greatest advantage of this apparent difference in lending processes are smaller firms, that are not able to provide adequate financial data in order to lend from large banks (Petersen and Rajan, 1994; Strahan and Weston, 1998; Berger et al., 2001).

3.3 Data

In order to analyse the role and impact of hard information with regard to obstacles to firm operation, we use firm level data procured from the World Business Enterprise Survey (WBES). A pooled sample across the years of 2006-2016, the coverage of the World Bank survey spans 139 countries at differing stages of development, economic or otherwise. The objective of this particular survey, by conducting face-to-face interviews with senior employees and owners of firms, is to gain an insight not only into the standard operations of the firm, but to attempt to elucidate exactly what elements within the business environment, both domestically and globally, influence firm production, and arguably more importantly, to what extent. Exploring the dataset more rigorously, standard firm variables such as firm sales, age, size, legal status and ownership are reassuringly present, although by permeating past the surface, herein lays the fundamental components that our empirical analysis is concerned with.

Before we look at these particular variables, it may be prudent to inspect the composition of firms within the dataset by both size and legal status. Table 3.1 presents such disaggregation. Considering first the distribution of firms by size, the

Table 3.1: Composition of Firm Sample

Firm's legal status	**Firm size**			
	Small	Medium	Large	**Total**
Publicly listed company	487	823	1,385	2,695
Privately held, limited liability company	9,552	10,551	7,087	27,190
Sole proprietorship	15,384	6,685	1,864	23,933
Partnership	3,064	2,334	1,168	6,566
Limited partnership	1,623	2,220	1,603	5,446
Other	406	485	308	1,199
Total	30,516	23,098	13,415	67,029

most frequent size of firm is small, account for around 45% of firms. That being said, the proportion of both medium and large-sized firms are not trivial, accounting for around 35% and 20% of the sample respectively. Conversely, the dispersion of firms by legal status is somewhat less even. Privately-owned, limited companies and sole proprietorships make up around 77% of the sample; whilst the remaining 4 types of legal status are representative of the resultant 33%, cumulatively. Moreover, briefly on the allocation of firms by sector, manufacturing dominates with 32,636 (56%) firms in the sample, whilst 10,782 firms (24%) are located within the service sector.

Variable definitions and their respective summary statistics can be found in tables 3.2 and 3.3 respectively. In addition to the above, we have a number of variables that encapsulates the informational aspect of the empirical exercise. These include: experience of the most senior manager, number of hours spent on regulatory adminis-

tration per week, if the firm has had a tax inspection in the last 12 months, the firm's possession of a checking and savings account; and overdraft, if the firm has had an external audit performed in the last 12 months, if the firm has a quality certificate, if the firm has a loan or credit line in the last year, as well as whether or not the firm has its own website and email address. While most firms attest to having a checking and savings account (89%), only around 38% of firms had a loan or line of credit with a financial institution. Moreover, despite the majority of firms claim to have had a tax inspection and external audit within the last year, only approximately 25% of firm have been issued a internationally-recognised quality certificate. Additionally, with regard to e-commerce and the digital economy, nearly three quarters of firms use email as a part of operation but fewer than half take use of a company website to conduct business.

Lastly, following the methodology of the work done by Beck et al. (2006), we have included a number of country-level variables to control for other factors that may explain the variation of obstacle severity amongst firms in the sample. Firstly, we include GDP per capita as a measure of a given countries economic development, in US dollars. Secondly we include three measures from the World Bank's World-wide Governance Indicators project, namely law and order, control of corruption and quality of regulation. The aforementioned composite measures are calculated by taking responses of individuals to their perception of a range of questions on the topic of governance and they are appropriately assigned to the matching indicator, where the aggregate score for each measure are standardised normally in the range of -2.5 to 2.5. The three used in this exercise are employed as a multifaceted measure

of institutional development. Consulting the summary statistics, all three measures have mean values which are negative, indicating mildly unfavourable perceptions in aggregate of the various indicators of institutional development. Given the sample of firms is based within primarily developing and transition economies, this may be expected. Finally, we use two proxies to include the aspect of financial intermediary and stock market development, namely Private Credit and Stock Market, the former measuring the financial resources provided to the private sector by financial institutions and the latter, the market capitalisation of companies listed in a given country, both measured as a percentage of GDP.

Table 3.2: Variable Definitions

Variable	Definition
Dependent variables	
Access to finance	To what extent access to finance is an obstacle to firm operations.
Firm-level variables	
Age	Firm age.
Sales	Adjusted total firm sales last year.
Size: small	Firms with less than 20 employees.
Size: medium	Firms with between 20 and 99 employees.
Private domestic	Percentage of the firm owned by private domestic individuals, companies or organisations.
Private foreign	Percentage of the firm owned by private foreign individuals, companies or organisations.
Government	Percentage of the firm owned by government.
Public	Binary variable equal to one if the firm's legal status is public, zero otherwise.
Limited	Binary variable equal to one if the firm's legal status is limited, zero otherwise.
Sole Prop	Binary variable equal to one if the firm's legal status is sole proprietorship, zero otherwise.
Partnership	Binary variable equal to one if the firm's legal status is partnership, zero otherwise.
Limited partnership	Binary variable equal to one if the firm's legal status is limited partnership, zero otherwise.
Top manager experience	Number of years of experience the top manager has working in the sector.
Regulation time	Percentage of senior management time spent dealing with government regulations, in a typical week.
Tax inspection	Binary variable equal to one if the firm's was inspected or visited by tax officials in the last year, zero otherwise.
Check/savings account	Binary variable equal to one if the firm has a checking or savings account, zero otherwise.
Overdraft	Binary variable equal to one if the firm has an overdraft, zero otherwise.
Loan credit	Binary variable equal to one if the firm has a line of credit or loan from a financial institution, zero otherwise.
External audit	Binary variable equal to one if the firm has had a external financial audit in the last year, zero otherwise.
Quality cert	Binary variable equal to one if the firm has an internationally recognised quality certification, zero otherwise.
Email	Binary variable equal to one if the firm utilises email to communicate with clients, zero otherwise.
Website	Binary variable equal to one if the firm utilises their website to communicate with clients, zero otherwise.
Country-level institutional variables	
GDP per capita	Gross domestic product divided by mid-year population, in current US dollars.
Law and Order	Composite measure capturing perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.[a].
Reg Quality	Composite measure capturing perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.
Corruption	Composite measure capturing perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.
Private Credit	Domestic credit to private sector refers to financial resources provided to the private sector by financial corporations, that establish a claim for repayment, as a percentage of GDP.
Stock Market	Market capitalisation of listed companies as a percentage of a country's GDP.

[a]For the sake of exactness, definitions for law and order, regulation quality and control of corruption are given as written by Kaufmann et al. (2009)

Table 3.3: Summary statistics

Variable	Mean	Standard Deviation	N
Dependent variable			
Access to finance	1.515	1.34	66946
Firm-level variables			
Age	18.102	17.322	67109
Sales	1127306.89	88112009.732	62661
Size: small	0.455	0.498	67029
Size: medium	0.345	0.475	67029
Private domestic	89.528	28.439	67028
Private foreign	8.252	25.627	67010
Government	0.676	6.581	67022
Public	0.04	0.196	67029
Limited	0.406	0.491	67029
Sole proprietorship	0.357	0.479	67029
Partnership	0.098	0.297	67029
Limited partnership	0.081	0.273	67029
Top manager experience	16.905	10.853	67029
Regulation time	10.151	17.737	66989
Tax inspection	0.398	0.489	67010
Check/savings account	0.117	0.322	67029
Overdraft	0.567	0.495	64993
Loan credit	0.628	0.483	65806
External audit	0.469	0.499	66953
Quality cert	0.762	0.426	67029
Email	0.294	0.455	67003
Website	0.556	0.497	67000
Country-level institutional variables			
GDP per capita	4599.684	4858.497	66026
Law and Order	-0.418	0.609	66084
Reg Quality	-0.261	0.638	66084
Private Credit	43.221	32.278	63552
Stock Market	52.828	47.583	38330
Corruption	-0.434	0.601	66084

Table 3.4 lists the variables of interest in this analysis alongside the class of information they belong to - soft or hard. The choice of information type is made considering the cost of verification, the way in which the data is stored, as well as how quickly the information can be verified. Additionally, we are considering these criteria from the perspective of the lender deliberating over prospective loan applications. We consider the financial intermediary to be able to verify firm age, sales, size and ownership composition with ease and at low, if not zero cost and as such, classify these variable as a store of hard information. In addition to these, we also classify if the firm has has a checking or savings account, overdraft or any type of loan or credit from a financial institution as hard information. In the case where the firm has either of these three services from the institution considering the loan application, the information is instantly verifiable and at zero cost. Even if one or more of these services resides with another financial institution, the lender should be able to verify this with relative ease.

With respect to aspects that relate to reported behaviour of senior firm staff, while it may be quantitative data, for the financial intermediary, this is not something that can be verified swiftly and without non-trivial time and monetary cost. Moreover, whether or not the firm communicates with clients using either a website or email falls under the same consideration. While it is true the firm may be able to demonstrate they have an email address as well as a function website, this alone is not sufficient to suitably demonstrate communication with clients, unless time is taken to verify with those same clients. Given this, we will then classify these variables as containing soft information.

Table 3.4: Classification of Information Variables

Variable	Information Type
Age	Hard
Sales	Hard
Firm size	Hard
Private domestic	Hard
Private foreign	Hard
Government	Hard
Public	Hard
Limited	Hard
Sole Prop	Hard
Partnership	Hard
Limited partnership	Hard
Top manager experience	Soft
Regulation time	Soft
Tax inspection	Soft
Check/savings account	Hard
Overdraft	Hard
Loan credit	Hard
External audit	Hard
Quality cert	Hard
Email	Soft
Website	Soft

Regarding information on firm tax inspections, classification of this variable is heavily dependent on the financial intermediary's relationship with the government. For the most part, unless the institution that is lending is owned by the state, other than abiding by government regulation and associated bodies, the transfer of information will be limited, particularly in the case of individual loan applications. Given this is the case, the verification process is unlikely to be swift and according we will class this as a form of soft information also. Finally, the case of a firm's external audit or having a internationally-recognised quality certification. In the latter case, this will typically come with documentary proof or some unique identifier which can be verified relatively and for the former, similarly, documentary proof should be available in the case of an external audit. For these reasons, these variables will be treated as hard information types.

3.4 Methodology

3.4.1 Generalised ordered probit

As is the usual convention with this form of estimation, where the typical model specification is thus:

$$y_i^* = \boldsymbol{\beta}'\boldsymbol{x}_i + \epsilon_i \quad \text{where } \epsilon_i \sim N(0,1) \tag{3.1}$$

where dependent variable y_i^* is a latent variable which is unobserved, intended to encapsulate the extent to which access to finance is an obstacle to the firm's oper-

ation. $\boldsymbol{x}_i$ is an nxk matrix of observable explanatory covariates, $\boldsymbol{\beta}'$ is a $kx1$ vector of unknown parameters and ϵ_i is a random error term that is assumed to be normally distributed with mean zero and variance one. The notion of some observable naturally-occurring quantitative measure of such obstacle, as that of which we are interested in is non-existent and as such, we employ the ordinal responses to the question, 'To what extent is access to finance an obstacle to the day-to-day operations of the firm?'. The ordinal response and corresponding severity can be expressed thus:

$$y_i = \begin{cases} 0, & \text{if } y_i^* \leq \mu_1 \text{ (no obstacle)} \\ 1, & \text{if } \mu_1 < y_i^* \leq \mu_2 \text{ (minor)} \\ 2, & \text{if } \mu_2 < y_i^* \leq \mu_3 \text{ (moderate)} \\ 3, & \text{if } \mu_3 < y_i^* \leq \mu_4 \text{ (major)} \\ 4, & \text{if } y_i^* > \mu_4 \text{ (severe)} \end{cases} \tag{3.2}$$

where μ_1, μ_2, μ_3 and μ_4 are threshold values that are to be estimated, which will define the distribution of y_i to the respected ordered categories.

The respective probabilities that a firm i will face a particular level of severity k, for a given value of x_i, is given as follows:

$$\begin{aligned} P(y_i = 0) &= \phi(-\boldsymbol{\beta}'\boldsymbol{x}_i) \\ P(y_i = k) &= \phi(\mu_k - \boldsymbol{\beta}'\boldsymbol{x}_i) - \phi(\mu_{k-1} - \boldsymbol{\beta}'\boldsymbol{x}_i) \quad \text{where } k = 1, 2, 3 \\ P(y_i = 4) &= 1 - \phi(\mu_4 - \boldsymbol{\beta}'\boldsymbol{x}_i) \end{aligned} \tag{3.3}$$

where ϕ is the density function of a standard normal distribution. Naturally, we must

impose the restriction, $\mu_1 < \mu_2 < \mu_3 < \mu_4$ if we are to allow the probability of each outcome, $P(Y_i = k)$ to be strictly positive. Estimation of an equation such as that in 3.1 would yield estimates which are not rendered altogether redundant in their interpretation, that is, the sign attributed with the estimated parameter informs the direction of latent variable y_i* and a given regressor x_i. However, unlike other conventional methods of estimation, the estimated parameters cannot be used in the first instance to assess magnitude. In order to do so, we proceed to calculate the marginal effects, which expresses the probability of firm i expressing severity class k for a increase in a given regressor x_r:

$$\frac{\partial P(y_i = k)}{\partial x_{ir}} = \left[\phi(\mu_k - \boldsymbol{\beta}'\boldsymbol{x}_i) - \phi(\mu_{k-1} - \boldsymbol{\beta}'\boldsymbol{x}_i)\right] \beta_r \tag{3.4}$$

In the preceding estimation framework, we consider the ordered probit where, underlying the inner workings, is the acceptance of the parallel line assumption. Borrowing from the exposition of Long and Freese (2006), following from the individual probabilities from the ordered probit model given in 4.3, it follows that the cumulative probabilities can be given as:

$$P(y_i \leq k|x) = \phi(\mu_k - \boldsymbol{\beta}'\boldsymbol{x}_i) \quad \text{where } k = 1, \ldots, 4 \tag{3.5}$$

As noted by Long and Freese (2006, p.150), the cumulative function given in 3.5 is equivocal to $m - 1$ binary regressions, where by construction, these cumulative probability curves are parallel to each other as the vector of slope parameters $\boldsymbol{\beta}$ is assumed to be homogeneous across regressions.

In order to accommodate the possibility of slope heterogeneity, as proposed by Terza (1985), we will augment the threshold, μ_k, such that it is a function of covariate matrix x_i:

$$\mu_k = \tilde{\mu_k} + \boldsymbol{x}_i'\gamma_k \tag{3.6}$$

substitution of the new expression for the threshold parameter, yields the following probabilites for a firm i will face a particular level of severity k, for a given value of x_i:

$$\begin{aligned} P(y_i = k) &= \phi(\tilde{\mu_k} + \boldsymbol{x}_i'\gamma_k - \boldsymbol{\beta}'\boldsymbol{x}_i) - \phi(\tilde{\mu_{k-1}} + \boldsymbol{x}_i'\gamma_{k-1} - \boldsymbol{\beta}'\boldsymbol{x}_i) \\ P(y_i = k) &= \phi(\tilde{\mu_k} - \boldsymbol{\beta}_k'\boldsymbol{x}_i) - \phi(\tilde{\mu}_{k-1} - \boldsymbol{\beta}_{k-1}'\boldsymbol{x}_i) \\ &\text{where } \boldsymbol{\beta}_k = \boldsymbol{\beta} - \gamma_k \end{aligned} \tag{3.7}$$

and the average marginal effects can be calculated thus:

$$\frac{\partial P(y_i = k)}{\partial x_{ir}} = [\phi(\mu_k - \boldsymbol{\beta}_k'\boldsymbol{x}_i)]\beta_{kr} - [\phi(\mu_{k-1} - \boldsymbol{\beta}_{k-1}'\boldsymbol{x}_i)]\beta_{k-1r} \tag{3.8}$$

3.5 Empirical Results

3.5.1 Access to finance

As a brief reminder, the research question attempting to be answered in this chapter via empirical analysis is what exactly determines how much of a barrier to firm production, attaining external finance is. We begin by analysing the full sample and

the look at the same analysis, disaggregated by firm size.

Full sample

Tables 3.5 and 3.6 present the estimates and marginal effects of the generalised ordered probit respectively. Amongst the seven specification estimated with country, industry and year fixed effects, the likelihood-ratio test provides evidence that the specification with all 6 of the country-level institutional controls is preferred (P<0.0000) and moreover, an F-Test on these variables provides evidence of their joint significance (P<0.0000). Furthermore, in an extension to the work of Beck et al. (2006), we test for the possibility of heterogenous slopes and find evidence to reject the parallel lines assumption (P<0.0000) and hence proceed by using the generalised ordered probit estimator.

Table 3.5: Access to Finance: Ordered Probit Estimates

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: No Obstacle							
log(Age)	-0.0392	-0.0366	-0.0375	-0.0412	-0.0717*	-0.0401	-0.0751*
	(0.0318)	(0.0318)	(0.0318)	(0.0321)	(0.0424)	(0.0318)	(0.0425)
$\log(\text{Age})^2$	-0.00108	-0.00174	-0.00155	-0.00168	0.00306	-0.000989	0.00336
	(0.00620)	(0.00621)	(0.00620)	(0.00626)	(0.00813)	(0.00621)	(0.00816)
log(Sales)	-0.0254**	-0.0287**	-0.0290**	-0.00696	0.0222	-0.0272**	0.0239
	(0.0127)	(0.0127)	(0.0127)	(0.0128)	(0.0188)	(0.0127)	(0.0188)
$\log(\text{Sales})^2$	-0.000683	-0.000525	-0.000494	-0.00204***	-0.00482***	-0.000552	-0.00489***
	(0.000667)	(0.000665)	(0.000666)	(0.000678)	(0.000999)	(0.000665)	(0.00100)
Size: small	0.0342	0.0307	0.0313	0.00991	-0.0450	0.0354	-0.0487*
	(0.0217)	(0.0218)	(0.0218)	(0.0220)	(0.0285)	(0.0218)	(0.0286)
Size: medium	0.0649***	0.0643***	0.0647***	0.0475***	0.00870	0.0665***	0.00710
	(0.0180)	(0.0180)	(0.0180)	(0.0182)	(0.0227)	(0.0180)	(0.0228)
Private domestic	0.0000144	-0.0000253	-0.0000157	0.000243	-0.00109	0.00000543	-0.00109

	(0.000558)	(0.000558)	(0.000558)	(0.000560)	(0.000750)	(0.000558)	(0.000751)
Private foreign	-0.00223***	-0.00226***	-0.00225***	-0.00207***	-0.00339***	-0.00223***	-0.00340***
	(0.000600)	(0.000600)	(0.000600)	(0.000603)	(0.000813)	(0.000600)	(0.000814)
Government	-0.00326***	-0.00324***	-0.00323***	-0.00301***	-0.00500***	-0.00324***	-0.00486***
	(0.00106)	(0.00106)	(0.00106)	(0.00107)	(0.00137)	(0.00106)	(0.00137)
Public	0.200***	0.200***	0.199***	0.190***	0.200***	0.199***	0.196***
	(0.0519)	(0.0519)	(0.0519)	(0.0525)	(0.0627)	(0.0519)	(0.0629)
Limited	0.154***	0.153***	0.152***	0.135***	0.186***	0.155***	0.180***
	(0.0446)	(0.0446)	(0.0446)	(0.0452)	(0.0532)	(0.0446)	(0.0534)
Sole Prop	0.211***	0.216***	0.216***	0.190***	0.214***	0.214***	0.222***
	(0.0451)	(0.0451)	(0.0451)	(0.0457)	(0.0538)	(0.0451)	(0.0540)
Partnership	0.272***	0.278***	0.277***	0.254***	0.235***	0.276***	0.244***
	(0.0478)	(0.0478)	(0.0478)	(0.0484)	(0.0568)	(0.0478)	(0.0571)
Limited partnership	0.200***	0.202***	0.202***	0.192***	0.197***	0.201***	0.208***
	(0.0480)	(0.0480)	(0.0480)	(0.0487)	(0.0568)	(0.0480)	(0.0571)
Top manager experience	-0.00477***	-0.00483***	-0.00484***	-0.00460***	-0.00494***	-0.00482***	-0.00483***
	(0.000614)	(0.000614)	(0.000614)	(0.000618)	(0.000782)	(0.000614)	(0.000783)
Regulation time	0.00158***	0.00156***	0.00155***	0.00149***	0.00236***	0.00154***	0.00231***
	(0.000343)	(0.000343)	(0.000343)	(0.000345)	(0.000447)	(0.000343)	(0.000448)
Tax inspection	-0.131***	-0.133***	-0.133***	-0.132***	-0.173***	-0.131***	-0.170***
	(0.0127)	(0.0127)	(0.0127)	(0.0128)	(0.0162)	(0.0127)	(0.0162)
Check/savings account	-0.0383*	-0.0374*	-0.0370*	-0.0320	-0.0425	-0.0381*	-0.0348
	(0.0209)	(0.0209)	(0.0209)	(0.0210)	(0.0284)	(0.0209)	(0.0284)
Overdraft	0.000122	0.00178	0.00177	0.00770	-0.0313*	0.000754	-0.0287
	(0.0142)	(0.0142)	(0.0142)	(0.0143)	(0.0184)	(0.0142)	(0.0185)
Loan credit	-0.312***	-0.311***	-0.311***	-0.325***	-0.352***	-0.312***	-0.357***
	(0.0136)	(0.0136)	(0.0136)	(0.0138)	(0.0174)	(0.0136)	(0.0175)
External audit	0.0174	0.0136	0.0139	0.0182	0.0318*	0.0152	0.0323*
	(0.0141)	(0.0141)	(0.0141)	(0.0142)	(0.0186)	(0.0141)	(0.0186)
Quality cert	0.0401***	0.0398**	0.0402***	0.0394**	-0.00655	0.0402***	-0.00665
	(0.0155)	(0.0155)	(0.0155)	(0.0157)	(0.0193)	(0.0155)	(0.0193)
Email	-0.0254	-0.0217	-0.0223	-0.0309*	-0.0272	-0.0230	-0.0312
	(0.0177)	(0.0176)	(0.0176)	(0.0178)	(0.0241)	(0.0176)	(0.0241)
Website	0.0525***	0.0534***	0.0538***	0.0494***	0.0351*	0.0541***	0.0375**

	(0.0145)	(0.0145)	(0.0145)	(0.0147)	(0.0185)	(0.0145)	(0.0185)
log(GDP)	-0.0644***						-0.0389
	(0.0200)						(0.211)
Law and Order		0.0305					0.651
		(0.0365)					(0.503)
Reg Quality			0.0268				0.0592
			(0.0414)				(0.233)
Private Credit				-0.00799***			-0.00864
				(0.000617)			(0.00539)
Stock Market					-0.00138		-0.000300
					(0.00150)		(0.00256)
Corruption						-0.0569*	-0.0145
						(0.0291)	(0.208)
Constant	1.685***	1.235***	1.229***	1.372***	2.161***	1.193***	2.687*
	(0.191)	(0.125)	(0.124)	(0.125)	(0.187)	(0.123)	(1.397)

Panel B: Minor Obstacle

log(Age)	-0.0246	-0.0236	-0.0229	-0.0256	-0.0706*	-0.0268	-0.0656
	(0.0299)	(0.0299)	(0.0299)	(0.0303)	(0.0410)	(0.0300)	(0.0411)
$\log(\text{Age})^2$	-0.00527	-0.00553	-0.00578	-0.00583	0.00112	-0.00484	-0.0000811
	(0.00589)	(0.00589)	(0.00588)	(0.00594)	(0.00790)	(0.00589)	(0.00792)
log(Sales)	-0.0326***	-0.0348***	-0.0364***	-0.0172	-0.00544	-0.0333***	-0.00312
	(0.0121)	(0.0121)	(0.0121)	(0.0122)	(0.0183)	(0.0121)	(0.0184)
$\log(\text{Sales})^2$	-0.000305	-0.000214	-0.000108	-0.00149**	-0.00335***	-0.000233	-0.00347***
	(0.000643)	(0.000641)	(0.000643)	(0.000652)	(0.000989)	(0.000641)	(0.000992)
Size: small	0.0879***	0.0849***	0.0847***	0.0639***	0.0156	0.0895***	0.00992
	(0.0210)	(0.0211)	(0.0210)	(0.0213)	(0.0281)	(0.0211)	(0.0282)
Size: medium	0.0625***	0.0613***	0.0617***	0.0441**	0.0117	0.0635***	0.00932
	(0.0175)	(0.0175)	(0.0175)	(0.0177)	(0.0225)	(0.0175)	(0.0226)
Private domestic	0.000399	0.000371	0.000369	0.000598	-0.00000572	0.000397	0.0000337
	(0.000529)	(0.000529)	(0.000529)	(0.000531)	(0.000709)	(0.000529)	(0.000710)
Private foreign	-0.00169***	-0.00171***	-0.00171***	-0.00150***	-0.00235***	-0.00168***	-0.00227***
	(0.000573)	(0.000573)	(0.000572)	(0.000575)	(0.000778)	(0.000573)	(0.000779)
Government	-0.000900	-0.000891	-0.000859	-0.000238	-0.00158	-0.000899	-0.00150
	(0.00108)	(0.00108)	(0.00108)	(0.00109)	(0.00147)	(0.00108)	(0.00146)

Public	0.0649	0.0655	0.0629	0.0642	0.0414	0.0632	0.0407
	(0.0505)	(0.0505)	(0.0505)	(0.0511)	(0.0616)	(0.0505)	(0.0618)
Limited	0.0496	0.0492	0.0471	0.0416	0.0384	0.0503	0.0336
	(0.0433)	(0.0433)	(0.0433)	(0.0439)	(0.0519)	(0.0433)	(0.0522)
Sole Prop	0.0835*	0.0864**	0.0867**	0.0706	0.0465	0.0837*	0.0535
	(0.0439)	(0.0439)	(0.0439)	(0.0445)	(0.0529)	(0.0439)	(0.0532)
Partnership	0.190***	0.193***	0.193***	0.179***	0.180***	0.191***	0.192***
	(0.0464)	(0.0464)	(0.0464)	(0.0470)	(0.0558)	(0.0464)	(0.0562)
Limited partnership	0.112**	0.113**	0.112**	0.113**	0.107*	0.111**	0.127**
	(0.0469)	(0.0469)	(0.0469)	(0.0476)	(0.0562)	(0.0469)	(0.0566)
Top manager experience	-0.00180***	-0.00185***	-0.00186***	-0.00146**	-0.000591	-0.00184***	-0.000603
	(0.000595)	(0.000595)	(0.000595)	(0.000599)	(0.000766)	(0.000595)	(0.000768)
Regulation time	0.00203***	0.00202***	0.00201***	0.00190***	0.00203***	0.00200***	0.00197***
	(0.000334)	(0.000334)	(0.000334)	(0.000336)	(0.000440)	(0.000334)	(0.000441)
Tax inspection	-0.0906***	-0.0922***	-0.0928***	-0.0866***	-0.118***	-0.0906***	-0.117***
	(0.0122)	(0.0122)	(0.0122)	(0.0124)	(0.0159)	(0.0122)	(0.0159)
Check/savings account	-0.0421**	-0.0416**	-0.0415**	-0.0377*	-0.0741***	-0.0422**	-0.0627**
	(0.0199)	(0.0199)	(0.0199)	(0.0201)	(0.0278)	(0.0199)	(0.0279)
Overdraft	0.0392***	0.0399***	0.0403***	0.0423***	0.0271	0.0390***	0.0275
	(0.0137)	(0.0136)	(0.0136)	(0.0138)	(0.0181)	(0.0137)	(0.0181)
Loan credit	-0.286***	-0.285***	-0.284***	-0.293***	-0.320***	-0.285***	-0.318***
	(0.0131)	(0.0131)	(0.0131)	(0.0132)	(0.0170)	(0.0131)	(0.0170)
External audit	0.0187	0.0164	0.0158	0.0182	0.00449	0.0181	0.00943
	(0.0135)	(0.0135)	(0.0135)	(0.0136)	(0.0181)	(0.0135)	(0.0182)
Quality cert	0.0796***	0.0799***	0.0806***	0.0774***	0.0634***	0.0802***	0.0638***
	(0.0151)	(0.0151)	(0.0151)	(0.0152)	(0.0191)	(0.0151)	(0.0191)
Email	-0.0239	-0.0218	-0.0219	-0.0289*	-0.0398*	-0.0232	-0.0414*
	(0.0168)	(0.0168)	(0.0168)	(0.0169)	(0.0236)	(0.0168)	(0.0236)
Website	0.0608***	0.0613***	0.0616***	0.0583***	0.0402**	0.0619***	0.0428**
	(0.0140)	(0.0140)	(0.0140)	(0.0142)	(0.0181)	(0.0140)	(0.0182)
log(GDP)	-0.0343*						-0.950***
	(0.0184)						(0.201)
Law and Order		0.0338					1.173**
		(0.0347)					(0.478)

Reg Quality			0.0903**				-0.226
			(0.0387)				(0.214)
Private Credit				-0.00634***			-0.0292***
				(0.000582)			(0.00517)
Stock Market					-0.00186		0.00399
					(0.00144)		(0.00255)
Corruption						-0.0521*	0.434**
						(0.0277)	(0.200)
Constant	0.726***	0.502***	0.523***	0.591***	1.742***	0.460***	8.215***
	(0.177)	(0.118)	(0.118)	(0.118)	(0.179)	(0.117)	(1.330)

Panel C: Moderate Obstacle

log(Age)	-0.0425	-0.0369	-0.0367	-0.0399	-0.115**	-0.0414	-0.112**
	(0.0317)	(0.0317)	(0.0317)	(0.0320)	(0.0452)	(0.0317)	(0.0454)
$\log(\text{Age})^2$	0.00336	0.00203	0.00188	0.00282	0.0153*	0.00298	0.0149*
	(0.00629)	(0.00628)	(0.00628)	(0.00634)	(0.00872)	(0.00629)	(0.00876)
log(Sales)	-0.0297**	-0.0343***	-0.0361***	-0.0225*	0.0112	-0.0325**	0.0133
	(0.0128)	(0.0128)	(0.0128)	(0.0129)	(0.0199)	(0.0128)	(0.0200)
$\log(\text{Sales})^2$	-0.0000172	0.000204	0.000331	-0.000683	-0.00435***	0.000190	-0.00447***
	(0.000687)	(0.000685)	(0.000687)	(0.000696)	(0.00110)	(0.000685)	(0.00110)
Size: small	0.0933***	0.0871***	0.0876***	0.0722***	-0.00572	0.0938***	-0.00916
	(0.0235)	(0.0235)	(0.0235)	(0.0238)	(0.0326)	(0.0236)	(0.0326)
Size: medium	0.0501**	0.0476**	0.0485**	0.0371*	-0.0143	0.0510**	-0.0158
	(0.0199)	(0.0199)	(0.0199)	(0.0202)	(0.0263)	(0.0199)	(0.0264)
Private domestic	0.000507	0.000472	0.000467	0.000554	0.00123	0.000501	0.00127
	(0.000570)	(0.000570)	(0.000570)	(0.000572)	(0.000785)	(0.000570)	(0.000787)
Private foreign	-0.00129**	-0.00131**	-0.00131**	-0.00114*	-0.000599	-0.00127**	-0.000525
	(0.000620)	(0.000620)	(0.000620)	(0.000622)	(0.000870)	(0.000620)	(0.000872)
Government	0.00203*	0.00207*	0.00210*	0.00242**	0.00306*	0.00206*	0.00317*
	(0.00118)	(0.00118)	(0.00118)	(0.00119)	(0.00166)	(0.00118)	(0.00167)
Public	0.0176	0.0197	0.0160	0.0169	-0.00850	0.0157	-0.0161
	(0.0559)	(0.0559)	(0.0559)	(0.0565)	(0.0698)	(0.0559)	(0.0701)
Limited	0.0308	0.0310	0.0287	0.0263	0.0342	0.0320	0.0263
	(0.0473)	(0.0473)	(0.0474)	(0.0481)	(0.0582)	(0.0473)	(0.0584)
Sole Prop	0.0793*	0.0875*	0.0876*	0.0734	0.0508	0.0833*	0.0564

	(0.0480)	(0.0480)	(0.0480)	(0.0488)	(0.0595)	(0.0480)	(0.0598)
Partnership	0.169***	0.178***	0.177***	0.167***	0.152**	0.174***	0.162**
	(0.0508)	(0.0508)	(0.0508)	(0.0515)	(0.0630)	(0.0508)	(0.0634)
Limited partnership	0.161***	0.166***	0.166***	0.168***	0.171***	0.163***	0.185***
	(0.0517)	(0.0517)	(0.0517)	(0.0525)	(0.0639)	(0.0517)	(0.0643)
Top manager experience	0.000418	0.000251	0.000223	0.000472	0.00163*	0.000271	0.00157*
	(0.000652)	(0.000651)	(0.000651)	(0.000655)	(0.000858)	(0.000651)	(0.000861)
Regulation time	0.00305***	0.00297***	0.00296***	0.00290***	0.00284***	0.00295***	0.00276***
	(0.000362)	(0.000362)	(0.000362)	(0.000365)	(0.000494)	(0.000362)	(0.000495)
Tax inspection	-0.0493***	-0.0544***	-0.0549***	-0.0446***	-0.0417**	-0.0521***	-0.0392**
	(0.0135)	(0.0134)	(0.0134)	(0.0136)	(0.0180)	(0.0135)	(0.0180)
Check/savings account	-0.00223	-0.000972	-0.00101	0.00220	-0.0337	-0.00197	-0.0283
	(0.0212)	(0.0212)	(0.0212)	(0.0214)	(0.0314)	(0.0212)	(0.0315)
Overdraft	0.111***	0.113***	0.114***	0.113***	0.117***	0.112***	0.117***
	(0.0151)	(0.0151)	(0.0151)	(0.0152)	(0.0205)	(0.0151)	(0.0205)
Loan credit	-0.207***	-0.205***	-0.205***	-0.211***	-0.215***	-0.206***	-0.215***
	(0.0144)	(0.0144)	(0.0144)	(0.0146)	(0.0192)	(0.0144)	(0.0193)
External audit	0.0301**	0.0256*	0.0253*	0.0255*	0.0194	0.0280*	0.0184
	(0.0147)	(0.0147)	(0.0147)	(0.0149)	(0.0207)	(0.0147)	(0.0208)
Quality cert	0.0499***	0.0500***	0.0508***	0.0479***	0.000747	0.0505***	-0.000159
	(0.0169)	(0.0169)	(0.0169)	(0.0170)	(0.0219)	(0.0169)	(0.0220)
Email	-0.00472	0.00173	0.00135	-0.00393	-0.0484*	-0.000555	-0.0469*
	(0.0181)	(0.0181)	(0.0181)	(0.0182)	(0.0266)	(0.0181)	(0.0266)
Website	0.0698***	0.0716***	0.0721***	0.0716***	0.0467**	0.0724***	0.0478**
	(0.0155)	(0.0155)	(0.0155)	(0.0157)	(0.0206)	(0.0155)	(0.0206)
log(GDP)	-0.0941***						-0.959***
	(0.0197)						(0.226)
Law and Order		0.0478					1.624***
		(0.0387)					(0.544)
Reg Quality			0.0987**				0.316
			(0.0424)				(0.230)
Private Credit				-0.00430***			-0.0158***
				(0.000624)			(0.00588)
Stock Market					-0.000480		-0.00170

					(0.00160)		(0.00302)
Corruption						-0.0711**	0.197
						(0.0306)	(0.227)
Constant	0.152	-0.489***	-0.473***	-0.447***	0.551***	-0.549***	7.050***
	(0.187)	(0.127)	(0.127)	(0.127)	(0.189)	(0.126)	(1.503)
Panel D: Major Obstacle							
log(Age)	-0.0538	-0.0481	-0.0481	-0.0479	-0.121**	-0.0521	-0.124**
	(0.0403)	(0.0403)	(0.0403)	(0.0407)	(0.0593)	(0.0403)	(0.0598)
$\log(\text{Age})^2$	0.00673	0.00536	0.00531	0.00550	0.0172	0.00618	0.0175
	(0.00810)	(0.00809)	(0.00809)	(0.00816)	(0.0116)	(0.00809)	(0.0116)
log(Sales)	-0.0219	-0.0291*	-0.0298*	-0.0144	0.0111	-0.0274	0.0112
	(0.0168)	(0.0167)	(0.0167)	(0.0169)	(0.0257)	(0.0167)	(0.0257)
$\log(\text{Sales})^2$	-0.000783	-0.000416	-0.000360	-0.00154*	-0.00436***	-0.000416	-0.00441***
	(0.000910)	(0.000906)	(0.000910)	(0.000920)	(0.00143)	(0.000906)	(0.00143)
Size: small	0.0328	0.0249	0.0253	0.00806	-0.0754*	0.0320	-0.0879*
	(0.0316)	(0.0316)	(0.0315)	(0.0319)	(0.0451)	(0.0316)	(0.0454)
Size: medium	0.00804	0.00493	0.00557	-0.00811	-0.0808**	0.00871	-0.0851**
	(0.0271)	(0.0272)	(0.0271)	(0.0275)	(0.0369)	(0.0272)	(0.0370)
Private domestic	0.0000342	-0.0000202	-0.0000186	0.000112	0.000727	0.00000998	0.000690
	(0.000720)	(0.000720)	(0.000719)	(0.000721)	(0.00102)	(0.000720)	(0.00102)
Private foreign	-0.00141*	-0.00142*	-0.00142*	-0.00124	-0.00132	-0.00139*	-0.00126
	(0.000787)	(0.000786)	(0.000786)	(0.000789)	(0.00114)	(0.000786)	(0.00114)
Government	0.00247*	0.00248*	0.00249*	0.00273*	0.00321	0.00247*	0.00381*
	(0.00147)	(0.00146)	(0.00146)	(0.00149)	(0.00216)	(0.00146)	(0.00216)
Public	-0.0201	-0.0178	-0.0192	-0.0268	-0.141	-0.0223	-0.148*
	(0.0713)	(0.0713)	(0.0713)	(0.0721)	(0.0891)	(0.0713)	(0.0896)
Limited	-0.0567	-0.0554	-0.0563	-0.0669	-0.153**	-0.0548	-0.158**
	(0.0595)	(0.0595)	(0.0595)	(0.0604)	(0.0726)	(0.0595)	(0.0730)
Sole Prop	-0.0110	-0.0000451	0.0000626	-0.0220	-0.125*	-0.00485	-0.110
	(0.0603)	(0.0603)	(0.0603)	(0.0612)	(0.0748)	(0.0603)	(0.0754)
Partnership	0.0362	0.0492	0.0487	0.0273	-0.0981	0.0438	-0.0848
	(0.0643)	(0.0643)	(0.0643)	(0.0652)	(0.0808)	(0.0643)	(0.0817)
Limited partnership	0.0325	0.0378	0.0378	0.0259	-0.0617	0.0327	-0.0271
	(0.0662)	(0.0662)	(0.0662)	(0.0674)	(0.0833)	(0.0662)	(0.0842)

Top manager experience	0.00135	0.00107	0.00107	0.00138	0.00162	0.00111	0.00152
	(0.000849)	(0.000847)	(0.000847)	(0.000854)	(0.00115)	(0.000847)	(0.00115)
Regulation time	0.00307***	0.00294***	0.00294***	0.00289***	0.00369***	0.00293***	0.00359***
	(0.000464)	(0.000463)	(0.000463)	(0.000467)	(0.000635)	(0.000463)	(0.000636)
Tax inspection	-0.0412**	-0.0484***	-0.0485***	-0.0442**	-0.0332	-0.0460***	-0.0332
	(0.0177)	(0.0177)	(0.0177)	(0.0179)	(0.0245)	(0.0177)	(0.0246)
Check/savings account	-0.00242	-0.00212	-0.00229	-0.00560	-0.0438	-0.00340	-0.0406
	(0.0271)	(0.0271)	(0.0271)	(0.0273)	(0.0426)	(0.0271)	(0.0428)
Overdraft	0.138***	0.140***	0.141***	0.140***	0.139***	0.140***	0.135***
	(0.0200)	(0.0200)	(0.0199)	(0.0201)	(0.0278)	(0.0199)	(0.0279)
Loan credit	-0.159***	-0.154***	-0.154***	-0.158***	-0.141***	-0.156***	-0.139***
	(0.0191)	(0.0191)	(0.0191)	(0.0193)	(0.0263)	(0.0191)	(0.0265)
External audit	0.0402**	0.0340*	0.0338*	0.0382*	0.00190	0.0370*	0.00499
	(0.0194)	(0.0194)	(0.0193)	(0.0195)	(0.0281)	(0.0194)	(0.0283)
Quality cert	0.0313	0.0312	0.0317	0.0283	-0.00775	0.0320	-0.00482
	(0.0230)	(0.0230)	(0.0230)	(0.0232)	(0.0304)	(0.0230)	(0.0305)
Email	0.0210	0.0302	0.0301	0.0196	-0.0180	0.0274	-0.0197
	(0.0234)	(0.0234)	(0.0233)	(0.0236)	(0.0359)	(0.0234)	(0.0360)
Website	0.0313	0.0349*	0.0352*	0.0342	0.0186	0.0356*	0.0199
	(0.0207)	(0.0207)	(0.0207)	(0.0210)	(0.0283)	(0.0207)	(0.0284)
log(GDP)	-0.150***						-0.613**
	(0.0269)						(0.308)
Law and Order		0.0288					1.426*
		(0.0567)					(0.767)
Reg Quality			0.0464				0.690**
			(0.0605)				(0.313)
Private Credit				-0.00632***			-0.0150*
				(0.000848)			(0.00828)
Stock Market					0.000644		0.0000178
					(0.00216)		(0.00470)
Corruption						-0.100**	-0.383
						(0.0438)	(0.325)
Constant	-0.0840	-1.094***	-1.090***	-0.992***	-0.170	-1.161***	3.881*
	(0.242)	(0.164)	(0.163)	(0.163)	(0.240)	(0.162)	(2.063)

Log-likelihood	-77384.665	-77406.555	-77403.377	-75998.785	-45212.645	-77403.138	-44988.299
Psuedo R^2	0.0773	0.0770	0.0771	0.0788	0.0774	0.0771	0.0787
χ^2_{24}	-	-	-	-	-	-	135.72 (0.0000)
LR Test (P> χ^2_5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-
Brandt Test (P> χ^2_{344})	-	-	-	-	-	-	0.0000
N	54434	54434	54434	53577	32650	54434	32550

Standard errors in parentheses, country, industry and year effects are included.
* p<0.10, ** p<0.05, *** p<0.01

Table 3.6: Marginal Effects of Generalised Ordered Probit Estimates

Variable	No Obstacle		Minor Obstacle		Moderate Obstacle		Major Obstacle		Severe Obstacle	
	dy/dx	Std. Er.	dy/dx	Std. Er.	dy/dx	Std. Er.	dy/dx	Std. Er.	dy/dx	Std. Er.
log(Age)	0.0203***	0.004 14	0.003 77	0.003 45	−0.0152***	0.003 49	−0.004 76	0.003 25	−0.007 32**	0.003 32
log(Sales)	0.0230***	0.001 97	0.000 832	0.001 70	−0.005 79***	0.001 75	−0.008 52***	0.001 70	−0.0124***	0.001 78
Size: small	0.0174*	0.0102	−0.0202**	0.008 69	0.006 09	0.009 12	0.0109	0.008 79	−0.0180*	0.009 28
Size: medium	−0.002 53	0.008 12	−0.000 856	0.007 09	0.007 68	0.007 34	0.008 50	0.007 14	−0.0174**	0.007 58
Private domestic	0.000 387	0.000 268	−0.000 384*	0.000 220	−0.000 333	0.000 227	0.000 273	0.000 205	0.000 141	0.000 208
Private foreign	0.001 21***	0.000 290	−0.000 363	0.000 240	−0.000 680***	0.000 249	0.000 038 6	0.000 229	−0.000 258	0.000 233
Government	0.001 73***	0.000 488	−0.001 14***	0.000 433	−0.001 41***	0.000 432	0.000 360	0.000 427	0.000 779*	0.000 443
Public	−0.0697***	0.0224	0.0526***	0.0179	0.0191	0.0199	0.0181	0.0174	−0.0302*	0.0183
Limited	−0.0641***	0.0190	0.0497***	0.0147	0.005 01	0.0166	0.0324**	0.0142	−0.0322**	0.0149
Sole Prop	−0.0790***	0.0192	0.0570***	0.0153	0.004 02	0.0169	0.0340**	0.0146	−0.0225	0.0154
Partnership	−0.0871***	0.0204	0.0158	0.0162	0.0256	0.0179	0.0618***	0.0158	−0.0173	0.0167
Limited partnership	−0.0742***	0.0203	0.0265	0.0164	−0.004 43	0.0179	0.0598***	0.0162	−0.005 53	0.0172
Top manager experience	0.001 72***	0.000 279	−0.001 44***	0.000 225	−0.000 647***	0.000 244	0.000 236	0.000 229	0.000 311	0.000 235
Regulation time	−0.000 822***	0.000 160	0.000 095 8	0.000 131	−0.000 038 8	0.000 139	0.000 271**	0.000 126	0.000 733***	0.000 131
Tax inspection	0.0607***	0.005 76	−0.0171***	0.004 79	−0.0317***	0.005 05	−0.006 61	0.004 81	−0.006 78	0.005 02
Check/savings account	0.0124	0.0101	0.0102	0.008 43	−0.0150*	0.008 73	−0.002 18	0.008 54	−0.008 30	0.008 76
Overdraft	0.0102	0.006 58	−0.0195***	0.005 60	−0.0219***	0.005 78	0.0141***	0.005 47	0.0276***	0.005 74
Loan credit	0.127***	0.006 16	−0.0102**	0.005 17	−0.0566***	0.005 46	−0.0428***	0.005 23	−0.0285***	0.005 44
External audit	−0.0115*	0.006 62	0.007 73	0.005 41	−0.001 59	0.005 85	0.004 74	0.005 57	0.001 02	0.005 78
Quality cert	0.002 37	0.006 89	−0.0248***	0.006 08	0.0232***	0.006 10	0.000 701	0.005 86	−0.000 985	0.006 23
Email	0.0111	0.008 59	0.003 89	0.007 06	−0.002 21	0.007 43	−0.0110	0.007 07	−0.004 03	0.007 37
Website	−0.0133**	0.006 61	−0.002 26	0.005 55	0.002 48	0.005 78	0.0113**	0.005 54	0.004 06	0.005 81
log(GDP)	0.0139	0.0753	0.321***	0.0626	−0.0830	0.0649	−0.193***	0.0593	−0.125**	0.0630
Law and Order	−0.232	0.179	−0.191	0.147	−0.0174	0.159	0.266*	0.147	0.292*	0.157
Reg Quality	−0.0211	0.0831	0.100	0.0657	−0.168**	0.0706	−0.0125	0.0623	0.141**	0.0641
Private Credit	0.003 08	0.001 92	0.007 34***	0.001 59	−0.006 27***	0.001 69	−0.002 42	0.001 59	−0.003 07*	0.001 69
Stock Market	0.000 107	0.000 914	−0.001 51**	0.000 753	0.001 91**	0.000 845	−0.000 513	0.000 886	0.000 003 64	0.000 961
Corruption	0.005 17	0.0741	−0.158***	0.0611	0.104	0.0646	0.119*	0.0618	−0.0783	0.0664
N	11092		7483		7129		4517		2329	

Both firm age and sales seem to portray analogous outcomes; increases in both variables are most likely in firms where access to finance is not an obstacle (0.375% and 0.376% respectively)[1] and conversely least probable in firms where the obstacle is most severe (0.365% and 0.363% respectively). Amongst the three measures of firm ownership included, whilst all but one report a positive and significant marginal effect, firms with larger proportions of government ownership are most likely to face no obstacle to finance access and accordingly the least likely of the three types to experience minor obstruction to firm financing. The one exception to this is the highest severity level where there is marginal but significant evidence of firms in this category as the proportion of government ownership increases. In combination with these two results at either end of the scale, interestingly firms are less likely to experience financial access as a moderate obstacle, in relation to government ownership. While the estimates in each of these categories are relatively small, it suggests the effect of government ownership on a firm's ability to access finance is binary in relation to either extreme.

The effect of the firm's legal status however, is inverted by comparison. Across the sample as a whole, firms are more likely to experience major obstacles to firm financing than no obstacle at all. Firms that are classed as partnership or limited partnerships are around twice as likely to face such a level of severity compared with limited firms and sole proprietorships. Moving now to the more intricate firm variables, we take into account the years of experience obtained by the individual enlisted as the top manager by the firm. Perhaps somewhat as expected, senior

[1]The estimated coefficients of logged variables are transformed by using an exponent transformation ($exp(\hat{\beta} - 1)$) for a more meaningful interpretation.

management with higher levels of experience in the sector which the firm operates, are most likely to be employed in firms that do not face financing obstacles, while they are less likely to be found in firms that face minor or moderate financing difficulties.

A compelling result that has resulted however relates to manager experience and firms who face severe financing obstacles, in that, while to a lesser extent than that of firms who face no such obstacles, are positively related. Despite perhaps not a straightforward or expected result, there does exist a relatively simple and intuitive explanation that could be posited to provide elucidation.Underlying our expectation of the effect increasing experience of top management has, is that the experience will be utilised in both an effective and transparent manner that is beneficial to the firm. However, it is sometimes the case that top management with high levels of experience, depending on the firm's ownership structure, are employed to appease shareholders in the hope to bolster a firm's value and to act as a method of augmenting perceptions to portray a firm which is taking positive and progressive steps for the future. Although, as it may now implicitly seem, this approach is somewhat myopic and does not necessarily deal with the systemic issues at hand. Additionally, the prospect of employing an experienced individual to lead the firm is an attractive one, however despite the experience being sector specific, that is not to say it is specific to the problems that firms face; in this case, access to finance.

Another role taken by senior management in firms is taking the time to review regulations and ensure their adhesion in accordance to firm operation. In our analysis, we find significant evidence that shows firms who experience major or severe obstacles to finance access are more likely to spend a higher proportion of the working week

dealing with government regulation and as such, it is conversely the case for firms who do not face any obstacles to financing. What we understand from this exactly has to be taken with caution as this relationship assumes that senior management are the sole individuals to deal with the government regulation and not another employee that is not encapsulated under the umbrella of senior management. Furthermore, we cannot know either whether or not this government regulation is anyway related to the the firms acquisition of finance at all. The two possibilities that we can posit are that either senior managements time used away from firm operation to deal with regulation may be detrimental to access to finance; or alternatively, increased government regulation is in and of itself an obstacle to access to finance for the firm.

In the above cases, whilst we have provided a narrative that would go some way to explaining the estimated coefficient of both characteristics of management, the arises the issue of there being the possibility of causality in both directions. Take for example, the expereience of the senior manager. There could exist the possilbity that a firm with expereienced senior management face more obstacles to external financing due to said management acting in a complacent manner, with a view that their embodied human capital and experience are enough to deal with these perceived obstacles. On the other hand, it may be that due to the firm facing accessing financial markets as a severe obstacle to firm performance, that they then decide to employ a manager with higher levels of experience, with a view to over come said obstacle in time. The same could be said for the time spent by senior management on regulatory matters; the question arises whether senior managers are spending more time on regulation-related matters results in them facing this obstacle

with such severity or if the obstacle is a severe one for the firm then leads to senior management having to expend much of their resources on these matters. In any case, this prospect of reverse causality, and moreover endogeniety, prevents us from gaining any useful interpretation from the estimated coefficient. While steps could be taken to address this endogeniety and endevour to ascertain the direction of causality, the WBES dataset is unable to equip us with the necessary components to be able to do so. As a result, we will not be taking this any further in this chapter but it is necessary make clear this issue when analysing the provided estimates.

Our measure for tax transparency, indicating whether or not a given firm has been either visited or inspected by a tax official in the last year, portrays a binary view; there is significant evidence to show that a firm which has been visited by the tax inspector is most likely to encounter no obstacle to acquiring finance, supporting transparency of the firms dealings with matters pertaining to tax and excise. While we attempt to cover heterogeneity between countries, industry and year, as well as other institutional aspects, it is difficult to justify why this is the case without knowing what process dictates why a particular firm is chosen for a tax inspection. One conjecture, relating to the information type is that given this may be difficult to verify, is that firms may believe there are negative connotations to admitting to having had a tax inspection, which may arguably act as a negative signal that encourages lenders to analyse a firm's financial records more scrupulously. Hence, it may only be in the interest of firm's that already have no obstacles to capital markets to admit this, given their financial records have already been classed as satisfactory for borrowing.

Considering our variable of interest is in reference to access to finance, the following variables concerning the firms involvement with banks and financial intermediaries, are of particular interest. While we find that there is overwhelming evidence of a positive relationship between the firm having an overdraft and their inability to access finance, that is firms are more likely to face financial obstacles if they have overdraft facility; additionally if the firm has a checking and savings account, they are most likely to face no obstacles to finance. Perhaps unsurprisingly, those firms who have received a loan or line of credit from a financial institution in the last year are most likely to have not experienced any obstacles to financing. In relation to the asymmetric information literature, the outcome regarding overdraft access and borrowing difficulty is consistent. In lieu of historic borrowing records, a firm's use of an overdraft, which is observable by the lending institution, may act as an signal that the firm is unable to maintain day-to-day firm operation without need for intermittent bank funds. While it is true we do not know how often a firm will use this overdraft, as well as the amount; compared with a planned bank loan, an overdraft may indicate unplanned or unexpected shortfalls in available firm finance.

Continuing the theme of transparency, we find that those firms that have had an external audit within the last year are less likely those experiencing no obstacles to financing, perhaps indicating that the need for an audit is not so much part of maintaining transparency of firm operation but more the need to involve outside organisations to aid current operations. Finally, we find significant evidence that those firms who communicate with suppliers and clients by means of a website, are less likely to experience no obstacles to financing but instead more likely to be classified

as experiencing major obstacles to financial access.

Effects by firm size

Considering the the same empirical model but across the three classes of firm size in the sample, we observe that the results in figures 3.8, 3.9 and 3.10 are mostly consistent to that of the full sample but with a few deviations and additions. While firm sales reflect the full sample estimates, firm age reports a significant and positive marginal effect of identical magnitude for both minor and no obstacle categories. This appears to be out of line with the theoretical predictions made by Greenbaum et al. (1989) and Sharpe (1990) that easing of lending conditions would be offered to younger firms due to market competition. On the firm's legal status, with the exception of publicly listed firms, large firms of all other legal status types are found to be least likely to face no obstacles to firm financing. In the case of medium firms, sole proprietorships and private limited firms are most likely to face minor obstacles, whereas both types of partnership are most likely to ensure major obstacles to borrowing. In large firms however, firms of all legal status are more likely to face obstacles to firm finances of some severity, either minor in the case of public, private limited, sole proprietorships and limited partnerships or major in the class of partnerships.

Table 3.7: Access to Finance: Ordered Probit Estimates by Firm Size

Variable	Small	Medium	Large
Panel A: No Obstacle			
log(Age)	0.0478	-0.119	-0.0904
	(0.0663)	(0.0795)	(0.0997)

$\log(\text{Age})^2$	-0.0267*	0.0155	0.00827
	(0.0140)	(0.0152)	(0.0174)
log(Sales)	0.112***	-0.0757	0.0378
	(0.0368)	(0.0471)	(0.0571)
$\log(\text{Sales})^2$	-0.0102***	0.000144	-0.00572**
	(0.00251)	(0.00259)	(0.00254)
Private domestic	-0.00146	-0.00136	0.000743
	(0.00110)	(0.00136)	(0.00177)
Private foreign	-0.00246*	-0.00370**	-0.00177
	(0.00138)	(0.00147)	(0.00181)
Government	-0.00378	-0.00738***	-0.00273
	(0.00313)	(0.00241)	(0.00246)
Public	0.0995	0.0936	0.383***
	(0.129)	(0.108)	(0.110)
Limited	0.224**	0.113	0.313***
	(0.0976)	(0.0875)	(0.101)
Sole Prop	0.186*	0.170*	0.468***
	(0.0966)	(0.0881)	(0.108)
Partnership	0.179*	0.201**	0.401***
	(0.103)	(0.0923)	(0.114)
Limited partnership	0.178*	0.220**	0.298***
	(0.108)	(0.0924)	(0.107)
Top manager experience	-0.00461***	-0.00581***	-0.00345**
	(0.00143)	(0.00128)	(0.00149)
Regulation time	0.00153**	0.00231***	0.00304***
	(0.000727)	(0.000762)	(0.000902)
Tax inspection	-0.162***	-0.175***	-0.167***
	(0.0275)	(0.0262)	(0.0337)
Check/savings account	0.0463	-0.0152	-0.184**
	(0.0410)	(0.0505)	(0.0722)
Overdraft	-0.0690**	-0.0302	-0.00471
	(0.0331)	(0.0294)	(0.0366)
Loan credit	-0.349***	-0.372***	-0.370***
	(0.0319)	(0.0281)	(0.0340)

External audit	0.0650**	0.0123	0.0251
	(0.0314)	(0.0298)	(0.0412)
Quality cert	0.0284	-0.0168	-0.0115
	(0.0414)	(0.0293)	(0.0350)
Email	-0.0216	-0.0827**	0.0187
	(0.0352)	(0.0404)	(0.0760)
Website	0.0422	0.0498*	-0.0112
	(0.0318)	(0.0284)	(0.0422)
log(GDP)	0.188	-0.0336	0.0536
	(0.345)	(0.353)	(0.488)
Law and Order	1.543*	-0.222	0.274
	(0.806)	(0.844)	(1.219)
Reg Quality	-0.641	0.766*	0.293
	(0.412)	(0.394)	(0.439)
Private Credit	-0.0184**	-0.00163	0.00394
	(0.00907)	(0.00898)	(0.0111)
Stock Market	0.00115	0.00413	-0.00805
	(0.00424)	(0.00434)	(0.00576)
Corruption	-0.199	-0.203	0.328
	(0.362)	(0.344)	(0.450)
Constant	0.797	3.103	1.983
	(2.257)	(2.344)	(3.324)

Panel B: Minor Obstacle

log(Age)	0.0231	-0.145*	-0.116
	(0.0643)	(0.0758)	(0.0991)
$\log(\text{Age})^2$	-0.0155	0.0159	0.00439
	(0.0137)	(0.0145)	(0.0173)
log(Sales)	0.0555	-0.0989**	0.0655
	(0.0349)	(0.0469)	(0.0592)
$\log(\text{Sales})^2$	-0.00748***	0.00127	-0.00600**
	(0.00239)	(0.00261)	(0.00267)
Private domestic	0.000715	-0.00112	-0.000384
	(0.00103)	(0.00130)	(0.00166)
Private foreign	-0.00111	-0.00304**	-0.00267

	(0.00132)	(0.00142)	(0.00171)
Government	-0.00466	-0.00568**	0.000152
	(0.00390)	(0.00272)	(0.00251)
Public	0.0340	0.0324	0.0620
	(0.126)	(0.104)	(0.112)
Limited	0.123	-0.0318	0.0895
	(0.0942)	(0.0842)	(0.102)
Sole Prop	0.101	-0.0429	0.0959
	(0.0938)	(0.0861)	(0.111)
Partnership	0.132	0.145	0.278**
	(0.1000)	(0.0901)	(0.116)
Limited partnership	0.124	0.103	0.151
	(0.105)	(0.0905)	(0.110)
Top manager experience	-0.00226	-0.000135	0.000613
	(0.00137)	(0.00125)	(0.00150)
Regulation time	0.00110	0.00243***	0.00228**
	(0.000714)	(0.000747)	(0.000903)
Tax inspection	-0.113***	-0.142***	-0.0572*
	(0.0264)	(0.0256)	(0.0344)
Check/savings account	0.00576	-0.0631	-0.249***
	(0.0397)	(0.0503)	(0.0747)
Overdraft	0.00766	0.0157	0.0647*
	(0.0317)	(0.0289)	(0.0368)
Loan credit	-0.244***	-0.317***	-0.421***
	(0.0301)	(0.0270)	(0.0348)
External audit	0.0536*	-0.0179	-0.0317
	(0.0304)	(0.0291)	(0.0417)
Quality cert	0.102**	0.0468	0.0779**
	(0.0412)	(0.0287)	(0.0350)
Email	-0.0736**	-0.0738*	0.0347
	(0.0343)	(0.0396)	(0.0769)
Website	0.0405	0.0538*	0.0108
	(0.0310)	(0.0276)	(0.0427)
log(GDP)	-0.593*	-1.100***	-1.344***

	(0.323)	(0.338)	(0.456)
Law and Order	1.068	1.102	2.134*
	(0.753)	(0.806)	(1.143)
Reg Quality	-0.168	-0.559	0.579
	(0.370)	(0.358)	(0.416)
Private Credit	-0.0221**	-0.0409***	-0.0149
	(0.00858)	(0.00864)	(0.0107)
Stock Market	0.00561	0.00809*	-0.00728
	(0.00425)	(0.00426)	(0.00570)
Corruption	0.400	0.158	0.854*
	(0.338)	(0.324)	(0.459)
Constant	5.365**	9.740***	10.85***
	(2.119)	(2.253)	(3.111)

Panel C: Moderate Obstacle

log(Age)	-0.114	-0.0717	-0.161
	(0.0694)	(0.0845)	(0.115)
$\log(\text{Age})^2$	0.0217	0.00997	0.0172
	(0.0147)	(0.0160)	(0.0202)
log(Sales)	0.0803**	-0.0958*	0.00749
	(0.0374)	(0.0507)	(0.0666)
$\log(\text{Sales})^2$	-0.00860***	0.000210	-0.00312
	(0.00259)	(0.00288)	(0.00304)
Private domestic	0.00166	0.00165	0.000590
	(0.00111)	(0.00147)	(0.00184)
Private foreign	0.000803	0.000347	-0.00148
	(0.00144)	(0.00161)	(0.00191)
Government	-0.00549	0.00392	0.00410
	(0.00503)	(0.00334)	(0.00278)
Public	-0.0870	-0.0463	0.0413
	(0.140)	(0.116)	(0.135)
Limited	0.0534	0.0128	0.0901
	(0.102)	(0.0929)	(0.124)
Sole Prop	0.0905	-0.0116	0.109
	(0.102)	(0.0960)	(0.136)

Partnership	0.0763	0.121	0.200
	(0.109)	(0.101)	(0.141)
Limited partnership	0.0628	0.226**	0.270**
	(0.117)	(0.102)	(0.135)
Top manager experience	-0.00127	0.00275**	0.00303*
	(0.00148)	(0.00140)	(0.00179)
Regulation time	0.00208***	0.00302***	0.00256**
	(0.000801)	(0.000834)	(0.00103)
Tax inspection	-0.0160	-0.0891***	0.0420
	(0.0290)	(0.0294)	(0.0412)
Check/savings account	0.0289	-0.00447	-0.175*
	(0.0436)	(0.0578)	(0.0912)
Overdraft	0.160***	0.0828**	0.0999**
	(0.0348)	(0.0328)	(0.0438)
Loan credit	-0.195***	-0.181***	-0.291***
	(0.0324)	(0.0306)	(0.0422)
External audit	0.0574*	0.0199	-0.103**
	(0.0334)	(0.0337)	(0.0503)
Quality cert	-0.0214	-0.0129	0.0463
	(0.0463)	(0.0333)	(0.0410)
Email	-0.110***	-0.00527	0.0713
	(0.0384)	(0.0447)	(0.0878)
Website	0.0764**	0.0192	0.0652
	(0.0343)	(0.0315)	(0.0504)
log(GDP)	-0.632*	-1.091***	-1.009*
	(0.354)	(0.382)	(0.533)
Law and Order	1.943**	1.034	2.176
	(0.840)	(0.921)	(1.348)
Reg Quality	0.0342	0.0266	1.204**
	(0.390)	(0.374)	(0.479)
Private Credit	-0.0204**	-0.0214**	0.0103
	(0.00942)	(0.00981)	(0.0131)
Stock Market	0.00182	0.00196	-0.0163**
	(0.00495)	(0.00503)	(0.00688)

Corruption	-0.405	0.529	0.838
	(0.368)	(0.367)	(0.559)
Constant	4.216*	8.513***	7.942**
	(2.334)	(2.566)	(3.626)

Panel D: Major Obstacle

log(Age)	-0.134	-0.0595	-0.0965
	(0.0898)	(0.117)	(0.166)
$\log(\text{Age})^2$	0.0276	0.00412	0.00559
	(0.0191)	(0.0224)	(0.0290)
log(Sales)	0.102**	-0.155**	0.0330
	(0.0496)	(0.0612)	(0.0967)
$\log(\text{Sales})^2$	-0.0108***	0.00478	-0.00452
	(0.00345)	(0.00349)	(0.00450)
Private domestic	0.00189	-0.00113	0.00145
	(0.00143)	(0.00188)	(0.00288)
Private foreign	0.00109	-0.00328	-0.000319
	(0.00185)	(0.00209)	(0.00297)
Government	-0.00411	0.00407	0.00301
	(0.00707)	(0.00380)	(0.00415)
Public	0.0369	-0.288*	-0.200
	(0.178)	(0.151)	(0.176)
Limited	-0.0608	-0.184	-0.239
	(0.129)	(0.117)	(0.161)
Sole Prop	-0.00277	-0.246**	-0.131
	(0.131)	(0.121)	(0.181)
Partnership	-0.0902	-0.188	-0.130
	(0.142)	(0.130)	(0.190)
Limited partnership	-0.00946	-0.0556	-0.0429
	(0.155)	(0.132)	(0.182)
Top manager experience	-0.00342*	0.00160	0.00783***
	(0.00197)	(0.00189)	(0.00248)
Regulation time	0.00428***	0.00406***	0.00314**
	(0.00103)	(0.00108)	(0.00136)
Tax inspection	0.0349	-0.0986**	-0.0144

	(0.0388)	(0.0412)	(0.0598)
Check/savings account	0.0144	-0.0942	-0.214
	(0.0574)	(0.0852)	(0.132)
Overdraft	0.194***	0.113**	0.0723
	(0.0463)	(0.0455)	(0.0635)
Loan credit	-0.194***	-0.0719*	-0.112*
	(0.0434)	(0.0425)	(0.0628)
External audit	0.0381	-0.0171	-0.114
	(0.0442)	(0.0475)	(0.0743)
Quality cert	-0.00584	-0.0303	0.0679
	(0.0646)	(0.0471)	(0.0587)
Email	-0.0726	0.0244	-0.0163
	(0.0519)	(0.0621)	(0.130)
Website	0.0174	-0.0126	0.151**
	(0.0463)	(0.0443)	(0.0726)
log(GDP)	-1.197**	0.134	0.217
	(0.491)	(0.553)	(0.701)
Law and Order	2.227*	-0.930	1.977
	(1.221)	(1.396)	(1.834)
Reg Quality	0.526	0.448	2.007***
	(0.538)	(0.513)	(0.682)
Private Credit	-0.0294**	-0.0146	0.0381**
	(0.0133)	(0.0138)	(0.0191)
Stock Market	-0.000156	0.0179**	-0.0318***
	(0.00797)	(0.00817)	(0.0112)
Corruption	-0.932*	-0.228	-0.0467
	(0.500)	(0.570)	(0.812)
Constant	6.591**	-0.340	-1.148
	(3.274)	(3.782)	(4.762)
Country, Industry and			
Year Fixed Effects	Yes	Yes	Yes
Log-likelihood	-16597.358	-17072.1	-10563.076
Psuedo R^2	0.0885	0.0835	0.1060
N	11863	12441	8246

Standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01

Table 3.8: Marginal Effects of Generalised Ordered Probit Estimates: Small Firms

Variable	No Obstacle		Minor Obstacle		Moderate Obstacle		Major Obstacle		Severe Obstacle	
	dy/dx	Std. Er.	dy/dx	Std. Er.	dy/dx	Std. Er.	dy/dx	Std. Er.	dy/dx	Std. Er.
log(Age)	0.0310***	0.007 37	−0.009 06	0.005 94	−0.0179***	0.005 99	−0.001 91	0.005 65	−0.001 23	0.006 33
log(Sales)	0.0128***	0.003 51	0.006 77**	0.002 94	−0.006 53**	0.003 02	−0.003 32	0.003 01	−0.0138***	0.003 55
Private domestic	0.000 517	0.000 392	−0.000 747**	0.000 341	−0.000 216	0.000 305	0.000 194	0.000 314	0.000 463	0.000 349
Private foreign	0.000 872*	0.000 491	−0.000 421	0.000 416	−0.000 636	0.000 404	0.000 064 2	0.000 405	0.000 266	0.000 451
Government	0.001 34	0.001 11	0.000 424	0.001 37	−0.000 125	0.001 43	−0.001 01	0.001 46	−0.001 00	0.001 73
Public	−0.0353	0.0459	0.0210	0.0367	0.0374	0.0402	−0.0335	0.0367	0.009 01	0.0435
Limited	−0.0793**	0.0346	0.0302	0.0270	0.0297	0.0288	0.0271	0.0272	−0.0149	0.0315
Sole Prop	−0.0660*	0.0342	0.0256	0.0272	0.0110	0.0286	0.0288	0.0275	−0.000 676	0.0319
Partnership	−0.0633*	0.0365	0.0119	0.0292	0.0263	0.0307	0.0393	0.0297	−0.0220	0.0346
Limited partnership	−0.0632*	0.0383	0.0148	0.0310	0.0272	0.0326	0.0213	0.0323	−0.002 31	0.0379
Top manager experience	0.001 64***	0.000 507	−0.000 725*	0.000 413	−0.000 460	0.000 421	0.000 190	0.000 416	−0.000 836*	0.000 481
Regulation time	−0.000 543**	0.000 258	0.000 114	0.000 213	−0.000 195	0.000 221	−0.000 083 6	0.000 216	0.001 05***	0.000 253
Tax inspection	0.0576***	0.009 71	−0.0134*	0.007 83	−0.0367***	0.008 36	−0.0110	0.008 24	0.008 51	0.009 49
Check/savings account	−0.0164	0.0145	0.0134	0.0118	−0.006 20	0.0126	0.006 57	0.0125	0.003 52	0.0140
Overdraft	0.0245**	0.0117	−0.0259***	0.009 61	−0.0432***	0.0101	0.0167*	0.009 83	0.0475***	0.0114
Loan credit	0.124***	0.0112	−0.0286***	0.009 32	−0.0330***	0.009 37	−0.0277***	0.009 24	−0.0474***	0.0106
External audit	−0.0230**	0.0111	0.002 32	0.008 86	0.003 10	0.009 65	0.0114	0.009 45	0.009 31	0.0108
Quality cert	−0.0101	0.0147	−0.0273**	0.0132	0.0432***	0.0126	−0.005 69	0.0133	−0.001 43	0.0158
Email	0.007 67	0.0125	0.0194*	0.0103	0.004 70	0.0110	−0.0219**	0.0109	−0.0177	0.0127
Website	−0.0150	0.0113	−0.000 543	0.009 20	−0.007 16	0.009 99	0.0209**	0.009 66	0.004 26	0.0113
log(GDP)	−0.0667	0.122	0.278***	0.101	−0.0349	0.105	0.007 77	0.0992	−0.292**	0.120
Law and Order	−0.547*	0.286	0.130	0.238	−0.168	0.253	0.226	0.243	0.544*	0.299
Reg Quality	0.227	0.146	−0.154	0.115	−0.0712	0.125	−0.0795	0.112	0.129	0.131
Private Credit	0.006 51**	0.003 21	0.001 85	0.002 64	−0.002 21	0.002 78	−0.001 34	0.002 70	−0.007 17**	0.003 26
Stock Market	−0.000 409	0.001 50	−0.001 64	0.001 27	0.001 52	0.001 42	0.000 596	0.001 59	−0.000 038 0	0.001 95
Corruption	0.0706	0.128	−0.211**	0.105	0.262**	0.110	0.0331	0.102	−0.228*	0.122
N	3844		2380		2645		1907		1087	

Table 3.9: Marginal Effects of Generalised Ordered Probit Estimates: Medium Firms

Variable	No Obstacle		Minor Obstacle		Moderate Obstacle		Major Obstacle		Severe Obstacle	
	dy/dx	Std. Er.	dy/dx	Std. Er.	dy/dx	Std. Er.	dy/dx	Std. Er.	dy/dx	Std. Er.
log(Age)	0.0125*	0.006 82	0.008 66	0.005 62	−0.0166***	0.005 84	0.000 244	0.005 61	−0.007 05	0.005 31
log(Sales)	0.0258***	0.003 39	0.002 03	0.002 99	−0.002 91	0.003 04	−0.0169***	0.002 90	−0.0141***	0.002 88
Private domestic	0.000 481	0.000 480	−0.000 070 6	0.000 405	−0.000 845*	0.000 449	0.000 660*	0.000 374	−0.000 211	0.000 352
Private foreign	0.001 31**	0.000 520	−0.000 190	0.000 437	−0.001 19**	0.000 484	0.000 583	0.000 414	−0.000 614	0.000 392
Government	0.002 61***	0.000 849	−0.000 515	0.000 826	−0.003 10***	0.000 948	0.000 581	0.000 702	0.000 763	0.000 714
Public	−0.0331	0.0383	0.0203	0.0300	0.0241	0.0341	0.0283	0.0294	−0.0541*	0.0283
Limited	−0.0400	0.0309	0.0493**	0.0248	−0.0149	0.0271	0.0308	0.0226	−0.0346	0.0220
Sole Prop	−0.0600*	0.0311	0.0723***	0.0255	−0.0123	0.0280	0.0326	0.0236	−0.0462**	0.0228
Partnership	−0.0710**	0.0326	0.0174	0.0267	0.0196	0.0292	0.0639**	0.0250	−0.0352	0.0244
Limited partnership	−0.0778**	0.0326	0.0386	0.0270	−0.0236	0.0292	0.0760***	0.0255	−0.0104	0.0248
Top manager experience	0.002 05***	0.000 451	−0.001 92***	0.000 364	−0.000 786**	0.000 398	0.000 592	0.000 375	0.000 300	0.000 355
Regulation time	−0.000 817***	0.000 269	−0.000 066 9	0.000 222	0.000 066 0	0.000 240	0.000 313	0.000 212	0.000 761***	0.000 204
Tax inspection	0.0619***	0.009 23	−0.009 77	0.007 90	−0.0272***	0.008 19	−0.0123	0.007 88	−0.0185**	0.007 75
Check/savings account	0.005 37	0.0179	0.0169	0.0159	−0.0215	0.0153	0.0124	0.0162	−0.0177	0.0160
Overdraft	0.0107	0.0104	−0.0157*	0.009 24	−0.0165*	0.009 14	0.008 33	0.008 72	0.0211**	0.008 56
Loan credit	0.132***	0.009 79	−0.0153*	0.008 32	−0.0657***	0.008 56	−0.0437***	0.008 20	−0.0135*	0.007 98
External audit	−0.004 36	0.0105	0.0104	0.008 79	−0.0118	0.009 39	0.008 46	0.009 17	−0.003 20	0.008 91
Quality cert	0.005 94	0.0104	−0.0220**	0.009 13	0.0203**	0.009 11	0.000 549	0.008 87	−0.005 68	0.008 84
Email	0.0292**	0.0143	−0.002 20	0.0123	−0.0252**	0.0121	−0.005 15	0.0118	0.004 57	0.0116
Website	−0.0176*	0.0100	−0.001 92	0.008 63	0.0142	0.008 86	0.007 60	0.008 44	−0.002 36	0.008 31
log(GDP)	0.0119	0.125	0.373***	0.101	−0.104	0.110	−0.347***	0.104	0.0251	0.104
Law and Order	0.0785	0.298	−0.460**	0.232	0.120	0.272	0.446*	0.262	−0.174	0.262
Reg Quality	−0.271*	0.139	0.454***	0.111	−0.208*	0.115	−0.0575	0.101	0.0839	0.0962
Private Credit	0.000 576	0.003 17	0.0137***	0.002 59	−0.009 00***	0.002 78	−0.004 27*	0.002 60	−0.002 73	0.002 60
Stock Market	−0.001 46	0.001 53	−0.001 43	0.001 26	0.002 39*	0.001 41	−0.002 03	0.001 50	0.003 35**	0.001 54
Corruption	0.0716	0.121	−0.124	0.0976	−0.0848	0.106	0.192*	0.106	−0.0428	0.107
N	4089		3016		2799		1720		817	

Table 3.10: Marginal Effects of Generalised Ordered Probit Estimates: Large Firms

Variable	No Obstacle		Minor Obstacle		Moderate Obstacle		Major Obstacle		Severe Obstacle	
	dy/dx	Std. Er.	dy/dx	Std. Er.	dy/dx	Std. Er.	dy/dx	Std. Er.	dy/dx	Std. Er.
log(Age)	0.0149*	0.008 07	0.0149**	0.007 06	−0.0174**	0.007 19	−0.008 57	0.006 59	−0.0118*	0.007 18
log(Sales)	0.0321***	0.003 61	−0.009 20***	0.003 25	−0.008 39***	0.003 18	−0.008 27***	0.003 00	−0.0118***	0.003 35
Private domestic	−0.000 264	0.000 627	0.000 381	0.000 535	−0.000 275	0.000 472	−0.000 017 5	0.000 485	0.000 270	0.000 538
Private foreign	0.000 629	0.000 642	0.000 263	0.000 547	−0.000 582	0.000 492	−0.000 367	0.000 499	−0.000 059 4	0.000 553
Government	0.000 970	0.000 874	−0.000 988	0.000 764	−0.000 925	0.000 684	0.000 752	0.000 729	0.000 561	0.000 774
Public	−0.136***	0.0391	0.111***	0.0320	0.0119	0.0354	0.0360	0.0303	−0.0374	0.0329
Limited	−0.111***	0.0357	0.0784***	0.0280	0.009 87	0.0323	0.0542**	0.0274	−0.0446	0.0301
Sole Prop	−0.166***	0.0381	0.130***	0.0317	0.007 59	0.0351	0.0460	0.0303	−0.0244	0.0337
Partnership	−0.143***	0.0406	0.0473	0.0332	0.0496	0.0369	0.0707**	0.0322	−0.0242	0.0355
Limited partnership	−0.106***	0.0379	0.0531*	0.0308	−0.0114	0.0349	0.0791***	0.0303	−0.007 99	0.0340
Top manager experience	0.001 23**	0.000 529	−0.001 39***	0.000 439	−0.000 507	0.000 479	−0.000 138	0.000 428	0.001 46***	0.000 468
Regulation time	−0.001 08***	0.000 320	0.000 298	0.000 271	0.000 190	0.000 279	0.000 312	0.000 244	0.000 586**	0.000 256
Tax inspection	0.0593***	0.0119	−0.0387***	0.0104	−0.0300***	0.0105	0.0133	0.0101	−0.002 68	0.0111
Check/savings account	0.0652**	0.0256	0.0181	0.0220	−0.0454**	0.0232	−0.0215	0.0217	−0.0399	0.0247
Overdraft	0.001 67	0.0130	−0.0227**	0.0113	−0.001 18	0.0114	0.0184*	0.0107	0.0135	0.0118
Loan credit	0.131***	0.0118	0.0101	0.0108	−0.0780***	0.0107	−0.0659***	0.0106	−0.0209*	0.0117
External audit	−0.008 90	0.0146	0.0189	0.0132	0.0135	0.0132	−0.0142	0.0126	−0.0212	0.0139
Quality cert	0.004 09	0.0124	−0.0294***	0.0109	0.0163	0.0108	0.004 28	0.009 93	0.0127	0.0110
Email	−0.006 64	0.0270	−0.004 88	0.0232	−0.004 86	0.0222	0.0215	0.0217	−0.003 03	0.0242
Website	0.003 96	0.0150	−0.007 34	0.0130	−0.0118	0.0130	−0.000 782	0.0123	0.0281**	0.0136
log(GDP)	−0.0190	0.173	0.457***	0.152	−0.230	0.142	−0.303**	0.123	0.0405	0.131
Law and Order	−0.0971	0.433	−0.602	0.392	0.229	0.359	0.351	0.322	0.369	0.343
Reg Quality	−0.104	0.156	−0.0880	0.127	−0.0845	0.132	0.0818	0.117	0.374***	0.129
Private Credit	−0.001 40	0.003 95	0.006 23*	0.003 38	−0.007 69**	0.003 49	−0.001 88	0.003 13	0.007 11**	0.003 59
Stock Market	0.002 86	0.002 04	−0.000 389	0.001 79	0.001 34	0.001 79	−0.000 538	0.001 84	−0.005 92***	0.002 11
Corruption	−0.116	0.160	−0.166	0.143	0.0994	0.138	0.235*	0.133	−0.008 70	0.151
N	3159		2087		1685		890		425	

Across all classes of firm size, firms with that have a senior manager with more years of experience are more likely to face no obstacles to finance and less likely so in the case of minor obstacle classes. The one exception to this is the sub-sample of large firms, where firms that have a manager with a given level of experience are just as likely to also face severe obstacles to financing also. While the size of the effect is small, it is significant. Offering an explanation to this depends on the direction of causality that is assumed, that is, firm may face severe financing obstacle due to the employment of an experienced but poorly performing manager or they may employ an experienced manager in the hope of alleviating the severity of the obstacle they face. Our current analysis does not endeavour to ascertain which is the case but highlights a significant association nonetheless. Again, irrespective of firm size, both time spent on regulation and tax inspections mirror that which was found to be the case in the full sample - an association that finds firm to be more likely to experience no or severe levels of financing obstacle respectively. Note, the same proviso with regards to direction of causality and inference applies here also.

Firms that report having some form of credit line or loan in the last 12 months are unsurprisingly significantly more likely to report no obstacles to financing, while the use of an overdraft by both small or medium-sized firms are more likely to face severe obstacles to financing but only of major severity for large firms. What is of note that for small firms, there is significant evidence that those who use an overdraft are also likely to face no obstacle to finance but in this instance, the estimate size just under half the size of the one reported with respect to the highest severity level. This may be that, while the previous explanation given on the negative effect of having

used an overdraft facility on lending may have to business with little to no borrowing history, smaller firms may find an overdraft facility sufficient as a way of borrowing smaller amount to finance firm projects or investment. Finally, across the three firm size profiles, we find evidence that medium–sized firms are either less likely to face no obstacles and both small and large firms are more likely to face major and severe obstacle to financing respectively, when they use a company website to communicate with clients.

3.6 Conclusion

The firm's inability to access to external finance and the implications of such have been heavily documented in the literature, particularly in reference to the development of small and medium-sized enterprise (Beck and Demirguc-Kunt, 2006; Ayyagari et al., 2007). Moreover, work on information types (Petersen, 2004) and their application in the consideration of borrowing application by loan officers in financial institutions (Boot and Thakor, 1994; Petersen and Rajan, 1995; Berger and Udell, 1995) has grew in interest, particularly so given the digital advances in the way information is stored and transferred between parties. In this chapter, we employ an generalised ordered probit methodology to investigate the effect that various soft and hard information variables regarding the firm inform how, if at all, firms experience obstacles to firm financing.

In short, we find that when considering how severe an obstacle a firm's ability to access finance is, different information types matter. Older firms are less likely to

encounter severe obstacle to financing, which holds true across all reported classes of firm size. In parallel, we find that firms with higher reported sales revenue are increasingly likely to face no obstacle to borrowing either. The years of experience amassed by the top manager of the firm is positively associated with firms that are more likely to face no obstacles, while it is conversely the case in relation to the time spent on regulatory matters. That being said, we realise that there is the possibility of the direction of causality being queried here and so, other techniques would be required to deal with the arising endogeniety. Due to limitation of the dataset, we do not endevour to ascertain the direction of causality in this chapter. Tax inspections, possession of a savings and/or checking account and being in receipt of a loan or line of credit in the last 12 months is beneficial in reducing constraints to financial borrowing, while access to an overdraft facility is associated with borrowing obstacles of the two highest levels of severity, major and severe.

The implications of these results are important not only to financial institutions issuing finance but also to those firms who seek it. Firstly, those considering applications for lending should acknowledge that an over-reliance of hard information, as has been observed by Cole et al. (2004), in making a decision about lending is to ignore a valuable source of information that may either potentially alter the outcome that is mutually beneficial for both parties. Furthermore, it is of interest for firms who endeavour to acquire external finance to make available information that goes past conforming to traditional balance sheet and associated accounting records for the very same reason. Ultimately, promoting mechanisms that both allow for the transmission of softer information types and additionally allow for their verification

at a lower cost and more timely manner, will help to ensure a more thorough and accurate lending system.

Chapter 4

What You Cannot See May In Fact Hurt You: The Effect of Unobserved Obstacles to Firm Operation on Firm Sales

4.1 Introduction

Historically, the empirical study and analysis of the firm has had a concentrated focus on firm performance - both measurement and determinants thereof. The early literature has considered a number of measures of firm performance. Furthermore, a number of econometric methods, namely data envelopment and stochastic frontier analyses, have allowed researchers to calculate the level of firm efficiency and attempt to explain variations in performance between firms, typically using various observed characteristics of the firm and the business they undertake. Building on the type of data used in these forms of study, namely production and accounting measures, newer breeds of surveys – both within and outside of the firm literature – have moved

to include, in addition to the aforementioned measures, the perception of particular aspects that are otherwise unmeasurable and/or unobservable. Household surveys, such as British Household Panel Survey, Household, Income and Labour Dynamics in Australia Survey and National Family Health Survey have established a long-standing adoption of such survey methodologies, to include questions that pertain to individual perceptions of autonomy and well-being. In contrast, particularly in worldwide surveys, such practices within survey methodology is relatively sparse and work using these existing perceptual measures are few.

One such survey, the World Bank Enterprise Survey (WBES), collects data from employees within firms across 139 countries, not only on quantities of employed factors of productions and related accounting measures, but asks these individuals about their perception of the obstacles that their firm faces and to which level of severity. In consideration of their role on the performance of the firm, there are a number of a points that must be acknowledged. Firstly, the obstacles relating to firm operation are reported as a perception and as such do not directly inform the researcher of the observed level of severity. Moreover, the way in which these measures are used to evaluate their association with firm performance is not immediately straightforward. Using these measures individually, risks omitting the potential interdependencies between obstacles that may, in and of itself, have some effect on firm performance. Furthermore, attempts to aggregate these measures by summation or other elementary arithmetic calculation, introduces the prospect of a erroneously treating these obstacles as homogenous, leading to a misleading inference when comparing firms.

In light of these issues raised, this chapter offers two novel approaches which takes

into consideration the heterogeneity of firm obstacles and additionally addresses the fact that manifested within these perceptions of obstacles, is a unobserved and latent measure that acts as an index to measure the obstacles that firms face. In the first proposed method, we use a generalised structural equation modelling approach to obtain estimated weights of the respective firm obstacles. These estimates act as the priors used to calculate the estimated posterior conditional (empirical Bayes) mean that embodies the latent measure of the level of obstacles that firms face. The firm obstacle index is then used, alongside other observable firm covariates to evaluate the effect on performance, as measured by the level of firm sales. In the second, owing to the ordinal nature of the reported obstacles, we employ polychoric principal component analysis (PCA), to create a measure which best captures the variation in the obstacles firm face.

Comparing the three measures - summative, empirical Bayes and polychoric PCA - both of the newly proposed measures are statistically significant in explaining variation in firm sales. For the full sample both exhibit a negative association between increases in firm obstacles measures and reductions in firm sales. Using Akaike information criterion, we find there is statistical preference towards the polychoric PCA measure over the empirical Bayes index, however while the linear relation is found to be significant, the same is not true for the added quadratic term.

With respect to the full sample, we find a linear relationship between the preferred index and firm sales that is, we find that firms that have a higher value on the constructed scale are associated with lower levels of firm sales. Quantile regression estimates reveal this same linear relationship also persists in and above the 40th per-

centile of firm sales. Studies of the disaggregated sample reveal the same phenomenon - the African, Middle East and North Africa, and South Asian regions, firms within the manufacturing sector, as well as medium and large-sized firm sub-samples.

In what follows, section 4.2 will present a review of the relevant literature, proceeding this, section 4.3 will contain an analysis and discussion of the data used in the chapter, while section 4.4 will elucidate the empirical strategy employed. Sections 4.5 and 4.6 will include a discussion of the results attained from the empirical analysis and conclusion, respectively.

4.2 Background and Relevant Prior Research

From the outset, it is important to note that while there is a significant literature looking at the measurement of firm performance, the notion of performance and its subsequent measurement vary widely across studies. While we appreciate this body of work is not in direct relation with latent firm obstacles, due to the relatively sparsity of studies in this area, it is pertinent to review this literature in order to identify the present gaps in the literature and how the work in this chapter will contribute to bridging this disconnect between both spheres.

4.2.1 Measures and determinants of firm performance

The notion of how firm performance is classified or measured is ambiguous and in part, context-specific. This evident from the literature concerning the calculation of firm performance or analysis of its determinants thereof. These have included Tobin's q (Chen and Lee, 1995; Wernerfelt and Montgomery, 1988; Agrawal and Knoeber, 1996; Bharadwaj et al., 1999; Anderson and Reeb, 2003), stock market price and returns (Klassen and McLaughlin, 1996; Zott and Amit, 2008) and return on assets (Maury, 2006; Morgan et al., 2009) to name but a few. In these cases, for the most part, are centered around the possession of financial data, where the variables acting as a measure of performance are either reported primarily or, particularly in the case of Tobin's q, calculated using financial records of market and book values of the firm's assets and taking the ratio of these two measures.

Alternatively, parametric and non-parametric methods within the production lit-

erature have allowed for researchers to acquire forms of firm performance, namely productivity efficiency, directly from production data. Data envelopment (DEA) and stochastic frontier analysis (SFA) are two such econometric methods that have emerged within the productivity literature. The former, emerging from the work of Charnes et al. (1978) which undertook the first attempt to estimate the production frontier, considers entities termed as decision-making units (DMUs) and their ability to covert inputs into outputs. While applicable in a range of fields (see Liu et al. (2013) for a survey of DEA applications), this particular approach has proven attractive within the management literature, principally due to the accessibility of the methodology that allows the empirical researcher to model efficiency of DMUs without a mathematical expression or understanding of the production process, instead relying on linear programming as the process of estimating the production frontier. Chen et al. (2015) notes in a comparison of both methods, DEA is more sensitive to outliers and in the absence of a formal model of production, testing of differing input-output specification is not possible.

In contrast, SFA is far more restrictive in nature due to the range of assumptions typically placed on different facets of the methodology. These tend to include, at a minimum, distributional assumptions on both error and inefficiency terms, as well as a known production function for the firms observed in the sample, typically of the Cobb-Douglas or translog forms, hence the popularity of SFA within the economics literature. While this approach can be utilised to estimate the production frontier and to attain the associated efficiency scores of individual firms or units of higher aggregation, SFA has evolved to allow the researcher to elucidate firm efficiency,

or lack thereof, using a set of covariates considered to be associated with increasing or decreasing a firm's score (see Kumbhakar and Lovell (2003) for a review of developments in SFA methodology).

Amongst the aforementioned spectrum of how a firm is considered to be operating or performing, the empirical literature has considered numerous attributes of the business environment which may be associated as having beneficial or detrimental effects to the firm. In light of this, only those pertaining to the perceived obstacles within this chapter are discussed. Corruption and informal practices have been extensively investigated, as to their effect on the economy as a whole and at lower levels of disaggregation. The literature is somewhat divided regarding its influence. Whilst there are those authors that regard corruption as detrimental at both country and firm level (Mauro, 1995; Kaufmann and Wei, 1999; Del Monte and Papagni, 2001; Teal and McArthur, 2002; De Rosa et al., 2010), the alternative view put forward argues that where the institutional set-up of a country is less developed or the rule of law is particularly ineffective, corruption may 'grease the wheels' of the bureaucratic process (Méon and Sekkat, 2005; Méon and Weill, 2010) and thus improve the ease of business more generally. Related to these two areas of consideration, crime in contrast, has received relatively less attention in the empirical firm performance literature. Gaviria (2002) conducts an analysis across firms within Latin America using World Bank survey data from 1996 and finds that those firms that report crime as an obstacle to firm performance will endure reductions in the level of sales growth; however, this finding is somewhat limited, as the author employs a binary measure of crime which is unable to account for the perception of different levels of severity.

Constraints that firms face in obtaining external financing is well-documented. Demirgüç-Kunt and Maksimovic (1998) find that, in addition to efficient legal systems, the presence and development of large banking sectors promotes firm growth attributed to external finance. Beck et al. (2005) corroborates the importance of the development of the financial sector and finds that within the sample of firms across 54 countries, small firms face the most severe constraints to obtaining financing. In contrast, their findings show that the continuing development of institutions, financial and legal, will alleviate the constraining effect most notably for small firms, in agreement with the findings of Beck and Demirguc-Kunt (2006), Beck et al. (2006) and Kuntchev et al. (2013). As such, firms will endeavour to set up their operations where financial and legal systems are more efficient and better-developed (Demirguc-Kunt et al., 2006).

On the issue of taxation that firms face, Da Rin et al. (2011) find a negative relationship between taxation on corporate income and the rate at which firms enter in the 17 European countries considered. Kim and Limpaphayom (1998) finds that in contrast with previous studies of US taxation and firm size, an analysis of firms and taxation within Hong Kong, Korea, Malaysia, Taiwan and Thailand reveals that the rate of tax and the size of the firm are inversely related, contrary to the political cost hypothesis the authors intended to test. While studies concerning the impact on tax rates on firm performance are limited, Fisman and Svensson (2007) find an inversely proportional association between the level of taxation and firm growth, while the same association is also true for bribery, the size of the effect is found to be approximately three times higher. Surrounding labour, namely that of regulation

surrounding employment and wages, are predominately focused on economic performance, income distribution and the effect of unemployment at the country level (Siebert, 1997; Nickell and Layard, 1999; Besley and Burgess, 2004; Botero et al., 2004). Despite this, some evidence of effects on the firm have been demonstrated. Almeida and Carneiro (2009) highlights the non-trival effect of labour regulation in Brazil, in finding that as the enforcement of labour regulation becomes more strict, there is a stronger associated constraint placed on firm size.

Ahsan and Pagés (2009) show that labour reforms in India that aid labour disputes and employment protection affect firms most in capital and labour-intensive industries, respectively. While Kleinknecht et al. (2006) find that while wage increases and regulation undertaken between 1980-90s in the Netherlands may have increased job creation but likely came at the detriment of labour productivity. Furthermore, the ramifications of domestic customs and excise policies, as well as tariffs, have been considered in the case of firm-level trade activities in addition to approaches that could potentially reduce such regulatory burden for firms trying to internationalise their business activity (see Fliess and Busquets (2006) for a discussion on trade barriers to SMEs). Lastly, with reference to transportation that firms in operations, there are several strands and variations within the literature. One such established area of consideration is the modelling of cost functions of transportation (see Oum and Waters II (1996) for a comprehensive survey of the origins and development of the empirical analyses of transportation cost functions). Alternatively, a longer-established area has involved deriving demand functions for freight transportation (see Zlatoper and Austrian (1989) for a survey of empirical and econometric studies

of freight transportation demand modelling).

4.2.2 Latent-based methodological approaches

While, to our knowledge, the latent approach utilised in this chapter has not been employed within the firm obstacle literature, some similarities can be drawn from other less relevant spheres of research. An establish method of accounting of latent aspects within empirical works is the use of structural equation modelling (SEM) approaches and related variants. For research within and outside of economics, SEM has been a popular approach when considering unobserved aspects of hypothesised relationships. Unlike the approach we adopt here, the purpose of the study adopting SEM may typically not have a particular interest in generating one or more latent variables but rather, given a structural model that connects variables with one another in accordance with theory, ascertain the relationship of the constructed pathways between observed and unobserved factors. Unsurprisingly, this attribute has made SEM an attractive mechanism to many disciplines within the social sciences, particularly psychology (see MacCallum and Austin (2000) for a review of application within psychological research).

Whilst the use of SEM in economics can be observed, it has been predominately adopted in a particular form, namely multiple indicators and multiple causes (MIMIC) models, a technique emanating from the work of Jöreskog and Goldberger (1975). In this setting, the latent variable is thought not only to influence but to be caused by variables that are observed within the data. The range of application that MIMIC has within economics is vast, ranging from measurements of the shadow

economy (Chaudhuri et al., 2006; Dell'Anno, 2007; Dell'Anno et al., 2007), quality of life and well-being (Di Tommaso et al., 2009; Rahman et al., 2011), indicators and causes of financial crises (Rose and Spiegel, 2012), as well as recent attempts to estimate firm performance (Chaudhuri et al., 2016). In parallel with the analysis in this chapter, an area of the literature where the resultant latent variable is useful in further analysis, lies in the development literature. Notably, with the advent of Indian household survey data, works by Sandberg and Rafail (2013) model the manifestation of a latent female autonomy index within a number of responses to questions pertaining to females choices, such as decision making, freedom of movement and acceptance of spousal abuse.

As an aside from SEM and related models, the implementation of the unobserved has also translated to the SFA literature, so-called the latent class approach (Greene, 2005). This is generally appealing as older methods were less able to account for technological heterogeneity across the data sample. Where previously, the considered approach to differences in technology would consist of the researcher splitting the sample into groups, based on existing information about the units in the sample and estimating the efficiency model, for each separate class. The clear benefit of latent class methods in contrast, is that rather than the requirement of *a priori* information about the data sample, the assumption is made that there exists a number of the classes which are unobserved by the researcher from the outset and for each unit, the estimated probability is calculated of membership to one of the finite number of classes. While this methodology removes the need to specify class membership, there does remain the need for the researcher to ascertain the number of classes which there

is assumed to exist but information criterion can be used to aid the determination process.

4.3 Data

In this chapter, we employ the use of data from the WBES, which provides researchers with a unique dimension of insight into firm operation. The survey, a pooled cross-section which covers firm across 139 different countries between 2006-16, presents conventional data on firm production, as well as coverage on standard accounting measures. Moreover, in following with the methodological changes to surveys of the household, the WBES attempts to uncover both what and how obstacle are affecting the firm's ability to operate. As is the case in all surveys of this kind, whether it is in reference to well-being, autonomy or in the case of this analysis, firm obstacles, these are typically subjects of interest that are unobserved by the researcher. Hence, as an approximation, the extent of these obstacles are measured as the individual's perception rather than any objective criteria.

In the WBES, the questions asked to measure perceived firm obstacles, is as follows:

'To what extent is $\boldsymbol{X}$ *an obstacle to firm operations?'*

where $\mathbf{X}$ is one of the included survey obstacles. They way surveyed individuals respond to this question is by choosing a level of severity that is presented on a Likert scale; the resultant measure is an ordered categorical variable:

$$\mathbf{X} = \begin{cases} 0 & \text{if } \mathbf{X} \text{ is no obstacle to firm operation} \\ 1 & \text{if } \mathbf{X} \text{ is a minor obstacle to firm operation} \\ 2 & \text{if } \mathbf{X} \text{ is moderate obstacle to firm operation} \\ 3 & \text{if } \mathbf{X} \text{ is major obstacle to firm operation} \\ 4 & \text{if } \mathbf{X} \text{ is severe obstacle to firm operation} \end{cases}$$

In understanding the coverage of obstacles **X**, the survey present 15 obstacle which perceived severity is reported, which are listed below.

List of Perceived Obstacles to Firm Operation

1. Business licensing	6. Electricity	11. Land
2. Corruption	7. Access to finance	12. Political instability
3. Courts	8. Informal economy	13. Tax administration
4. Crime	9. Labour education	14. Tax rates
5. Customs regulation	10. Labour regulation	15. Transportation

These fifteen measures of perceived obstacle severity are fundamental in the creation of the latent firm obstacle index, as we assume the unobserved is manifested in these subjective measures of obstructions to day-to-day operations. Details on the construction of the latent measure will be provided in section 4.4. Tables 4.1 and 4.2 present the definitions for the variables used in this chapter. Panel B of table

4.3 presents the summary statistics for perceived obstacle measures. Analysis of the respective

means across the whole data sample highlights taxation rates as the most prominent obstacle and courts, the obstacle of the lowest average reported severity. While the number of firms that has reported a perceived level of severity varies across obstacles, generally, the size of the useable sample is large, with the least reported obstacle, courts, reporting 66,690 firm responses.

In addition to these firm obstacles, panel A presents the summary statistics for the variables used in the second stage of our analysis, once the latent index has been created, assessing the effect on firm performance. The dependent variable that we are using as a way of considering firm performance is the firm's total sales in the last fiscal year. Due to the international coverage of this data, we convert all sales data from local currency units to United States Dollar and deflate using a GDP deflator, in order to aid with consistency in interpreting the estimated parameters. In addition to the latent measure, we will control for other aspects that may influence changes in firm sales. These include standard characteristics such as firm size and age, ownership type, legal status but also extend to more unique aspects of the firm - time spent on regulatory matters, whether a firm has had a tax inspection, experience of the most senior manager and the use of information technologies in conducting business with clients. Considering the sample as a whole, smaller firms are most prevalent and private domestic ownership dominates in the composition of firm ownership. The average amount of senior management experience is around 16.9 years, whilst the percentage of time in a typical week spent dealing with regulatory

Table 4.1: Variable Definitions: Indicies and Obstacles

Variable	Definition
Constructed Indicies	
Summative Index	The total number of obstacles firms face from 0-15.
Latent Problem	Empirical Bayes predicition of latent firm obstacles constructed from GSEM.
Principal Component	Polychoric principal components calculated from the 15 included obstacle perception measures.
Firm-level Obstacles (measured from 0-4)	
Access to finance	To what extent access to finance is an obstacle to firm operations.
Business licensing	To what extent business licensing is an obstacle to firm operations.
Corruption	To what extent corruption is an obstacle to firm operations.
Courts	To what extent are courts an obstacle to firm operations.
Crime	To what extent is crime an obstacle to firm operations.
Customs and trade regulation	To what extent is customs and trade regulation an obstacle to firm operations.
Electricity	To what extent is electricity an obstacle to firm operations.
Informal economy	To what extent is the informal economy an obstacle to firm operations.
Inadequately educated workforce	To what extent is workforce education crime an obstacle to firm operations.
Labour regulation	To what extent is labour regulation an obstacle to firm operations.
Access to land	To what extent is land access an obstacle to firm operations.
Tax administration	To what extent is tax administration an obstacle to firm operations.
Tax rates	To what extent is tax rates an obstacle to firm operations.
Political instability	To what extent is political instability an obstacle to firm operations.
Transportation of goods, supplies and inputs	To what extent is transportation an obstacle to firm operations.

Table 4.2: Variable Definitions: Firm Characteristics

Variable	Definition
Dependent variable	
Sales	Adjusted total firm sales last year.
Firm-level variables	
Age	Firm age.
Size: small	Firms with less than 20 employees.
Size: medium	Firms with between 20 and 99 employees.
Private domestic	Percentage of the firm owned by private domestic individuals, companies or organisations.
Private foreign	Percentage of the firm owned by private foreign individuals, companies or organisations.
Government	Percentage of the firm owned by government.
Public	Binary variable equal to one if the firm's legal status is public, zero otherwise.
Limited	Binary variable equal to one if the firm's legal status is limited, zero otherwise.
Sole Prop	Binary variable equal to one if the firm's legal status is sole proprietorship, zero otherwise.
Partnership	Binary variable equal to one if the firm's legal status is partnership, zero otherwise.
Limited partnership	Binary variable equal to one if the firm's legal status is limited partnership, zero otherwise.
Top manager experience	Number of years of experience the top manager has working in the sector.
Regulation time	Percentage of senior management time spent dealing with government regulations, in a typical week.
Tax inspection	Binary variable equal to one if the firm's was inspected or visited by tax officials in the last year, zero otherwise.
Check/savings account	Binary variable equal to one if the firm has a checking or savings account, zero otherwise.
Overdraft	Binary variable equal to one if the firm has an overdraft, zero otherwise.
Loan credit	Binary variable equal to one if the firm has a line of credit or loan from a financial institution, zero otherwise.
External audit	Binary variable equal to one if the firm has had a external financial audit in the last year, zero otherwise.
Quality cert	Binary variable equal to one if the firm has an internationally recognised quality certification, zero otherwise.
Email	Binary variable equal to one if the firm utilises email to communicate with clients, zero otherwise.
Website	Binary variable equal to one if the firm utilises their website to communicate with clients, zero otherwise.

Table 4.3: Summary statistics

Variable	Mean	Standard Deviation	N
Panel A: Firm characteristics			
Sales	1127360.349	88114118.758	62658
Private domestic	89.527	28.44	67024
Private foreign	8.253	25.627	67007
Government	0.676	6.581	67019
Public	0.04	0.196	67025
Limited	0.406	0.491	67025
Sole Prop	0.357	0.479	67025
Partnership	0.098	0.297	67025
Limited partnership	0.081	0.273	67025
Quality cert	0.238	0.426	67025
Tax inspection	0.602	0.489	67006
Regulation time	10.152	17.738	66985
External audit	0.531	0.499	66949
Top management exp	16.905	10.853	67025
Overdraft	0.433	0.495	64989
Loan and credit	0.372	0.483	65802
Email	0.706	0.455	66999
Website	0.444	0.497	66996
Checking and savings account	0.883	0.322	67025
Age	18.106	17.303	67015
Size: small	0.455	0.498	67025
Size medium	0.345	0.475	67025
Panel B: Obstacles			
Latent problem	0.000005	0.467	67025
Principal Component 1	-0.0846	2.075	66250
Principal Component 2	-0.0108	0.986	66250
Electricity	1.717	1.481	67018
Transportation	1.197	1.245	66975
Custom regulations	0.958	1.206	66735
Informal economy	1.472	1.374	66961
Land	1.021	1.271	66837
Courts	0.928	1.194	66690
Crime	1.17	1.278	66925
Tax rates	1.728	1.303	66983
Tax administration	1.372	1.241	66980
Business Licencing	1.041	1.171	66875
Political Instablity	1.537	1.459	66840
Corruption	1.697	1.474	66997
Access to finance	1.515	1.34	66942
Labour regulation	0.989	1.123	66964
Labour education	1.297	1.262	66968

matters is just over 10 percent. Finally, while the majority of the sample have a some form of checking and savings account with a financial institution, less than half of the sample have access to an overdraft facility or have had a loan or line of credit in the last 12 months.

4.4 Methodology

In order to estimate the variable which represents the latent problem which firms face, we follow a two-step procedure. In what follows, we will first outline the SEM used to construct the relation between observed firm obstacles and the latent problem variable. Following this, we will present a brief exposition of fundamental Bayesian methods to allow for a thorough review of how the latent variable is predicted from the SEM - an empirical Bayes prediction. Finally, we will outline how the standard principal component analysis framework can be augmented to allow for the use of ordinal data to create an alternative measure of firm obstacles.

4.4.1 Generalised structural equation modelling

We begin the prediction of the unobserved firm obstacle as follows:

$$Y = \gamma' \eta + \epsilon \tag{4.1}$$

where η is the latent variable of interest, Y represents the observed obstacle that firms report to face, γ are the respective parameter estimates and error term $\epsilon \sim \mathcal{N}(0, \sigma^2)$. Where we depart from the conventional methodology of structural

equation modelling is with regard to the treatment of the observed firm obstacles. Figure 4.1 presents the corresponding path diagram. These obstacles are reported by a firm representative by means of the level of severity on a Likert scale from 0-4.

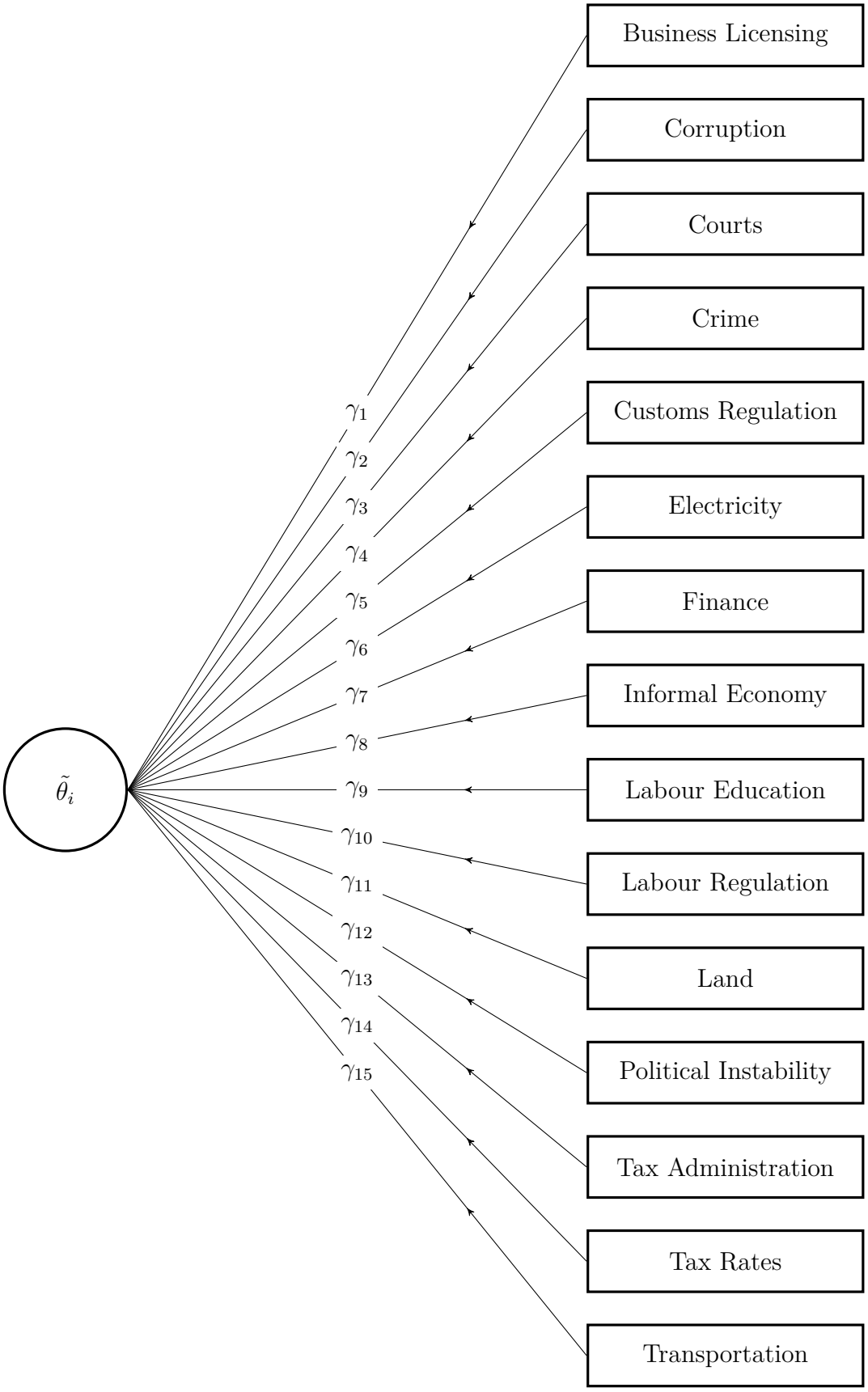


Figure 4.1: Path Diagram of Latent Obstacle

While the standard method could be utilised, instead we adopt to use the generalised form of this methodology. In doing so, we are able to take into consideration the ordered structure of response by using an ordered probit approach, that allows for a continuous latent variable to have a set of probabilities attributes to each categorial response for a given firm obstacle. The ordinal response and corresponding severity of firm obstacle can be expressed as follows:

$$y_i = \begin{cases} 0, & \text{if } y_i^* \leq \mu_1 \text{ (no obstacle)} \\ 1, & \text{if } \mu_1 < y_i^* \leq \mu_2 \text{ (minor)} \\ 2, & \text{if } \mu_2 < y_i^* \leq \mu_3 \text{ (moderate)} \\ 3, & \text{if } \mu_3 < y_i^* \leq \mu_4 \text{ (major)} \\ 4, & \text{if } y_i^* > \mu_4 \text{ (severe)} \end{cases} \tag{4.2}$$

where μ_1, μ_2, μ_3 and μ_4 are threshold values to be estimated. The respective probabilities that a firm i will face a particular level of severity k, for a given value of x_i, is given as follows:

$$\begin{aligned} P(y_i = 0) &= \Phi(-\gamma'\eta) \\ P(y_i = k) &= \Phi(\mu_k - \gamma'\eta) - \Phi(\mu_{k-1} - \gamma'\eta) \quad \text{where } k = 1, 2, 3 \\ P(y_i = 4) &= 1 - \Phi(\mu_4 - \gamma'\eta) \end{aligned} \tag{4.3}$$

where Φ is the cumulative normal distribution function.

Unlike the typical ordered probit estimation, the estimated parameter values γ are termed as factor loadings. These estimates in and of themselves do not provide

much in the way of analytical purposes in the analysis but rather serve as necessary components that are required in the prediction of the latent variable, discussed in the section that follows.

4.4.2 Parametric empirical Bayes prediction

In the process of predicting the latent variable, it is necessary to make a small deviation from the typical methodological exposition. The econometric literature, whilst currently in the process of rebalance, has historically saw the dominance of frequentist methods. As an alternative, promoted by the work of Zeller and encouraged into mainstream econometric thought by the likes of Koop and Poirier, Bayesian econometrics looks at applying the Bayesian ideas of probability theory in the area of econometric modelling.

Before we look at the application of empirical Bayes within the empirical model, it may be sensible to give some attention to the foundations of the Bayesian econometric framework. Given its simplest form, in a probability setting where there are two possible outcomes, A and B, the conditional probabilities can be expressed using Bayes' theorem:

$$P(B|A) = \frac{P(A|B)P(B)}{P(A)} \tag{4.4}$$

that is to say, the conditional probability of B *given* A ($P(B|A)$) is calculated as a function of the product the conditional probability of A *given* B ($P(A|B)$) and the marginal probability of A $P(A)$, all as a ratio of the marginal probability of B $P(B)$. Extending this towards a more econometric-centered exposition, we can replace the

probabilistic events in 4.4 with parameter θ and variable X, such that:

$$P(\theta|X) = \frac{P(X|\theta)P(\theta)}{P(X)} \tag{4.5}$$

Using the corresponding Bayesian terminology, the posterior density $P(\theta|X)$ is given as the product of the likelihood function $P(X|\theta)$ and the prior density $P(\theta)$, all divided by the marginal probability of X, $P(X)$. At this point, the central differences between frequentist and Bayesian econometrics can begin to be highlighted; firstly the parameter of interest that is to be estimated, θ. As Koop (2003, p.2) makes the distinction that while frequentists do not treat the unknown parameter as a random variable. Glickman and Van Dyk (2007, p.320) makes the contrast between both statistical methods by looking at trails in coin flipping; for the frequentist they claim the probability of attaining a head is $\frac{1}{2}$ by viewing the probability as a long run frequency. That is to say, for a fair coin, with two outcomes, in an infinite number of repeated trials, an individual will flip a head in half of those trails. It is this notion that lends credence to the frequentists of the fixed value of the parameter as it is related to the frequency of repeated events in an experiment.

For the Bayesian, it may be that they also claim that the probability of attaining a head is $\frac{1}{2}$ but the fundamental departure from the frequentist is that this probability is derived on certain beliefs or knowledge the individual has about the coin being fair and the number of outcomes, that lead them to this value. For this reason, probability in this context, is sometimes referred to as subjective. In context with 4.5, the element of the posterior density calculation that incorporates this information, is within the prior density.

The prior density, named such as it is decided by the econometrician prior to observing the data, that is solely based on their beliefs on the probabilities of the prospective outcomes. In the case of the coin flipping experiment, where the outcome is binary and the coin is fair, depending if there is going to be one or more trials, it would be justifiable to use either the Bernoulli or Binomial distributions respectively, to model the individual's prior beliefs. In combination, the other component of the posterior density is the likelihood function. In contrast to the prior, the likelihood function expresses what we know about the parameter of interest after the data has been observed by the researcher.

When both prior density and likelihood function, the posterior function in 4.5 can be expressed as a directly proportional relationship, as follows:

$$P(\theta|X) \propto P(X|\theta)P(\theta) \tag{4.6}$$

where $P(X)$ does not depend on the parameter θ and can be treated as a constant, thus it need not be explicitly included in this treatment. The interaction between the likelihood function with the prior density to produce the posterior density is described by Koop (2003, p.3) as an evolving and refining process where it tells us what we now know about θ, where the original priors can be updated given the likelihood function provides information about what is known once the data is observed.

Returning back to the empirical model this chapter endeavours to investigate, now that the elementary Bayesian terminology has been established, attention will now be given to the construction of the latent variable, denoted θ_i. To do so, we rely on utilising attributes of both frequentist and Bayesian approach, by calculating the

empirical Bayes mean, $\tilde{\theta}_i$, given as:

$$\tilde{\theta}_i = \int_{-\infty}^{\infty} \theta_i \omega(\theta_i | X_i; \hat{\gamma}) d\theta_i \tag{4.7}$$

where $\omega(\theta_i | X_i; \hat{\gamma})$ is the empirical conditional posterior distribution. The empirical aspect of the posterior distribution arises due to the properties of the parameter that the latent variable is conditioned on, γ. In the complete Bayesian framework, the prior densities of γ, that is, the information we have about the latent variable θ would be made *a priori*, however, the identifying feature of empirical Bayes is the allowance of prior of γ to be represented by point estimates, typically calculated by maximum likelihood. In this particular case, the factor loadings estimated by the structural model, denoted as $\hat{\gamma}_i$, are substituted in place of the unknown parameter, such that empirical conditional posterior distribution can be given as:

$$\omega(\theta_i | X_i; \hat{\gamma}) = \frac{f(x_i | \hat{\gamma}, \theta_i) \phi(\theta_i)}{\int_{-\infty}^{\infty} f(x_i | \hat{\gamma}, \theta_i) \phi(\theta_i) d\theta_i} \tag{4.8}$$

where the integral in the denominator is the likelihood for individual i, written succinctly as:

$$\omega(\theta_i | X_i; \hat{\gamma}) = \frac{f(x_i | \hat{\gamma}, \theta_i) \phi(\theta_i)}{L_i(\hat{\gamma})} \tag{4.9}$$

Returning briefly to the integral in 4.7, another parallel should be drawn for comparison of the full Bayesian treatment. Where the conditional posterior density is attained by taking the integral of the prior and likelihood product; if many unknowns exist and the priors densities chosen are unconventional or complex, along with the likelihood function, an analytical solution may not be attainable. In such a case,

alternative numerical methods exist, not to solve, but to approximate joint and marginal distributions, such as Gibbs sampling and other relevant Markov chain Monte Carlo algorithmic techniques, typically involving repetitive draws from given conditional distributions.

In the case of empirical Bayesian methods, the integral that is to be solved to attain $\tilde{\theta}_i$ is approximated by using mean-variance adaptive Gauss-Hermite quadrature. Using 7 quadrature points in order to attempt to evaluate the integral, the algorithm adapt the location of the quadrature points and their relative weights using the posterior mean and standard deviation.

4.4.3 Polychoric principal component analysis

When faced with a large number of explanatory factors, the standard treatment typically involves the use of principal component analysis (PCA) to condense numerous variables, which may be correlated with one another, into a set of linearly uncorrelated variables, that is, principle components. Furthermore, this reduction in explanatory variables is subject to retaining as much of the original variation found in the initial covariates. One assumption however, underlying PCA is the assumption of normality, typically adhered to with the use of continuous data; this is violated when considering discrete data, namely binary or ordinal data.

In the case of the latter, an alternative form of correlation is estimated, namely polychronic correlation. The treatment of said variables then follows a similar treatment to that of variables within an ordered probit framework, where the variable is thought to be latent and is theorised to be a continuous variable which is normally

distributed. In the simplest case with two ordered variables x_1 and x_2, the latent normally distributed continuous variables, x_1^* and x_2^* are as follows:

$$\begin{pmatrix} x_1^* \\ x_2^* \end{pmatrix} \sim N\left(0, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}\right), -1 \leq \rho \leq 1 \tag{4.10}$$

The parameter ρ, unlike the case of the usual correlation coefficient which is calculated analytically, is instead estimated by means of maximum likelihood. Once obtained, these correlations are used as in the standard PCA method, solving the eigenproblem in obtaining the various eigenvalues for each principal component. Once solved, the number of principal components used to replace the initial variables depends on the value of the corresponding eigenvalue - as a rule of thumb, those factors with an eigenvalue of one or above, would be used. Graphically, this is represented by the "elbow" of the screeplot.

4.4.4 Quantile regression

Once the empirical Bayes mean $\tilde{\theta_i}$ and polychoric principal components have been attained that represents the latent problem which firms face, we will use a quantile regression to observe how these measures may affect the performance of the firm, across the ten quantiles of firm sales. Beginning with 4.11:

$$Y = \alpha + X'\beta + \theta'\psi + \epsilon \tag{4.11}$$

where X is a matrix of covariates controlling for heterogeneity of firm characteristics and $\epsilon \sim \mathcal{N}(0, \sigma^2)$. For the ease of notation of the estimated model, we can reduce the model form by condensing the explanatory covariates and their respective parameters, such that 4.11 becomes the following:

$$Y = \alpha + \Phi'\lambda + \epsilon \tag{4.12}$$

where Φ is a vector that contains both X and θ; λ is the corresponding parameter vector. In doing so, 4.12 can be expressed in quantile form:

$$\hat{\boldsymbol{\lambda}}^{(\boldsymbol{p})} = \min_{\lambda \in \mathbb{R}} \left\{ (1-p) \sum_{\{i: y_i < \alpha + \Phi'\lambda\} \boldsymbol{x}} \left| Y - \alpha - \Phi'\lambda \right| + p \sum_{\{i: y_i \geq \alpha + \Phi'\lambda\} \boldsymbol{x}} \left| Y - \alpha - \Phi'\lambda \right| \right\} \tag{4.13}$$

where $\hat{\lambda}$ is estimated across all firms divided into ten quantiles (p) by the level of their total sales in the last fiscal year.

4.5 Empirical Results

4.5.1 Full sample

Before embarking on the discussion primary results, we will consider characteristics of the latent variable itself. Figure 4.2 shows the differing country averages of the latent firm obstacle variable. The distribution of values show that, on average, firms in Latin America and the Caribbean have the highest score relative to the other five

regions, while those firms in East Asia and Pacific posses the lowest. Interestingly, there appears be significant differences in county averages within the same region, particularly in Africa, where higher values are predominantly clustered within the northern and central areas while countries in Southern Africa have mean scores that are principally negative. Figure 4.3 present the factor loadings of the measurement model estimated within the generalised SEM framework. As is customary in the identification of the factor estimates, we set one of the parameters equal to one, which allows for meaningful interpretation of the factor loadings attributed to the other 14 perceived obstacles. With regards to the obstacle chosen for this treatment, electricity is a reasonable choice given the apparent lack of consideration in the firm performance literature. While seemingly uninformative, in fact, these estimates alone provide significant evidence in justifying the purpose of this chapter and highlighting the importance in considering alternative and more comprehensive methods that takes into account the heterogeneity of firm obstacles in creating an aggregate measure. This is because the estimated factor loadings, while all statistically significant, are all unequal in weight. This shows directly the importance of allowing these different perceptions of firm obstacles to have differing weights and manifestations in creating a latent scale which measures the obstacles firm face and why, as stated previously, simpler arithmetic methods such as averaging would failure to capture the dimensional heterogeneity across the perceived measures.

Relative to the normalised case, we find that perceived obstacles pertaining to tax administration, courts, corruption and business licensing carry the largest estimated weight, close to or greater than two. While these four obstacles may seem distinct,

they are in fact implicitly related. In the early theoretical corruption literature, Huntington (1968) and Leff (1964) remark on how bribery may have efficiency-improving effects by being able to reduce the amount of red tape that individuals would have to endure. Furthermore, if government officials are aware of this mechanism, in countries with a weaker rule of law, the level of red tape may increase in the knowledge of being able to extort bribes to reduce the administrative burden (Myrdal, 1968; Guriev, 2004). Access to financing has an estimated factor loading of just 1.121, a small relative difference to the normalised case. This is a surprising result, given the expansive literature that has found constraints to external financing as detrimental to the performance and development of the firm.

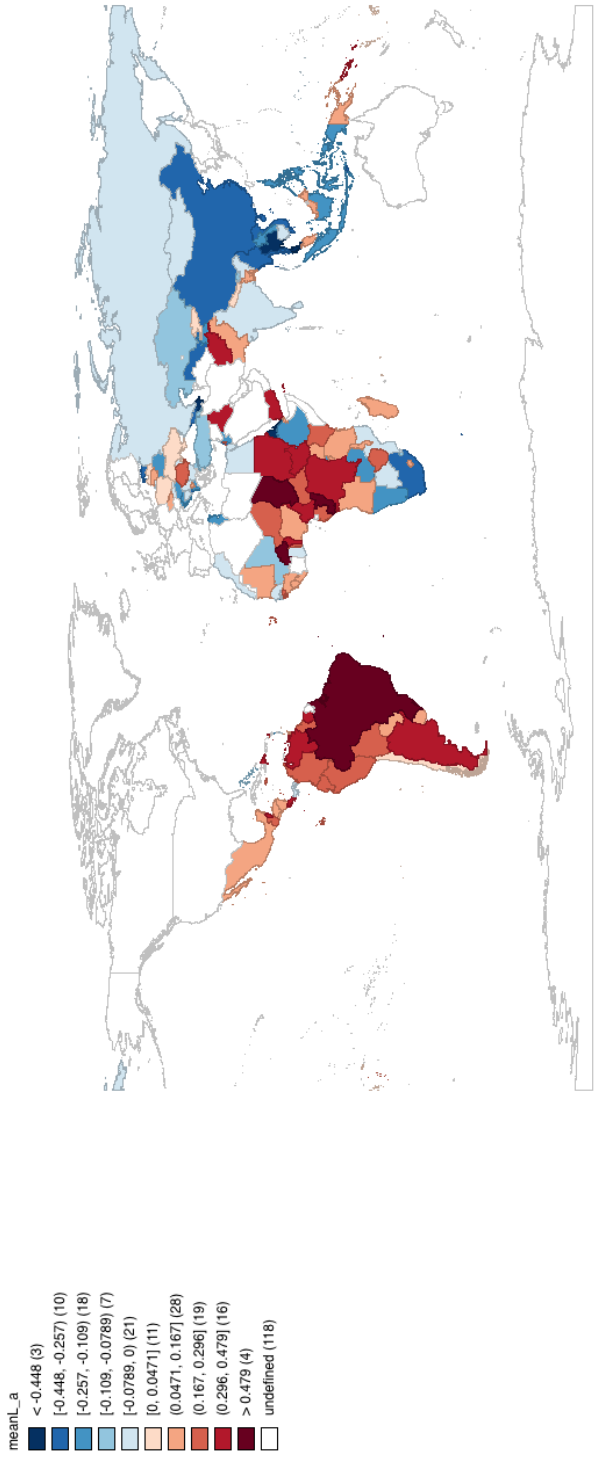


Figure 4.2: World Map of Mean Latent Score by Country

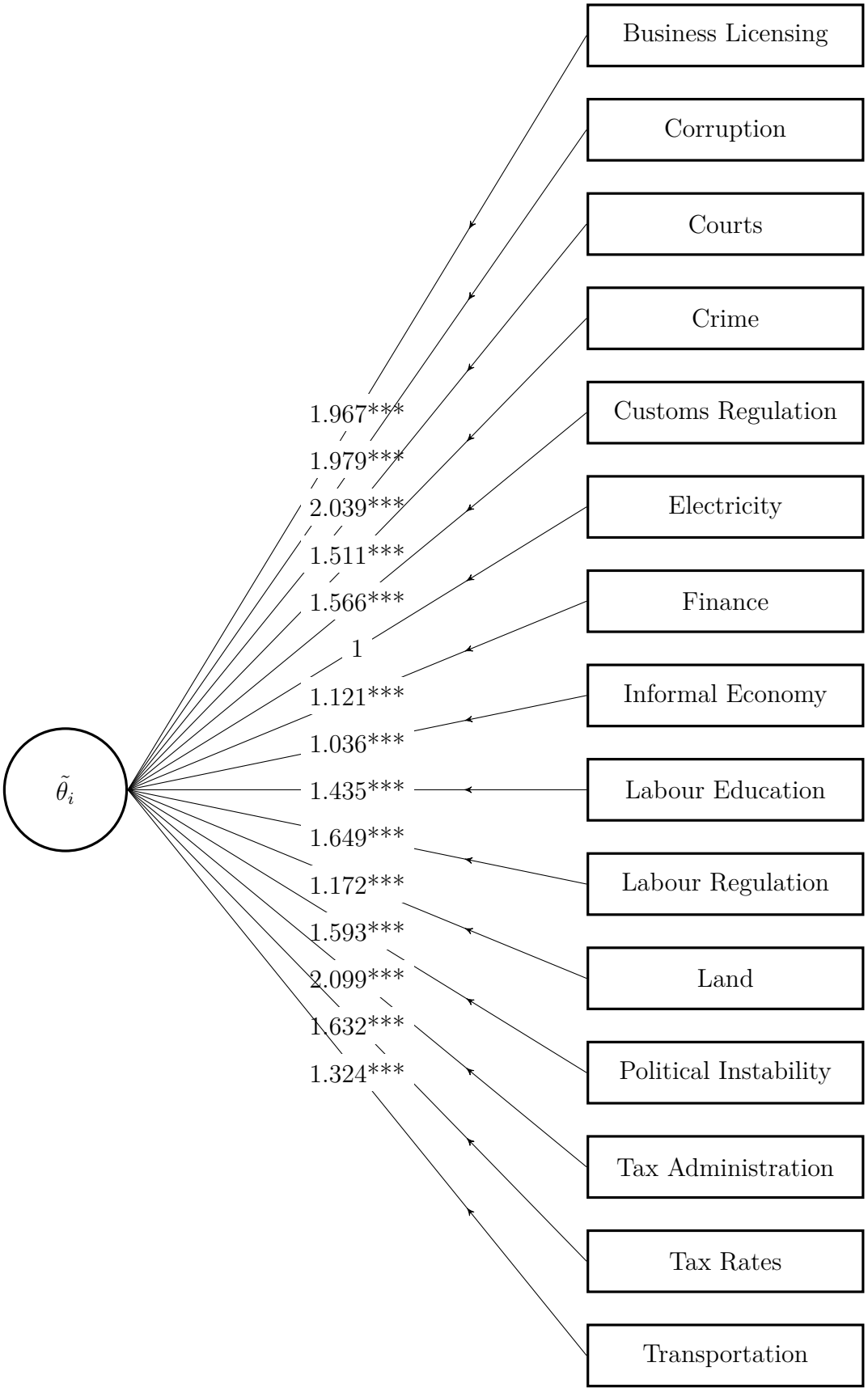


Figure 4.3: Estimated Latent Obstacle Factor Loadings

Turning to Table 4.2, which reports the information pertinant to the selection of principal components following the computation of the polychronic correlations between reported firm obstacles. Graphically, we would endevour to pick the number of components as signified by the 'elbow' of the scree plot in choosing principal components, however due to the augmentation of this proceedure in using polychronic correlations, we will choose the number of principal components by interpreting the corresponding eignevalue of each component. As a rule of thumb, we would choose the number of principal components that report an eigenvalue of one or above. Despite the fact that the first component accounts for 40.5% of the variation of the firm obstacles and the second only 8%, both have an eigenvalue above one and therefore proceed to the empirical analysis using the first two components from the polychronic principal component analysis.

Principal Components	**Eigenvalues**	**Proportion explained**	**Cumulative explained**
1	6.082461	0.405497	0.405497
2	1.211112	0.080741	0.486238
3	0.947270	0.063151	0.549390
4	0.927512	0.061834	0.611224
5	0.853465	0.056898	0.668121
6	0.741402	0.049427	0.717548
7	0.687319	0.045821	0.763370
8	0.593682	0.039579	0.802948
9	0.543004	0.036200	0.839149
10	0.521445	0.034763	0.873912

Table 4.4: Polychoric Principal Component Analysis

Table 4.5 presents the regression estimates for the full sample[1][2]. Model one

[1]For the sake of brevity, all empirical models estimated in this chapter report only the coefficients pertinent to the effect of the latent variable on firm sales. Full reporting of estimates for other included determinants of firm performance are included in the appendix for completeness.

[2]The same analysis was done for the only other available measure of firm performance (value

presents the estimates for the summative index, used as a control case, model two presents the empirical Bayes index measure estimates and model three presents the model estimates for the two included polychroic principal components. The included the summative measure has a negative estimated coefficient, significant to the 1% significance level. The interpretation here is simplier as at the margin, we are looking for an increase on the summative index by one obstacle, is associated with a fall in firm sales by 0.371%. The estimated coefficient of the empirical Bayes index is larger in magnitude, however direct comparison of the marginal effect is not possible, as this index – as well as the polychoric PCA index – looks at the associated change in firm sales from a one standard deviation increase in the problem index. A standard deviation increase in the latent problem index is associated with a 6.73% decrease in firm sales, the same negative relationship is true for the polychoric PCA index; both statistically significant.

While both present plausible alternatives to the naive summative index measure, we use Akaike information criterion to understand which of the two measures is statistically preferred in explaining the association between firm obstacles and performance. The values from the calculated information criterion conclude that the polychoric PCA index is preferred and analysis should proceed using this measure. Henceforth, we proceed by using only the first principal component for the ease of interpretation, which given the amount of variation that the principal component captures, this should be sufficient and is often the convention in the literature when a number of principal components are proposed. What is certain is that statisti-

added) and using both obstacle measures, the terms are statistically insignificant and therefore only continue the empirical analysis with the sales measure as the dependent variable

Variable	ln(Sales)			
Summative Index	-0.00371***			
	(0.000656)			
Latent Problem		-0.0673***		
		(0.0158)		
Principal Component 1			-0.0167***	-0.0166***
			(0.00354)	(0.00363)
(Principal Component 1)^2				-0.000366
				(0.00132)
Principal Component 2			-0.0161**	
			(0.00698)	
N	53314	53314	53314	53314
AIC		194363.3	192122	
Adjusted R^2	0.6786	0.6798	0.6796	0.6795

Table 4.5: Full Sample Regression Estimates

cal preference was establish using both of the principal components. Model four includes the linear and quadratic term for the first principal component. While the linear term is negative and significant, the quadratic term, while negative, is statistically insignificant from zero. Hence, we proceed to the remaining empirical analysis using only the linear term.

Table 4.6 presents the estimates from the linear regression of firm sales on the linear PCA term, across the 9 quantiles of firm sales. As well as controlling for a number of other firm characteristics, we find that for firms within the 40th percentile and above, there is a statistically significant negative relationship between increased firm obstacles and firm sales - that is, for a standard devation increase in the polychoric PCA index is associated with a fall in firm sales between 0.556% and 1.32%. It should be noted that for those firms within the 20th and 30th percentiles, the reported coefficient while positive, is statistically insignificant. Moreover, model fit is remarkably consistent across the 9 different quantiles for which the model was

	Dependent variable: ln(Sales)	
	(1)	
Quantile	Principal Component 1	Pseudo R^2
10th	-0.000534	0.4616
	(0.00333)	
20th	0.000599	0.4688
	(0.00346)	
30th	0.000949	0.4720
	(0.00325)	
40th	-0.00784**	0.4736
	(0.00323)	
50th	-0.0103***	0.4741
	(0.00334)	
60th	-0.0103***	0.4796
	(0.00339)	
70th	-0.00559	0.4787
	(0.00344)	
80th	-0.0127***	0.4807
	(0.00359)	
90th	-0.0132***	0.4798
	(0.00413)	
N	53945	

Standard errors in parentheses.
Country, industry and year effects are included.
* p<0.10, ** p<0.05, *** p<0.01

Table 4.6: Quantile Regression Estimates

estimated.

4.5.2 Disaggregated sample findings

In addition to consideration of the full sample effects, tables 4.7, 4.8 and 4.9 present the model estimates by region, sector and firm size, respectively. Looking first at the regionwise analysis, the first thing of note is that the relationship between firm obstacle measure and firm sales is not homogeneous across the six regions surveyed in the dataset. The African, Middle East and North Africa, and South Asian regions,

Region	AFR	EAP	ECA	LAC	MNA	SAR
Variable	ln(Sales)					
Principal Component	-0.0317***	-0.0157	0.00507	-0.00327	-0.0563***	-0.0140**
	(0.0113)	(0.0105)	(0.00693)	(0.00640)	(0.0129)	(0.00714)
N	10127	7297	10700	12296	3443	10082
Adjusted R^2	0.7189	0.5994	0.7109	0.7293	0.6399	0.6418

Standard errors in parentheses, country, industry and year effects are included.
Where AFR is Africa, EAP is East Asia and Pacific, ECA is Europe and Central Asia, LAC is Latin America and the Caribbean, MNA is Middle East and North Africa and SAR is South Asia.
* p<0.10, ** p<0.05, *** p<0.01

Table 4.7: Regional Regression Estimates

exhibit the same relationship as observed within the quantile estimates, negative and significant, with the magnitude of the effect ranging from between 1.4% and 5.63%. Interestingly, the effect in the Middle East and North Africa region is around 1.8 and 4 times larger than that of the African and South Asian regions respectively. While both East Asia and Pacific and Latin America and the Caribbean regions both find the same negative relationship and coversely the Europe and Central Asia region found a positive association, none of these estimated coefficient are statistically different from zero. Unlike the quantile analysis, the model fit varies by a considerable degree. The explained variation ranged from 59.9% to 72.9%.

Table 4.8 presents the sectorwise estimates across manufacturing and services. Both sectors yield estimates in line with the previous models but the same negative relation is statistically significant only for firms within the manufacturing sector. Finally, Table 4.9 presents the regression estimates by firm size. Both medium and large-sized firms report the same negative and significant relation, the magnitude of the effect larger for the latter than then former. Despite small-sized firms reporting as the largest group of firms by size, the reported coefficient is positive but insignificant.

Sector	Manufacturing	Service
Variable	ln(Sales)	
Principal Component	-0.0165***	-0.00781
	(0.00424)	(0.00622)
N	34929	19016
Adjusted R^2	0.7053	0.6620

Standard errors in parentheses, country, industry and year effects are included.
* p<0.10, ** p<0.05, *** p<0.01

Table 4.8: Sectoral Regression Estimates

Sector	Small	Medium	Large
Variable	ln(Sales)		
Principal Component	0.00275	-0.0234***	-0.0325***
	(0.00544)	(0.00550)	(0.00828)
N	23127	19409	11409
Adjusted R^2	0.5487	0.5246	0.4606

Standard errors in parentheses, country, industry and year effects are included.
* p<0.10, ** p<0.05, *** p<0.01

Table 4.9: Regression Estimates by Firm Size

4.6 Conclusion

While there have been a vast number of studies concerning the measurement of both firm efficiency and performance, few have focused on the measurement of the problems firms face in day-to-day operation. In part, this has been primarily due to the difficulty in measuring firm difficulties or attaining data to the same effect. While newer forms of survey data have began to explore the perceptions of individual in many different areas, including well-being and female autonomy, once such application is found within the WBES survey that asks firms to gave an indication of their perceived severity of a number of obstacles to firm operation. Despite access to such measures, a newer issue has arisen to the researcher regarding their use in empirical analysis. Firstly, by including such perceived measures individually is to risk omit-

ting important interactions between measures that may have an effect jointly, on the performance measure of choice. Secondly, in attempting to combine these measures in aggregate, simplistic methods such as arithmetic averages may overlook intricate differences, in particular severity of perceived obstacles.

In this chapter, in an attempt to overcome the issues raised, we employ two novel approaches that attempts to construct a latent measures of firm obstacles that is manifested within 15 different measures of perceived severity on a range of themes that could provide difficulty for firms within the business environment. The outcomes of this chapter are four-fold. Firstly, in constructing the latent measure, we find that perceived obstacles pertaining to tax administration, courts, corruption and business licensing carry the largest estimated weight and the values of the latent obstacle measure are highest on average, for firms located in Latin America and the Caribbean relative to the other five regions, while at their lowest within East Asia and Pacific. Secondly, for the sample used in this chapter, the polychoric PCA measure is statistically preferred to the empirical Bayes index. Thirdly, when we conduct regression analysis of the sample as a whole, we find substantial evidence in favour of a significant negative linear relationship between the preferred measure and firm performance. Finally, in testing for the presence of this same relationship across different sub-samples of the dataset, we find that it is dependent on region, sector and firm size.

While we do not claim to have conclusively addressed the initial issues beyond contention, given the absence of consideration in the literature, we hope to have made a significant contribution to allow other researchers to continue the development of

this strand of literature, in two senses; the first, to encourage further methodological advances in the treatment of obstacles to firm, perceived or otherwise, and to explore the effect of such measures on the available range of benchmarks for firm performance and efficiency. As shown in this chapter, there are important ramification on the performance of the firm as a whole but in relation to geographical location, industry and firm size, such that, why a developed literature is of benefit to researchers, more importantly, it informs policy makers internationally to ascertain the effects of obstacles of firm performance and how policy should be created to target particular facets of the business environment.

Chapter 5

Conclusion

In this thesis, we have attempted to fill several significant gaps in the firm performance and efficiency literature; in lieu of the lack of coverage internationally, no or few firm-level measures of obstacles to firm operation, as well as distinct lack of consideration to newer and more comprehensive techniques. In chapter two, we use a one-step technique to calculate and explain firm efficiency under two hypotheses concerning corruption and external financing. In contrast with the two-step process, which the technical literature has deemed to induce bias into the estimated coefficients (Greene, 2008), we find strong evidence to suggest higher levels of financial constraint are detrimental to the efficiency of the firm. Moreover, we find evidence that firms that classify corruption to be a minor obstacle to firm operation are, on average, more efficient. While in disagreement with the majority-held view in the literature, the latter effect highlights the importance of considering efficiency across a number of countries situated at differing levels of development, economically or

otherwise.

In chapter three, we contribute to the financial lending literature but considering what effect information types have on the severity of difficulty firms face in accessing finance. Building on the initial work of Beck et al. (2006), we find evidence to reject the assumption of parallel lines in the ordered probit method used in the aforementioned work and proceed by using the generalised approach, allowing for slope heterogeneity. In the first part of our analysis, we find that in determining the variation in difficulty firms face in borrowing from financial institutions, both forms of information, hard and soft, are important. Performing the same estimation across all three classes of firm size, this finding holds. In addition to financing, we continue to look at the effects of information types across all 15 obstacles identified in the survey, by creating two scales, measuring both number and severity in aggregate. Using a simultaneous quantile regression approach, we find the same importance discovered in the determination of lending difficulty, is found in consideration of obstacles firm face, as a whole.

Finally, in chapter four, in consideration of the failings and shortcoming of comparing firms in relation to the obstacles they face, by using simplistic arithmetic averaging; we adopt two novel and comprehensive approaches. By using all 15 perceived obstacle measures, we construct two firm obstacle indices by taking the empirical posterior conditional mean using factor loadings estimated by employing a generalised structural equation model, as well as calculating polychoric principal component indices. Using these measures, we find that there is a negative linear association within the sales of the firm, across the sample as a whole. When considering the disaggre-

gated sample, this effect is persistent within the higher percentiles of firm sales but not across all regions and sectors.

Considering the thesis as a whole, we provide a variety of applications of such novel data within the area of firm performance and efficiency. While the studies conducted in this thesis have considered either newer approaches or proposed methods within this area, we hope the contribution acts firstly to fill the highlighted gaps in the literature but act as a catalyst for others to build on the work done here, alongside the collection and release of newer data, with the inclusion of more detailed insights of firm operation. The purpose of these works will ultimate aid policy makers in making decisions with evidence that accounts for this difference in country development, abandoning any attempt to forge policy without any consideration to differing institutional development.

Appendix A

Full Regression Estimates from Chapter Three

Table A.1: Full Sample Regression Estimates

Variable	ln(Sales)		
Summative Index	-0.00371***		
	(0.000656)		
Latent Problem		-0.0673***	
		(0.0158)	
Principal Component 1			-0.0167***
			(0.00354)
Principal Component 2			-0.0161**
			(0.00698)
Private Domestic	0.00132*	0.00114	0.00115
	(0.000799)	(0.000790)	(0.000791)
Private Foreign	0.00703***	0.00687***	0.00686***
	(0.000843)	(0.000834)	(0.000836)
Government	0.0000652	-0.000298	-0.000166
	(0.00143)	(0.00141)	(0.00142)
Public	0.164***	0.176***	0.164***
	(0.0610)	(0.0607)	(0.0608)
Limited	0.0204	0.0317	0.0192
	(0.0497)	(0.0496)	(0.0496)
Sole Prop	-0.440***	-0.428***	-0.446***
	(0.0503)	(0.0502)	(0.0503)
Partnership	-0.214***	-0.231***	-0.220***
	(0.0535)	(0.0532)	(0.0534)
Limited Partnership	-0.228***	-0.234***	-0.234***
	(0.0541)	(0.0539)	(0.0540)
Quality Cert	0.371***	0.370***	0.368***
	(0.0169)	(0.0168)	(0.0168)
Tax Inspect	0.102***	0.101***	0.100***
	(0.0136)	(0.0134)	(0.0135)
Regulation Time	0.000938**	0.000947**	0.000890**
	(0.000392)	(0.000388)	(0.000389)
Ext Audit	0.303***	0.303***	0.301***
	(0.0152)	(0.0151)	(0.0151)
Top Management Exp	-0.000155	0.0000354	-0.000131
	(0.000658)	(0.000652)	(0.000655)
Overdraft	0.266***	0.266***	0.263***
	(0.0154)	(0.0152)	(0.0153)
Loan and Credit	0.210***	0.209***	0.212***
	(0.0144)	(0.0143)	(0.0143)
Email	0.423***	0.432***	0.428***
	(0.0196)	(0.0194)	(0.0195)
Website	0.315***	0.314***	0.315***
	(0.0153)	(0.0152)	(0.0152)
Bank Accounts	0.250***	0.275***	0.249***
	(0.0245)	(0.0238)	(0.0242)
ln(Age)	0.127***	0.127***	0.126***
	(0.00934)	(0.00926)	(0.00933)
Small	-2.806***	-2.810***	-2.805***
	(0.0216)	(0.0214)	(0.0215)
Medium	-1.619***	-1.618***	-1.621***
	(0.0187)	(0.0185)	(0.0185)
Constant	6.989	4.450***	6.822
	(0.224)	(0.207)	(2760.6)
N	53314	53314	53314
Adjusted R^2	0.6786	0.6798	0.6796

Table A.2: Quantile Regression Estimates

Variable	Quantile								
	10	20	30	40	50	60	70	80	90
Principal Component	-0.000534	0.000599	0.000949	-0.00784**	-0.0103***	-0.0103***	-0.00559	-0.0127***	-0.0132***
	(0.00333)	(0.00346)	(0.00325)	(0.00323)	(0.00334)	(0.00339)	(0.00344)	(0.00359)	(0.00413)
Private Domestic	0.00387***	0.00387***	0.00298***	0.00256***	0.00218***	0.00125**	0.000965	0.000334	-0.000846
	(0.000604)	(0.000560)	(0.000606)	(0.000699)	(0.000722)	(0.000614)	(0.000887)	(0.000677)	(0.000877)
Private Foreign	0.00849***	0.00844***	0.00791***	0.00788***	0.00792***	0.00695***	0.00720***	0.00693***	0.00630***
	(0.000662)	(0.000610)	(0.000659)	(0.000737)	(0.000760)	(0.000667)	(0.000926)	(0.000747)	(0.000949)
Government	-0.000155	0.000678	0.000180	0.000123	0.00134	0.0000840	0.00139	0.00181	0.000135
	(0.00190)	(0.00157)	(0.00175)	(0.00139)	(0.00174)	(0.00115)	(0.00214)	(0.00112)	(0.00189)
Public	0.0205	0.0759	0.112*	0.166***	0.169***	0.187***	0.299***	0.347***	0.361***
	(0.0667)	(0.0616)	(0.0639)	(0.0632)	(0.0551)	(0.0560)	(0.0640)	(0.0585)	(0.0649)
Limited	0.0915*	0.0588	0.0592	0.0537	0.0508	0.0533	0.0804	0.0777*	-0.0776**
	(0.0481)	(0.0480)	(0.0534)	(0.0511)	(0.0481)	(0.0445)	(0.0504)	(0.0413)	(0.0378)
Sole Prop	-0.327***	-0.396***	-0.387***	-0.407***	-0.420***	-0.431***	-0.417***	-0.437***	-0.545***
	(0.0486)	(0.0486)	(0.0536)	(0.0514)	(0.0489)	(0.0447)	(0.0511)	(0.0424)	(0.0389)
Partnership	-0.126**	-0.215***	-0.199***	-0.186***	-0.225***	-0.209***	-0.188***	-0.225***	-0.289***
	(0.0517)	(0.0502)	(0.0576)	(0.0535)	(0.0526)	(0.0495)	(0.0530)	(0.0478)	(0.0451)
Limited Partnership	-0.127**	-0.195***	-0.154***	-0.137**	-0.168***	-0.163***	-0.134**	-0.134***	-0.280***
	(0.0519)	(0.0540)	(0.0577)	(0.0547)	(0.0529)	(0.0503)	(0.0548)	(0.0467)	(0.0440)
Quality Cert	0.250***	0.296***	0.305***	0.328***	0.334***	0.359***	0.382***	0.411***	0.499***
	(0.0160)	(0.0153)	(0.0155)	(0.0160)	(0.0164)	(0.0163)	(0.0174)	(0.0194)	(0.0224)
Tax Inspect	0.0858***	0.0872***	0.0758***	0.0745***	0.0795***	0.0892***	0.0798***	0.0920***	0.0896***
	(0.0124)	(0.0128)	(0.0124)	(0.0123)	(0.0127)	(0.0126)	(0.0132)	(0.0138)	(0.0160)
Regulation Time	-0.000517	-0.000292	-0.000423	-0.000129	0.000516	0.000857**	0.00119***	0.00138***	0.00127***
	(0.000356)	(0.000384)	(0.000397)	(0.000378)	(0.000390)	(0.000347)	(0.000335)	(0.000426)	(0.000428)
Ext Audit	0.215***	0.245***	0.270***	0.291***	0.300***	0.305***	0.320***	0.345***	0.372***
	(0.0140)	(0.0143)	(0.0137)	(0.0136)	(0.0143)	(0.0141)	(0.0145)	(0.0151)	(0.0168)
Top Management Exp	0.00166***	0.000120	-0.000462	-0.000851	-0.000400	-0.000928	-0.000759	-0.00211***	-0.00111
	(0.000609)	(0.000614)	(0.000609)	(0.000604)	(0.000619)	(0.000594)	(0.000633)	(0.000690)	(0.000844)
Overdraft	0.225***	0.242***	0.264***	0.273***	0.264***	0.271***	0.282***	0.262***	0.278***
	(0.0148)	(0.0140)	(0.0139)	(0.0137)	(0.0142)	(0.0143)	(0.0145)	(0.0151)	(0.0174)
Loan and Credit	0.255***	0.245***	0.234***	0.231***	0.225***	0.221***	0.219***	0.180***	0.139***
	(0.0132)	(0.0130)	(0.0130)	(0.0131)	(0.0136)	(0.0137)	(0.0138)	(0.0145)	(0.0165)
Email	0.456***	0.438***	0.429***	0.436***	0.435***	0.432***	0.442***	0.447***	0.474***
	(0.0166)	(0.0189)	(0.0162)	(0.0171)	(0.0181)	(0.0171)	(0.0183)	(0.0187)	(0.0197)
Website	0.264***	0.255***	0.280***	0.297***	0.310***	0.322***	0.320***	0.324***	0.308***
	(0.0140)	(0.0142)	(0.0140)	(0.0141)	(0.0146)	(0.0148)	(0.0150)	(0.0157)	(0.0177)
Bank Accounts	0.314***	0.284***	0.268***	0.252***	0.266***	0.258***	0.238***	0.213***	0.184***
	(0.0216)	(0.0230)	(0.0218)	(0.0223)	(0.0233)	(0.0209)	(0.0260)	(0.0245)	(0.0271)
ln(Age)	0.115***	0.116***	0.110***	0.109***	0.0989***	0.0978***	0.103***	0.102***	0.0978***
	(0.00873)	(0.00830)	(0.00823)	(0.00845)	(0.00873)	(0.00872)	(0.00900)	(0.00950)	(0.0106)
Small	-2.654***	-2.714***	-2.775***	-2.788***	-2.817***	-2.857***	-2.871***	-2.893***	-2.970***
	(0.0216)	(0.0189)	(0.0212)	(0.0198)	(0.0209)	(0.0204)	(0.0212)	(0.0237)	(0.0269)
Medium	-1.453***	-1.534***	-1.596***	-1.615***	-1.649***	-1.677***	-1.688***	-1.706***	-1.747***
	(0.0193)	(0.0168)	(0.0194)	(0.0176)	(0.0189)	(0.0184)	(0.0189)	(0.0218)	(0.0255)
Constant	15.42***	15.78**	16.00***	16.04***	16.10	16.23***	16.33***	16.62***	17.00***
	(1.631)	(6.936)	(4.205)	(1.238)	(12.75)	(1.569)	(2.378)	(2.360)	(6.425)
N	53945	53945	53945	53945	53945	53945	53945	53945	53945
Pseudo R^2	0.4616	0.4688	0.4720	0.4736	0.4742	0.4771	0.4796	0.4807	0.4798

Table A.3: Regional Regression Estimates

Region[1]	AFR	EAP	ECA	LAC	MNA	SAR
Variable	ln(Sales)					
Principal Component	-0.0317***	-0.0157	0.00507	-0.00327	-0.0563***	-0.0140**
	(0.0113)	(0.0105)	(0.00693)	(0.00640)	(0.0129)	(0.00714)
Private Domestic	0.00139	-0.00125	0.000773	0.000599	-0.000828	0.00218
	(0.00118)	(0.00201)	(0.00186)	(0.00152)	(0.00253)	(0.00483)
Private Foreign	0.00561***	0.00481**	0.00726***	0.00773***	0.00413	0.00828
	(0.00129)	(0.00217)	(0.00194)	(0.00157)	(0.00278)	(0.00514)
Government	-0.00203	-0.00180	-0.0000372	0.00716*	0.00410	-0.00728
	(0.00373)	(0.00282)	(0.00256)	(0.00394)	(0.00577)	(0.00567)
Public	0.150	0.768***	0.0435	0.302***	-0.108	0.487***
	(0.210)	(0.191)	(0.134)	(0.0947)	(0.419)	(0.142)
Limited	-0.378**	0.492***	0.0644	0.0103	-0.131	0.0599
	(0.148)	(0.142)	(0.125)	(0.0737)	(0.405)	(0.102)
Sole Prop	-0.754***	0.140	-0.209	-0.396***	-0.542	-0.552***
	(0.147)	(0.138)	(0.130)	(0.0773)	(0.406)	(0.0917)
Partnership	-0.456***	0.413***	-0.00636	-0.200**	-0.286	-0.379***
	(0.156)	(0.150)	(0.146)	(0.0894)	(0.407)	(0.0941)
Limited Partnership	-0.400**	0.189	-0.140	-0.277***	-0.281	-0.0847
	(0.157)	(0.139)	(0.157)	(0.0936)	(0.409)	(0.0957)
Quality Cert	0.511***	0.402***	0.317***	0.366***	0.279***	0.289***
	(0.0572)	(0.0503)	(0.0316)	(0.0315)	(0.0738)	(0.0332)
Tax Inspect	0.126***	0.227***	0.0501*	0.148***	0.0421	-0.0550*
	(0.0427)	(0.0416)	(0.0261)	(0.0236)	(0.0561)	(0.0282)
Regulation Time	0.00887***	-0.00451***	0.000289	-0.000223	-0.00362***	0.00173*
	(0.00143)	(0.00160)	(0.000661)	(0.000654)	(0.00108)	(0.000917)
Ext Audit	0.265***	0.389***	0.247***	0.321***	0.251***	0.326***
	(0.0465)	(0.0444)	(0.0289)	(0.0255)	(0.0584)	(0.0345)
Top Management Exp	0.00558**	0.00155	0.000103	-0.00163	0.00325	-0.000236
	(0.00223)	(0.00219)	(0.00128)	(0.00100)	(0.00244)	(0.00154)
Overdraft	0.170***	0.191***	0.200***	0.213***	0.380***	0.309***
	(0.0489)	(0.0488)	(0.0285)	(0.0275)	(0.0627)	(0.0303)
Loan and Credit	0.194***	0.239***	0.307***	0.187***	0.193***	0.136***
	(0.0483)	(0.0421)	(0.0272)	(0.0252)	(0.0618)	(0.0302)
Email	0.353***	0.703***	0.471***	0.372***	0.470***	0.358***
	(0.0491)	(0.0517)	(0.0419)	(0.0383)	(0.0689)	(0.0386)
Website	0.360***	0.179***	0.276***	0.353***	0.139**	0.379***
	(0.0519)	(0.0422)	(0.0284)	(0.0273)	(0.0580)	(0.0332)
Bank Accounts	0.255***	0.381***	0.178***	0.169***	0.255***	0.212***
	(0.0619)	(0.0557)	(0.0573)	(0.0432)	(0.0680)	(0.0643)
ln(Age)	0.158***	0.202***	0.0752***	0.162***	0.0157	0.0578***
	(0.0260)	(0.0307)	(0.0201)	(0.0157)	(0.0318)	(0.0199)
Small	-2.708***	-2.698***	-2.728***	-2.987***	-2.726***	-2.661***
	(0.0778)	(0.0572)	(0.0417)	(0.0380)	(0.0851)	(0.0452)
Medium	-1.561***	-1.559***	-1.495***	-1.714***	-1.556***	-1.607***
	(0.0686)	(0.0477)	(0.0377)	(0.0311)	(0.0787)	(0.0394)
Constant	11.00***	8.497***	6.162***	7.324***	10.39***	6.794***
	(0.489)	(0.274)	(0.297)	(0.216)	(0.508)	(0.510)
N	10127	7297	10700	12296	3443	10082
Adjusted R^2	0.7189	0.5994	0.7109	0.7293	0.6399	0.6418

Standard errors in parentheses, country, industry and year effects are included.
* p<0.10, ** p<0.05, *** p<0.01

Table A.4: Sectoral Regression Estimates

Sector	Manufacturing	Service
Variable	ln(Sales)	
Principal Component	-0.0165***	-0.00781
	(0.00424)	(0.00622)
Private Domestic	-0.0000884	0.00299**
	(0.000993)	(0.00129)
Private Foreign	0.00539***	0.00920***
	(0.00105)	(0.00137)
Government	-0.000365	0.000256
	(0.00177)	(0.00220)
Public	0.229***	0.113
	(0.0718)	(0.106)
Limited	0.0268	0.0171
	(0.0578)	(0.0873)
Sole Prop	-0.413***	-0.426***
	(0.0585)	(0.0880)
Partnership	-0.242***	-0.172*
	(0.0624)	(0.0935)
Limited Partnership	-0.205***	-0.115
	(0.0638)	(0.0940)
Quality Cert	0.405***	0.268***
	(0.0199)	(0.0310)
Tax Inspect	0.109***	0.0729***
	(0.0163)	(0.0234)
Regulation Time	0.000926*	0.000888
	(0.000481)	(0.000649)
Ext Audit	0.320***	0.269***
	(0.0184)	(0.0253)
Top Management Exp	-0.00108	0.000598
	(0.000771)	(0.00120)
Overdraft	0.237***	0.269***
	(0.0187)	(0.0253)
Loan and Credit	0.192***	0.262***
	(0.0173)	(0.0241)
Email	0.408***	0.492***
	(0.0244)	(0.0308)
Website	0.356***	0.262***
	(0.0189)	(0.0251)
Bank Accounts	0.244***	0.255***
	(0.0291)	(0.0403)
ln(Age)	0.114***	0.134***
	(0.0111)	(0.0165)
Small	-2.832***	-2.773***
	(0.0256)	(0.0386)
Medium	-1.639***	-1.568***
	(0.0215)	(0.0355)
Constant	7.114***	11.12***
	(0.500)	(0.477)
N	34929	19016
Adjusted R^2	0.7053	0.6620

Standard errors in parentheses, country, industry and year effects are included.
* p<0.10, ** p<0.05, *** p<0.01

Table A.5: Regression Estimates by Firm Size

Sector	Small	Medium	Large
Variable	ln(Sales)		
Principal Component	0.00275	-0.0234***	-0.0325***
	(0.00544)	(0.00550)	(0.00828)
Private Domestic	0.00373***	-0.000976	-0.00485*
	(0.000947)	(0.00144)	(0.00252)
Private Foreign	0.00737***	0.00461***	0.00196
	(0.00108)	(0.00150)	(0.00255)
Government	-0.00164	-0.00545**	-0.000689
	(0.00275)	(0.00225)	(0.00313)
Public	0.339***	-0.209**	0.432***
	(0.114)	(0.0921)	(0.117)
Limited	0.229***	-0.108	0.0878
	(0.0766)	(0.0765)	(0.107)
Sole Prop	-0.263***	-0.583***	-0.274**
	(0.0766)	(0.0777)	(0.115)
Partnership	-0.120	-0.337***	-0.117
	(0.0814)	(0.0824)	(0.119)
Limited Partnership	-0.111	-0.363***	-0.0558
	(0.0874)	(0.0826)	(0.115)
Quality Cert	0.290***	0.326***	0.449***
	(0.0330)	(0.0249)	(0.0320)
Tax Inspect	0.0701***	0.0529**	0.161***
	(0.0204)	(0.0212)	(0.0321)
Regulation Time	0.00159***	0.000514	0.0000770
	(0.000600)	(0.000615)	(0.000871)
Ext Audit	0.230***	0.304***	0.429***
	(0.0231)	(0.0237)	(0.0384)
Top Management Exp	-0.00148	0.00181*	0.000489
	(0.00105)	(0.00104)	(0.00140)
Overdraft	0.263***	0.254***	0.261***
	(0.0241)	(0.0234)	(0.0354)
Loan and Credit	0.179***	0.220***	0.248***
	(0.0223)	(0.0220)	(0.0329)
Email	0.454***	0.390***	0.436***
	(0.0259)	(0.0337)	(0.0806)
Website	0.186***	0.337***	0.404***
	(0.0241)	(0.0230)	(0.0378)
Bank Accounts	0.298***	0.190***	0.0466
	(0.0308)	(0.0445)	(0.0848)
ln(Age)	0.101***	0.0902***	0.208***
	(0.0143)	(0.0151)	(0.0208)
Constant	1.330***	8.006***	7.666***
	(0.395)	(0.385)	(0.780)
N	23127	19409	11409
Adjusted R^2	0.5487	0.5246	0.4606

Standard errors in parentheses, country, industry and year effects are included.
* p<0.10, ** p<0.05, *** p<0.01

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