Firm Growth Threshold Effects

A CASE STUDY OF MOZAMBICAN MANUFACTURERS

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ABSTRACT

While the evidence from developed economies suggests that firm growth and exit rates are negatively related to firm size and age, developing country empirical analyses point to the large number of very small firms which survive and stagnate, while a vast literature on informality invokes barriers to micro-firm growth in developing economies. This may imply the presence of firm growth threshold effects. This paper looks for econometric evidence of threshold effects in long and short-run firm growth paths using cross-section and fixed-effects panel analysis and recent data from surveys of Mozambican manufacturers from 2002 and 2006. The evidence confirms the presence of growth threshold effects and suggests they relate to firm tax and regulatory burdens. Firm growth behaviour differs for firms above and below the threshold, with managers of European origin performing better than other firms starting below the threshold in the long-run, single ownership firms performing markedly worse than all other firms over the long and short-run, and the effects of investment only benefiting firms above the threshold. Further, the results using short-run data suggest that short-run firm growth rates decline as firms approach the size threshold from below. The implications of such threshold effects include a reduced degree of firm graduations from small-scale micro firms, thus weakening the market selection effect and protecting large firms from competition with potential effects on aggregate productivity, employment and poverty reduction.

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1. Introduction

In many developing countries the firm size distribution is highly dualistic, with a vast number of very small firms operating alongside a small number of very large firms. The potential implications of such market segmentation are several including a weakening of the market selection mechanism, reduced incentives for growth and productivity growth, lost employment opportunities and a relative lack of dynamic, successful small firms graduating to challenge incumbent large enterprises, with potential losses of aggregate productivity.

Such market structures are often associated with the high transaction costs in developing economies, high levels of idiosyncratic firm risk, and weak institutions, particularly with regards tax and regulatory enforcement (e.g. Collier and Gunning, 1999). Amongst others, Tybout (2000) notes that for many developing countries, "the size distribution exhibits a 'missing middle' because it never pays to be just large enough to attract enforcement". Although this concept is recognised and is implicitly the subject of the informality literature, it has only been analysed in descriptive terms. If a missing middle effect does exist, it implies the presence of threshold effects, defined as non-linearities in the firm growth path that may lead to discontinuities in some cases. These threshold effects might be identified econometrically.

This paper searches for econometric evidence of firm growth threshold effects by focusing on the long and short-run growth paths of a sample of Mozambican manufacturing firms. Although recent years have seen impressive economic growth in Mozambique, this was from a very low post-war base in 1992 and has to a large extent been driven by capital-intensive "mega projects". The official poverty headcount remains high at 54 percent of the population (GoM, 2004), while recent household survey evidence suggests that 75 percent of the economically active population is employed informally (INE, 2005). By hindering the expansion of otherwise successful firms, threshold effects may have important consequences for employment growth and poverty reduction in Mozambique.

The contribution of this paper is empirical in nature. Using a threshold regression approach, the paper responds to the following questions: i) Is there econometric evidence of a firm growth threshold effect in long and short-run firm growth? ii) If so, do the factors associated with growth vary between firms above and below the threshold? And iii) what differences exist between long and short-run growth threshold effects? The study also provides a brief analysis of the attributes of those firms which manage to cross the threshold.

Firm growth thresholds are found to exist for long and short-run firm growth, located between the 11 and 19 worker firm size in the firm size distribution. While firm growth is negatively associated with initial firm size for all firms, as in developed economy analyses, the effect is accentuated for firms below the threshold, suggesting a slowing of firm up to the threshold size. Single proprietorships are negatively associated with firm growth for all firms but especially so for firms below the threshold. Tax and regulatory burdens are found to be positively associated with firm growth for those firms below the long-run growth threshold, interpreted as an indication of increasing burdens as a firm grows, or firm growth despite increasing tax burdens over the long-run. In contrast, short-run growth is found to be negatively associated with tax and regulatory burdens, implying that firms may be "hiding" below the threshold. No single attribute determines which firms cross the threshold although if a firm does not cross the threshold early on, evidence suggests it will never do so. As well as preventing firms from satisfying their full potential and thus stunting economic growth, the presence of threshold effects puts into question the relevance of developed economy firm dynamics for developing economies.

The remainder of the paper is organised as follows: Section 2 reviews the literature; Section 3 presents the theoretical framework; Section 4 presents an overview of the data; Section 5 introduces the threshold regression model; the results are presented in Section 6 and conclusions in Section 7.

2. Background

A number of empirical regularities have emerged relating firm growth and survival rates to size and age.[2] Based principally on data from the United States and United Kingdom, Mansfield (1967), Hall (1987), Evans (1987), Dunne, Roberts and Samuelson (1988), and Dunne and Hughes (1994) find that competition effects and market selection mean that firm growth rates and exit probabilities are negatively associated with firm size and age. Small, young firms are thus expected to fail and exit, or succeed and grow, with growth rates and exit probabilities declining as successful firms grow and mature.

These empirical results find consistency in the predictions of Jovanovic's (1982) model of firm dynamics. Based on the premise that firm efficiency levels and true production costs are only learnt by firm managers through time spent in operation, firms choose a level of output each period

[2] Firm survival and firm growth in a selection model are the subject of an earlier paper employing the same dataset as here.

corresponding with their initial expected costs, based on the outcome of the previous period. Unexpectedly high profits in one period due to greater than expected efficiency lead firms to reduce their expected costs for the next period and raise output, while low realised profits signal inefficiency and eventual exit. By associating size and age with greater efficiency, this passive learning mechanism then reproduces the empirically found results that growth and age are positively associated with survival and negatively associated with growth rates.

However, empirical results from developed economies do not necessarily reflect reality in their developing counterparts, as shown by difference in firm size distributions. Tybout (2000) compares the numbers of firms in different firm-size categories in OECD and developing countries, highlighting the vast numbers of very small firms which survive alongside a very small number of large-scale enterprises, potentially leading to a "missing middle" in the firm-size distribution, a point made by de Soto (1989). Liedholm (2002) analyses employment data from manufacturing enterprise surveys in five sub-Saharan African countries (Botswana, Kenya, Lesotho, Malawi and Zambia) and finds that estimated employment levels in African micro and small enterprises is nearly double that of employment in large enterprises and the public sector. Sleuwaegen and Goedhuys (2002) similarly find a dualistic firm-size structure in the Cote d'Ivoire manufacturing sector where they estimated that "74% of employment in manufacturing takes place in firms with less than 10 employees, 4% in firms employing between 10 and 99 employees, while large firms account for 22% of employment in manufacturing".

McPherson (1996) also highlights differences in the growth dynamics of developing country firms as compared to those in developed economies. In his analysis of five African enterprise surveys he finds non-linearity in the growth patterns of firms. He finds that "in spite of the rather high growth rates presented…, the majority of MSEs [micro and small enterprises, defined as firms with less than 50 employees] do not grow at all… yet seem to survive for many years" (McPherson, 1996). Van Biesebroeck (2005) also finds that contrary to developed economies, "small firms rarely reach the top of the size and productivity distribution", further suggesting that developing country firm growth is hindered in some way.

A variety of potential explanations of this behaviour exist. Tybout (2000) points out that developing country policies are often either explicitly or implicitly non-neutral in firm-size, with larger more visible firms facing different regulatory burdens to those at the lower end of the size scale. For example, Gauthier and Gersowitz (1997) find an inverted-U relationship between Cameroonian firm tax-burdens and firm sizes, with very small and very large firms revealing low tax burdens.

This may also be exacerbated by weak tax administration which then concentrates its efforts on more visible firms from which revenue can be more easily extracted (e.g. Auriol and Wartlers, 2005; Azuma and Grossman, 2002; McLaren, 1998).

Fafchamps (2001) also points out that "because of small transaction size and rampant poverty, legal institutions offer little protection against breach of contract", thus limiting firm growth beyond the size where all commercial partners can be known and firms be responsible for their own contract enforcement. In an environment of weak legal institutions, initial size may also be important for growth by serving as proxy for legitimacy and reputation effects, as proposed by Sleuwaegen and Goedhuys (2002), while formality may contribute to firm growth by conveying legitimacy which then enhances trust and demand levels.

Contractual enforcement problems may also explain a link between firm growth and the ethnicity of the firm manager. Fafchamps (2000) finds evidence of ethnic discrimination against black entrepreneurs and female-headed firms in the provision of supplier credit in Kenya and Zimbabwe in response to asymmetric information and weak contract enforcement, potentially hindering the growth of excluded firms. After controlling for a range of firm characteristics, Ramachandran and Shah (1999) find that "non-indigenous firms" in Kenya, Zambia, Zimbabwe and Tanzania start out larger and grow faster than indigenous firms, also consistent with the notion that non-Africans benefit from informational and financial networks. Better firm performance by non-Africans may also result from historical factors. As Fafchamps (2001) notes: "favouritism by governments and colonial administrations can give one group a headstart, thereby giving it an advantage which is subsequently difficult to shake".

Laeven and Woodruff (2007) relate institutional quality to firm growth, through its mediating effect on firm-level idiosyncratic risk. Using a sample of Mexican firms they find that firm size is increasing with the quality of the legal system and that this effect is greater for single proprietorships, where risk is concentrated in the hands of a single owner. Single proprietorships are less likely to grow in a poor legal environment than partnerships or limited liability companies with diversified risk. This is also consistent with the New Institutional Economics literature which predicts that weak legal institutions hinder impersonal commercial exchange and restrict businesses in the scale of their operations (North, 2005).

The issues discussed thus far are principally linked to three main developing country characteristics: high transaction costs, high risk levels, and weak institutional or administrative coverage; also important elements in the literature on informality. The link between the two literatures becomes especially relevant when one replaces the concept of formality/informality as a binary state with one of informality as a question of degree, including "all the firms that, at least to some extent, choose to operate outside of the scope of existing regulations" (Perry et al., 2007).[3] This choice is made by a firm according to the incentives presented by its institutional environment.

Firms or individuals face a trade-off between the relative costs and benefits of operating at different degrees of formality, the probability of detection and the likelihood of being sanctioned if detected operating illegally. The principal costs of full formality include compliance with tax requirements, labour legislation, health and safety legislation, licensing laws (see de Soto (1989), Loayza (1997), Fortin et al., (1997), Botero et al. (2003), Perry et al. (2007), Dabla-Norris et al. (2008) amongst others). Proposed benefits to operating formally include the ability to take advantage of economies of scale (Giugale et al., 2000), legal protection and enforceability of property rights (Sarte, 2000, Loayza, 1997, de Soto, 1989), increased access to credit (Straub, 2005, Ihrig and Moe, 2004, Loayza, 1997) and the possibility of increasing productivity due to greater legal protection and access to other public goods such as public infrastructures and government support programmes (e.g. Loayza, 1997, Straub, 2005, Dessy and Pallage, 2003).

Underlying the trade-off between these costs and benefits is the administrative system which controls regulatory compliance, the quality of which determines the probability of being caught and the consequent degree and likelihood of punishment. In the developing country case, where administrative capacity is likely to be weak, detection and punishment are potentially related to size, thus implying the presence of an optimal "hideout size". In other words, "moderate-sized firms, which are large enough to show up on regulators' radar screens but too small to gain much from compliance, may be punished the most" (Tybout, 2000). Ultimately, it may be that in developing economies "maximising survival potential motivates the actor. Such motivation sometimes, but not always, coincides with wealth-maximising behaviour" (North, 1990).

Based on the premise that "informal firms behave no differently from small firms in industrialized countries", Levenson and Maloney (1998) link the literatures on firm performance and informality by including enterprises of all sizes and natures in the one analysis. They provide a theoretical framework where formality is couched in terms of "institutional participation", and where the benefits from participation or compliance increase with firm size. Extending the Jovanovic (1982) model, formal costs are considered as normal inputs with cost, complementary to labour and capital, with the effect of magnifying the associations between size and growth. As older firms also

[3] This is also consistent with the International Labour Organisation definition of informality (ILO, 2002).

have longer expected lifetimes the benefits of compliance also grow with age, while young, inefficient, small firms are likely to have lower degrees of regulatory compliance or “participation”. Although they have access only to cross-section data for Mexico, Levenson and Maloney (1998) find that the data on compliance with tax, labour and registration requirements are broadly consistent with their predictions.

Jackle and Li (2006) use panel data from a sample of Peruvian firms to test Levenson and Maloney’s (1998) predictions while also controlling for unobserved firm heterogeneity related to factors such as entrepreneurial drive and ability. Although they find that formality increases with size and firm growth (independent of initial size) as Levenson and Maloney (1998) predict, it does not increase with firm age, implying that firms which remain small may do so due to their perceived low net discounted benefit from “societal participation” and thus an unwillingness to absorb that cost in their production costs.[4]

3. Theoretical Framework

Extending the existing literature, this study builds on the premise that firm growth follows a non-linear path, with threshold effects created by a combination of bureaucratic barriers and a weak legal environment. This can be modelled by building on the Levenson and Maloney (1998) extension to the Jovanovic (1982) model.

In Jovanovic (1989), entrepreneurial ability, θ, is unobserved to the entrepreneur and randomly and normally distributed across entrepreneurs, with high ability associated with small θ. Differing entrepreneurial ability across firms translates into differences in firm efficiency levels, defined as its unit cost of production, only revealed to each firm through the learning process of spending time in business and the resultant firm cost structure. The total costs, $c(q_t)x_t$, of a firm in period t are a result of $c(q_t)$, the convex cost function associated with output, q_t, and the random variable $x_t = f(\theta + \epsilon_t)$, where $f(.)$ is a positive, continuous, strictly increasing function and ϵ_t are random firm-specific shocks with zero mean which are independent through time and across firms. High ability and only minimal shocks imply a small multiplier effect on $c(q_t)$, while low ability will multiplicatively increase total costs.

[4] Size and firm growth are measured in terms of deflated gross revenues. Note that they had no firm characteristics data.

Given that θ is unobservable, based on prior outcomes a firm forms expectations x_t^* of x_t, so that q_t is chosen to maximise expected profits, Π_t^*:

$$\max_{q_t} \Pi_t^* = \max_{q_t} [p_t q_t - c(q_t) x_t^*]$$

where p_t is the price associated with output q_t and firms are price-takers. The realised profits from each period provide new information regarding the firm cost structure, with unexpectedly high profits leading a firm to revise downwards its expectation of x_t^* and expand output, while unexpectedly low profits lead a firm to lower output and eventually exit.

Although they do not formalise it, Levenson and Maloney (1998) suggest that, "the distribution of formality among established firms reflects the underlying distribution of θ". This follows given that under the Jovanovic model more efficient firms grow and survive, and participation benefits are assumed to increase with firm size. They therefore hypothesise that "a firm will choose to become formal if the discounted benefit net of p_t across the expected lifetime of the firm exceeds the fixed costs, p_0" (Levenson and Maloney, 1998). Although not mentioned, a threshold effect would emerge under this framework if p_0 is large relative to p_t.

Taking this further, if participation is thought of as an ongoing cost rather than a single fixed cost, as is the case if formality is indeed a normal production input, the participation decision becomes a component of the choice of output level. Defining the degree of a firm's regulatory compliance or participation as $0 \leq r \leq 1$, ranging between zero and complete compliance, the threshold point as, γ, and the difference between profits for purely informal and partially formal firms as $\delta = (\Pi_t | r = 0, q_t) - (\Pi_t | r > 0, q_t)$, a threshold effect would imply that $\delta > 0$ for a given output level $q_t < \gamma$, but that $\delta \rightarrow 0$ as $q_t \rightarrow \gamma$, as depicted in Figure 3.1. The firm decision to expand therefore depends on the position of the threshold and the speed with which $|\delta|$ increases for $q_t > \gamma$: in Figure 3.1, the lower the gradient of the curve beyond the threshold, the greater the increase in output required to make profits from formality, and the greater the likelihood that firms will maintain low or zero participation and output levels below the threshold point γ.

Figure 3.1 Informal-Formal Profit Difference by Output Level

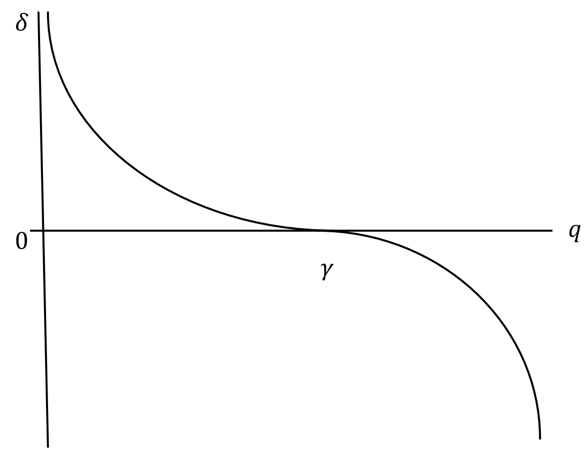
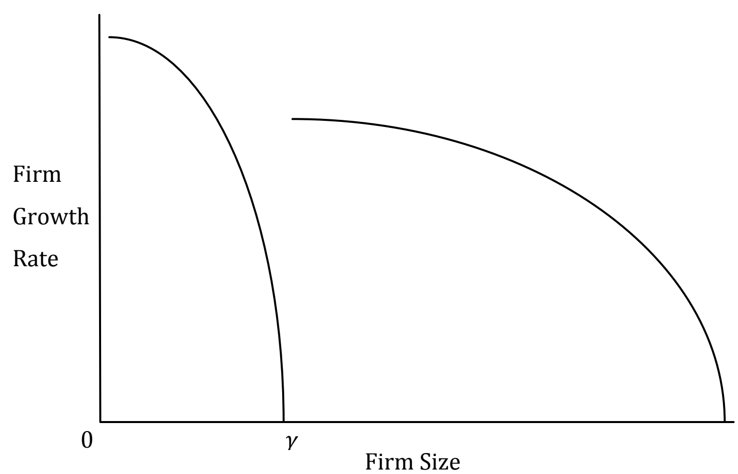


Figure 3.2 Firm Growth Path with Threshold Effect



Similarly to Levenson and Maloney (1998), this implies the following potential firm growth paths: i) a firm starts up above the threshold as a visible, large formal company, realises higher profits than expected, revises downwards its expected costs and grows, increasing participation along the way; ii) a firm begins production below the threshold, realises small profits, implying high costs and thus stops growing below the threshold, where the benefits of participation are small or zero; iii) a firm begins below the threshold, realises unexpectedly high profits and thus an opportunity for expansion beyond the threshold region, accelerates across the threshold to grow as in the first case, representing a threshold transition case.[5] This then leads to discontinuities in firm growth around the threshold of the nature displayed graphically in Figure 3.2.

The present analysis seeks to find econometric evidence of this firm growth threshold effect in long and short-run firm growth, to analyse whether or not the factors associated with growth vary between firms above and below the threshold, and to highlight any differences between long and short-run growth threshold effects. A brief analysis of the attributes associated with firms which cross the threshold is also presented.

4. Data

This analysis focuses on Mozambican manufacturing firms. The Mozambican enterprise sector in general is relatively undeveloped, with a recent enterprise census putting the total number of firms in the economy at 28,547. Of these, 2,799 firms are in the manufacturing sector (GoM, 2004a), with manufacturing accounting for approximately 20 percent of GDP (GoM, 2007). According to enterprise census employment figures, 90.9 percent of firms have up to ten workers while the 99th percentile of firms has sizes ranging from 110 workers to 14,000 workers.[6] The median firm size is of two workers, rising to three workers in the manufacturing sector.

Recent studies suggest that although the business environment is improving, firms continue to face high levels of bureaucracy in the day to day running of their business. For example, Mozambique was recently placed 128th out of 131 countries in the 2007-08 Global Competitiveness Index (World Economic Forum, 2007) and 134th out of 178 economies in the World Bank's 2008 Doing Business report (World Bank, 2007), this latter result reflecting an improvement of 6 places on the previous ranking.[7]

The data come from two manufacturing enterprise surveys carried out in 2002 and 2006, respectively. The first of these was the World Bank's Investment Climate Assessment (IFC, 2003) while the second, which aimed to form a panel of the same firms, was carried out by the Government of Mozambique in conjunction with the private sector association in 2006 (DNEAP, 2006).

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[5] There is a fourth case which would be of a firm which starts of large and decreases in size although this would be read as a pre-exit decline in size rather than a strategic choice.

[6] Based on author's calculations using data from the enterprise census CEMPRE (GoM, 2004a) using those 26,941 firms to have provided employment data.

[7] Note that these are broad indicators based on methodologies applied across countries which are not necessarily appropriate for a country such as Mozambique but are given for illustrative purposes only.

As in much of the literature on firm performance, firm growth in this study is defined in terms of employment numbers according to the following expression:

$$GRTH = \frac{\ln(EMPL_{t+\Delta}) - \ln(EMPL_t)}{\Delta}$$

where Δ is either the age of the firm or the number of years for which data are available. Two sets of growth rates are analysed here: i) a cross-section of long-run growth rates from reported size when the firm was established (start-up) to size in 2005, therefore measured over different periods for different firms; and ii) a balanced panel of short-run growth rates over the periods 2001 to 2002 and 2004 to 2005.[8]

Growth defined in terms of output sales or profits might be preferable to a workforce-based measure, however in their absence employment growth is a useful second best. As well as benefiting from lower measurement and reporting error, employment growth measures also have the benefit of being uncontaminated by price fluctuations or within-industry price differences, as noted by Foster et al., (2005), and may provide a crude estimator of market share (Tybout, 2000). Studies have also found that sales growth and employment growth are highly correlated (McPherson, 1996) although, given the potential lag behind real output and sales expansions, employment growth may only give a conservative, lower-bound estimate of actual firm growth. An exception to this may be for large firms which, following privatisation, may shed workers as part of an efficiency-increasing growth strategy, an aspect likely to be important in post-socialist African economies like Mozambique.

As Bigsten and Soderbom (2006) point out, almost all African enterprise surveys are characterised by relatively small and unrepresentative samples at a national level, particularly with regards small firms outside the capital. The present surveys are no different. As such, of the potential 192 firms surveyed in 2002, 137 were re-surveyed in 2006, providing data for long-run growth analysis for a maximum of 129 firms, while short-run analysis is based on a balanced panel of 92 firms. Although a wide range of firm sizes are included, there is a bias towards large firms. This is also a common problem in African countries where a statistically representative sample would be made up almost exclusively of micro firms, a point made by van Biesebroeck (2005). The present analysis is

[8] Note that, as Gunning and Mengistae (1999) point out, whereas in the short-run equation growth is compared over the same time interval so that the age coefficient in the growth equation reflects "some kind of life-cycle effect", the age effects in the long-run growth equation will reflect a mixture of start-up time effects and lifecycle effects given that firms start up at different points in time. Also, the data collected theoretically permit short-run growth to be analysed over the longer periods 1999-2002 and 2002-2005 although this further reduces the already small sample and so is not used.

nonetheless considered informative given the degree of variation in firm size, age and other characteristics and its coverage of the main sectors of the manufacturing sector.

Table 4.1 Summary of Main Variables

	N	Mean	S.D. on mean	Median	Min.	Max.
Long-run Growth (start-'05)	129	0.028	0.007	0.003	-0.173	0.316
Short-run Growth ('02-'05)	188	-0.006	0.028	0.000	-1.764	2.335
Initial Employment	129	81.403	13.715	31.000	1.000	1040.000
Firm Age	129	28.023	1.443	24.000	6.000	66.000
Tax & Regul. Constraints	125	0.000	0.126	0.251	-2.210	1.961
Recent Investment	128	0.695	0.041	1.000	0.000	1.000
Manager Second.Educ.+	129	0.690	0.041	1.000	0.000	1.000
European Origins	129	0.271	0.039	0.000	0.000	1.000
Main Comp. Importers & FDI	129	0.388	0.043	0.000	0.000	1.000
Single Proprietorship	129	0.364	0.043	0.000	0.000	1.000
Partnership	129	0.481	0.044	0.000	0.000	1.000
Ltd Liability Co.	129	0.140	0.031	0.000	0.000	1.000
Subsidiary Company	129	0.000	0.000	0.000	0.000	0.000
Other Legal Form	129	0.016	0.011	0.000	0.000	1.000
Food Processing	129	0.256	0.039	0.000	0.000	1.000
Furniture & Wood	129	0.225	0.037	0.000	0.000	1.000
Textiles & Garments	129	0.147	0.031	0.000	0.000	1.000
Metal-machinery	129	0.217	0.036	0.000	0.000	1.000
Other Sector	129	0.155	0.032	0.000	0.000	1.000
Micro (≤ 5 empl)	129	0.186	0.034	0.000	0.000	1.000
Small (6-25)	129	0.287	0.040	0.000	0.000	1.000
Medium (26-75)	129	0.240	0.038	0.000	0.000	1.000
Large (76-200)	129	0.194	0.035	0.000	0.000	1.000
Very Large (201+)	129	0.093	0.026	0.000	0.000	1.000

Based on the cross-section sample used for long-run growth analysis apart from "Short-run growth" which includes all panel observations.

Analysis is based only on firms surviving in 2005.[9] As Table 4.1 shows, long-run firm growth rates range from -17.0 percent to 31.6 percent, while short-run growth rates are more volatile, ranging from -176 percent to 235 percent growth.[10] In terms of initial employment size, as discussed, the

[9] An earlier paper on firm survival and growth finds no statistical evidence for selection effects, in common with other authors such as McPherson (1996).

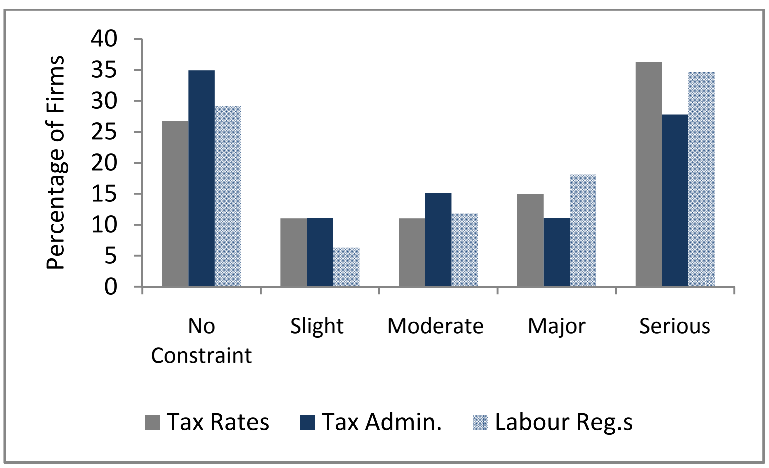
[10] Note that data reported are for those for which long-run growth data exist, except Short-run Growth, which gives the pooled average of growth rates over the years 2001-02 and 2004-05. For the 127 firms for which long-run growth data

sample is not nationally representative, with a mean of 81.4 workers and a median of 31 workers, although it covers the range of firms with start-up size from 1 to 1040 workers. Empirical results suggest that initial firm size is negatively associated with growth rates.

Firm ages also vary widely, from firms starting in 2000 to those starting in 1940, with a mean firm age of 28 years and median of 24 years in 2006. If the factors underlying models such as that of Jovanovic (1982) are correct, age is negatively associated with growth rates as firms arrive increasingly closer to their true efficiency levels. However, age may also affect growth through conditions at the time the firm began, particularly in a country such as Mozambique which has undergone the move from colonialism to independence in 1975, socialism up to the mid-1980s, structural adjustment thereafter and civil war from soon after independence until 1992.

As some of the main costs associated with formality are taxes and regulatory costs, surveyed firms were asked the level of constraint to firm growth and performance caused by tax rate levels, tax administration and labour regulations. Possible responses were 0 (no constraint), and the range from 1 (slight constraint) to 4 (serious constraint).[11 12] As Figure 4.1 shows, more firms complain of some degree of constraint than no constraint for all three aspects, while the distribution of burdens is relatively bimodal, with the highest levels for no constraint and serious constraint, potentially implying asymmetric regulatory burdens across firms.

Figure 4.1 Tax & Regulatory Burdens



exist, the short-run maximum and minimum growth rates are 107 and -117 percent, respectively, with a mean of 13.5 percent and a median of 0 percent.

[11] Business registration costs might have been included but were not deemed relevant given that the entire sample was in business prior to 2002.

[12] This method of evaluating the institutional environment is becoming a standardised form of doing so through the widespread use of World Bank Investment Climate Assessment surveys, now carried out on more than 30 countries. More information can be found at http://www1.worldbank.org/rped/index.asp?page=links.

As responses for all three may be correlated and represent proxy variables for different aspects of firm tax and regulatory burdens, the essence of all three is captured here in one tax and regulatory burden variable, formed using principal component analysis. As well as reducing the dimension of the data while retaining the characteristics with most variance, this has the benefit of reducing the risk of multicollinearity and of incorporating a number of subjective responses with potentially unreliable or unstable results into one single proxy variable. A high value of the resultant variable therefore implies the highest degree of correlation between all three variables and thus the highest degree of constraint, while the lowest negative scores correspond with a low degree of correlation between the different forms of constraint, implying a lower degree of constraint to those firms.[13]

The tax and regulatory burden variable is normalised so has a mean value of zero by construction, with a maximum of 1.961 which implies a major constraint to firm growth and performance due to tax rates, tax administration and labour regulations, while the minimum value of -2.210 implies little or no constraints from any of the three. While the absolute values are hard to interpret following this data transformation, tax and regulatory burdens are found to be positively associated with firm size so that if taxes and regulations are indeed associated with threshold effects, one would expect those firms who start and remain below the threshold to have negative values for this variable while those who grow and cross the threshold to have positive values, having experienced the increased burden felt above the threshold.

An investment variable indicates whether or not the enterprise carried out any investments in the three years prior to the survey. This is likely to affect firm growth and may capture such additional factors as the introduction of new technology and more productive equipment, expected to be positively associated with firm growth. In 2006, almost 70 percent of sample firms had carried out an investment.

Manager education is introduced as a proxy for firm efficiency levels in addition to firm age. A dummy variable is included if the general manager has a secondary education or above, with almost 70 percent of surveyed firms having an educated manager under this definition. This is expected to be positively associated with firm growth rates.

[13] Principal component analysis uses the covariance matrix of the component parts and calculates eigenvalues and eigenvectors which provide the "best fit" to characterise the data. The total variation for each variable in the analysis can be partitioned into the sum of a common component, a specific or unique component, and an error component. Principal component analysis extracts factors so as to explain as much of the total variance as possible" (Caudill, et al., 2000). Consequently, the "principal component of a set of variables is the linear index of all the variables that captures the largest amount of information" (Filmer and Pritchett, 2001).

A dummy variable is included for managers of European origin. As discussed above, ethnic background may provide information and financial networks as well as historical advantage and is therefore expected to be positively associated with growth.

In terms of competition, also potentially a stimulating force for growth, 38.8 percent of firms count imports or the output of foreign direct investment as their principal competitor.[14] This dummy variable takes the value zero if the principal competition comes from any other source. Caution may be required in interpretation of this variable as for some large firms, foreign competition as the principal competitor may also reflect a domination in a protected domestic market.

As discussed in the literature review, legal form may also have an important effect on firm growth in an economy with relatively weak legal institutions. The majority of survey firms are either single proprietorships (36.4 percent) or partnerships (48.1 percent), with a smaller share of limited liability companies (14 percent) and the remaining two percent shared between parastatal firms, cooperatives and subsidiary firms.

As shown in Table 4.1, there is a fairly even split of firms across the five manufacturing sectors covered, as is the case for firm sizes, divided into firm-size categories simply for illustrative purposes.

Table 4.2 presents the long-run firm-size transition matrix from start-up size to employment size at the end of 2005, illustrating growth from firm establishment to 2005 and firm exits after 2002. Each entry represents the share of firms to have started in the size category given by the row headings and to have ended in the size category given by the column titles.

Table 4.2 Long-run Size Transition Probability Matrix (start-up SIze-2005)

	Exit05	Micro05	Small05	Medium05	Large05	V. Large05	Unknown05	Total	Obs.
Micro start-up	0.10	**0.23**	0.40	0.20	0.03	0.00	0.03	1.00	30
Small start-up	0.19	0.09	**0.40**	0.21	0.07	0.02	0.02	1.00	57
Medium start-up	0.15	0.00	0.17	**0.47**	0.13	0.06	0.02	1.00	47
Large start-up	0.13	0.00	0.06	0.25	**0.41**	0.13	0.03	1.00	32
V. Large start-up	0.00	0.07	0.07	0.07	0.21	**0.50**	0.07	1.00	14
Unknown start-up	0.63	0.00	0.13	0.25	0.00	0.00	0.00	1.00	8
Observations	30	13	47	51	27	15	5		188

Note size categories: Micro(1-5), Small (6-25), Medium (26-75), Large(76-200), V. Large (201+)

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Among other things, Table 4.2 shows the different exit probabilities of firms given their start-up size. No very large start-ups had closed by the end of 2005, consistent with the conventional finding that survival increases with size (and age) consistent with the notion that very large firms are a results of large investments which have therefore been subject to analyses of potential demand, market size, and production techniques etc.[15]

More unusually, micro firms show the second lowest probability of exit of the five size categories, with only 10 percent of micro start-ups having closed by the end of 2005. This is considerably lower than the 19 percent for small firms and 15 percent for medium firms and runs counter to the common empirical finding of high exit rates for micro start-ups, providing prima facie evidence of "different" micro firm behaviour in the developing country context, as highlighted by McPherson (1995).

Nonetheless, the micro firm category displays more conventional long-run growth characteristics, representing the category with the greatest growth probability. Although 23 percent of micro start-ups remained micro in the long-run, 40 percent ended 2005 as small, and 20 percent as medium suggesting a high level of mobility for micro firms. This may imply only small threshold effects given the relatively large share of firms which did grow according to the arbitrary size categories employed here.

Small start-ups have a similar probability of expanding to the medium category although 9 percent declined in size to become micro. In contrast, the small to very large size categories display high levels of size persistence although relatively large shares of large and very large firms declined in size over the long-run, indicating that they may have begun operations et the "wrong" size and therefore required to shed workers.

Table 4.3 displays short-run growth transition matrices covering firm growth for the years 2001 to 2002 and 2004 to 2005, respectively, for the balanced panel plus thirty firms which exited between surveys. According to the top half of this table, micro firms again displayed the highest level of mobility, in accordance with general empirical findings, although 50 percent of micro firms in 2001 remained so in 2002. However, these proportional figures are based on only six firms to have begun 2002 as micro and, as can be seen in the bottom half of the table, micro firms form the least mobile category along with very large firms in the second period. Small and medium firms appear the least mobile in both the first and second period.

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[15] The two very large firms which became micro and small were "paralysed", in the process of being sold at the time of the survey.

These descriptive statistics suggest that there may be threshold effects operating in the growth path of this sample of Mozambican manufacturing firms. More detailed analysis is provided by a threshold regression approach.

Table 4.3 Short-run Growth Transition Matrices

	Micro02	Small02	Medium02	Large02	V. Large02	Total	Obs.
Micro01	**0.50**	0.50	0.00	0.00	0.00	1.00	6
Small01	0.03	**0.89**	0.09	0.00	0.00	1.00	35
Medium01	0.00	0.05	**0.90**	0.05	0.00	1.00	40
Large01	0.00	0.00	0.08	**0.81**	0.12	1.00	26
V. Large01	0.00	0.00	0.00	0.00	**1.00**	1.00	6
Unknown01	0.00	0.67	0.11	0.11	**0.11**	1.00	9
Observations	4	42	42	24	10		122
	Micro05	Small05	Medium05	Large05	V. Large05	Total	Obs.
Micro04	**1.00**	0.00	0.00	0.00	0.00	1.00	6
Small04	0.00	**0.93**	0.07	0.00	0.00	1.00	27
Medium04	0.00	0.09	**0.91**	0.00	0.00	1.00	34
Large04	0.00	0.00	0.17	**0.78**	0.06	1.00	18
V. Large04	0.00	0.00	0.00	0.00	**1.00**	1.00	7
Observations	6	28	36	14	8		92

5. The Threshold Regression Model[16]

An estimable model of enterprise growth rates might take the following form:

$$y_i = \beta' x_i + e_i$$

where y_i represents enterprise growth rate as defined above; $x_i$represents a selection of firm characteristics thought to determine firm growth rates, including initial size, firm age, manager education level, legal form, investments, competition and tax and regulatory burdens and sector controls; and $e_i$represents the regression error term.

However, this restricted model of firm growth assumes that growth rates are similarly determined across all firms.[17] Allowing for differential effects for firms on either side of a threshold point then requires an unrestricted model of the following form:

[16] This section draws on work on threshold regressions by Hansen (1996, 1999, 2000).

$$y_i = \beta' x_i + e_i \quad \begin{cases} y_i = \beta_1' x_i + e_i & q_i \le \gamma \\ y_i = \beta_2' x_i + e_i & q_i > \gamma \end{cases}$$

where q_i is the threshold variable, initial firm size, and $\gamma \in q_i$ is the threshold estimate. This then implies distinct coefficient estimates $\beta_1$and β_2 for firms above and below the estimated threshold point, implying the introduction of a full set of interactive indicator variables. The above equations can be expressed as follows:

$$y_i = \beta' x_i + \delta_n' x_i(\gamma) + e_i$$

$$x_i(\gamma) = \begin{cases} x_i I(q_i \le \gamma) \\ x_i I(q_i > \gamma) \end{cases} \quad I = 1 \; if \; q_i \le \gamma$$

I=0 otherwise

where $\delta_n = \beta_2 - \beta_1$is the threshold effect and I is an indicator variable taking the value one for firms below the threshold.

The threshold estimate itself is most simply attained using concentrated least squares (Hansen, 2000):

$$\hat{\gamma} = \text{argmin} S_n\big(\hat{\beta}(\gamma), \hat{\beta}(\gamma), \gamma\big) \text{ where } S_n = \hat{e}(\gamma)'\hat{e}(\gamma)$$

where $S(.)$ is the sum of squared errors $S_n = \hat{e}(\gamma)'\hat{e}(\gamma)$. Assuming $e_i$is $iid \; N(0, \sigma^2)$, the least-squares estimator is also the maximum likelihood estimator and the threshold estimate can be found by maximising the log-likelihood value across all possible threshold values.

While this approach is straightforward to apply, it introduces some problems for statistical inference. In particular, a conventional F-test or Chow test on the null hypothesis that the coefficients of the set of interactive terms are equal to zero requires the assumption that a threshold effect is known to exist and that its location is known. In addition, the threshold parameter appears only in the alternative hypothesis, a so-called "nuisance parameter" (Andrews, 1993, Hansen, 1996). Consequently, conventional test statistics constructed with the threshold treated as a parameter lose their standard large sample asymptotic distributions, making calculation of critical values impossible.

Hansen (1996) provides a technique for carrying out inference in the presence of a nuisance parameter (i.e. testing for the presence of a threshold). He also develops the asymptotic theory for

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[17] This also ignores potential self-selection bias given that growth is analysed on the basis of surviving firms only. A companion paper uses the same sample of firms to analyse firm survival and growth without threshold effects, finding that the evidence for selection bias from market selection effects is weak, as revealed by analysing growth using the Heckman selection procedure.

hypothesis tests based on the threshold estimate (Hansen, 2000), and summarises both of these in the context of fixed-effects panel estimation (Hansen, 1999). Looking specifically at the carrying out inference in the presence of nuisance parameters for models with additive non-linearity, Hansen (1996) proves the validity of computed asymptotic p-values by a bootstrap analogue. Following Hansen (1999), (based on Hansen, 1996), the null hypothesis of no threshold is equivalent to:

$$H_0: \beta_1 = \beta_2$$

The simulation process for estimating the asymptotic p-values then entails fixing the independent variables and bootstrapping the OLS residuals from the estimated threshold model to produce bootstrapped likelihood ratio statistics (comparing with the constrained linear model). These are then compared with the likelihood ratio statistic for the estimated threshold value (Hansen, 1999). The likelihood ratio statistic is given as follows:

$$F_1 = \frac{S_0 - S_1(\hat{\gamma})}{\hat{\sigma}^2}$$

(where for the panel case with T periods, $\hat{\sigma}^2 = S_1(\hat{\gamma})/[n(T-1)]$). The bootstrap estimate of the asymptotic p-value for the LR statistic is then simply the percentage of draws for which the simulated statistic exceeds the actual statistic (Hansen, 1999).

Relying principally on the assumption that the threshold effect $\delta_n = \beta_2 - \beta_1$ disappears asymptotically i.e. the threshold model becomes the linear model, Hansen (2000) provides an asymptotic distribution for the threshold parameter estimate and calculates critical values. More specifically, if a threshold effect is established (i.e. $\beta_1 \neq \beta_2$), then Hansen (2000) shows that $\hat{\gamma}$ is a consistent estimate of γ_0 based on the following principal assumptions for the cross-sectional case:

1. Correct specification
2. Conditional and unconditional moment bounds on the error and *x* terms
3. Continuous threshold variable and continuous conditional variance at the threshold (no regime-dependent heteroscedasticity)
4. Decreasing threshold effect (slope differences) as sample size increases ($\delta_n \to 0$ as $n \to \infty$)[18]
5. Full-rank conditions to exclude multicollinearity & "continuous threshold" model

Hansen (2000) then develops an asymptotic distributional theory for the threshold estimate, leading to the large, non-standard sample distribution of the likelihood ratio test for hypotheses on

[18] A potential problem is that this may limit validity to cases of small threshold effects relative to sample size.

γ. Assuming in addition that the errors are independent of the regressors and normally distributed, a conservative estimate of the confidence interval for the threshold estimate can be calculated using the normalised likelihood ratio sequence:

$$LR_n^*(\gamma) = \frac{LR_n(\gamma)}{\hat{\eta}^2} = \frac{S_n(\gamma) - S_n(\hat{\gamma})}{\hat{\sigma}^2\hat{\eta}^2}$$

where $\hat{\eta}^2$=1 if have homoscedastic errors, or if heteroscedastic errors are suspected, $\hat{\eta}^2$ is estimated using the following: $\hat{\eta}^2 = \frac{\hat{\mu}_{10}+\hat{\mu}_{11}\hat{\gamma}+\hat{\mu}_{12}\hat{\gamma}^2}{\hat{\mu}_{20}+\hat{\mu}_{21}\hat{\gamma}+\hat{\mu}_{22}\hat{\gamma}^2}$, where $\hat{r}_{1i} = \left(\hat{\delta}_n' x_i\right)^2 (\frac{\hat{e}_i^2}{\hat{\sigma}^2})$ and $\hat{r}_{2i} = \left(\hat{\delta}_n' x_i\right)^2$ are used to estimate the following using OLS: $\hat{r}_{ji} = \hat{\mu}_{j0} + \hat{\mu}_{j1}q_i + \hat{\mu}_{j2}q_i^2 + \hat{\varepsilon}_{ji}$

In terms of the estimated coefficients, $\hat{\beta} = \hat{\beta}(\hat{\gamma})$ and $\hat{\delta} = \hat{\delta}(\hat{\gamma})$, "the dependence on the threshold estimate is not of first-order asymptotic importance, so inference on β can proceed as if the threshold estimate $\hat{\gamma}$ were the true value" (Hansen, 1999). As described in Hansen (1999), the above technique can be easily applied to the fixed-effects analysis of panel data, with differencing removing the individual firm level effects.

6. Estimation & Results

6.1 Long-Run Growth Threshold Estimation

Long-run growth threshold estimation entails estimating an equation for firm growth from start-up size. Threshold estimation is carried out for three specifications. Specification (1) includes variables for initial firm size, firm age, recent investment and a secondary or above educated manager in addition to sectoral dummy variables, as displayed in Table 6.2. Specification (2) introduces firm tax and regulatory burdens while specification (3) further includes legal form, with limited liability companies representing the base case. The results of threshold estimation imply the presence of threshold effects at $\gamma = 18$ for specifications 1 and 2, and $\gamma = 19$ for specification 3 (details in appendix). Bootstrapping the OLS residuals from the threshold model using these estimates, the likelihood ratio statistics indicate that the null hypothesis of the presence of a threshold at the estimated values be rejected with 14.3 percent, 14.1 percent and 16.1 percent confidence, respectively. Although considerably above the generally accepted five or ten percent significance levels, given the small sample-size and caveats regarding data quality these are still considered low enough to suggest that threshold effects exist.

Table 6.1 provides the confidence intervals for the threshold estimates, assuming the log-likelihood function crosses the 95% critical line in a straight line. There is a probability of approximately 0.95 that the threshold location lies between the values 6.8 and 30.6 under the first specification, 6.3 and 24.4 under the second and between 6.9 and 29.2 under the third, as shown in Table 6.1. While imprecise, the results further confirm the statistical evidence of a threshold effect.

Table 6.1 Confidence Intervals for Threshold Estimates

	95% C.I. [γ1,γ2]	
Spec.1	6.8	30.6
Spec.2	6.3	24.4
Spec.3	6.9	29.2

Adopting the estimated threshold values, Table 6.2 provides the partial effects from estimating the model under these three specifications. In accordance with expectations, the introduction of a size threshold suggests that firm growth is different for firms starting life above and below the threshold to different degrees for different variables.[19]

As in the firm growth literature from developing economies, initial size is found to be negatively related to firm growth rates for firms above the threshold at the one percent significance level in all three specifications. For firms below the threshold, the negative sign on the effect of initial firm size implies that growth rates indeed decline more sharply than for those above, as implied under the hypothesised threshold growth path, although this is only well determined under specification (3) at the ten percent significance level. This implies consistency with the stylised graph of firm growth presented in Figure 3.2.

For firms above the estimated threshold, the older a firm is, the lower its growth rate, although this is tempered by a quadratic term, meaning that beyond the age of 25.8 (24.0 in (2)) growth rates increase with age. This would imply higher growth rates for firms formed above the threshold size during the turbulent times following Mozambican independence and may reflect unobservable firm characteristics relating to network effects established in the post-independence period, although this can only be speculated. The estimated partial effects on firm growth of age for firms above the threshold are determined at the 10 percent confidence level under specifications (1) and (2) only.

[19] Note that the threshold is introduced here using an interactive threshold dummy, implying that the coefficients for T=1 be interpreted as an effect compared with those above the threshold.

Table 6.2 Long-run Firm Growth with Threshold

	(1)		(2)		(3)	
	T = 1 if γ≤18		T = 1 if γ≤18		T = 1 if γ≤19	
	T=0	T=1	T=0	T=1	T=0	T=1
ln(empl)	-0.034	-0.032	-0.033	-0.029	-0.034	-0.024
	[0.007]***	[0.014]**	[0.007]***	[0.014]**	[0.007]***	[0.012]*
ln(firm age)	-0.147	-0.008	-0.149	-0.027	-0.15	-0.019
	[0.096]	[0.166]	[0.098]	[0.162]	[0.104]	[0.158]
ln(firm age)^2	0.023	-0.007	0.023	-0.003	0.023	-0.004
	[0.016]	[0.026]	[0.016]	[0.026]	[0.017]	[0.025]
Recent	0.069	-0.063	0.069	-0.045	0.07	-0.039
Investment⁺	[0.014]***	[0.020]***	[0.014]***	[0.023]**	[0.015]***	[0.021]*
Manager Second.	-0.005	0.043	-0.004	0.034	-0.005	0.03
Educ.⁺	[0.013]	[0.022]**	[0.014]	[0.020]*	[0.016]	[0.020]
European	-0.002	0.056	-0.004	0.062	-0.003	0.029
Origins⁺	[0.013]	[0.029]*	[0.014]	[0.027]**	[0.013]	[0.028]
Tax & Regul.			-0.003	0.017	-0.003	0.028
Burdens			[0.005]	[0.008]**	[0.005]	[0.007]***
Single					0.002	-0.062
Proprietorship					[0.021]	[0.027]**
Observations	125		125		125	
Firms below γ	50		50		51	
R-Squared	0.67		0.7		0.72	
F: T-terms = 0	4.53		4.86		5.17	
P>F	0.00		0.00		0.00	

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. ⁺ symbolises a discrete dummy variable. Sectoral dummies included but not reported.

The estimated coefficients for the effect of investment on firm growth rates show a sharp distinction between firms below and above the threshold, particularly under specification (1), where the coefficients are statistically significant at the one percent significance level. The estimated effects suggest that for firms which start life above the threshold, long-run growth and investment are positively associated, while for firms which started below the threshold any positive investment effect is cancelled out, almost completely under specification (1). Investments may thus not be productivity enhancing for firms which begin life "too small".

The results in Table 6.2 also suggest that a manager with at least secondary education is associated with higher long-run growth only for firms with initial size below the threshold, under specifications (1) and (2), while the effect is indeterminate for firms beginning life above the threshold. This may fit with the hypothesis that firms with better educated managers are more efficient and therefore more able to grow from a small size and eventually make the jump across the size threshold, an issue to be analysed in more detail below. The apparent absence of any relationship between education level and growth above the threshold level perhaps indicates the relatively lower importance of education once a firm reaches a certain size and other factors come into play.

Although only weakly determined in columns (2) and (3), contrary to expectations tax and regulatory burdens are positively associated with firm growth for firms which started life below the threshold. Given the cross-sectional nature of the data, this may simply reflect those firms which have grown up to and beyond the threshold and which therefore have suffered the constraints caused by emerging from under the radar, a distinct possibility given the high level of long-run mobility described in Section 4 and something the next section sheds further light on.

In column (3), single proprietorships have a strong negative effect on growth for those beginning life below the estimated threshold compared with limited liability companies, where the threshold under this specification is 19 compared with 11 workers for the other two specifications. The legal form estimates are jointly statistically significant at the one percent significance level and would confirm the results found elsewhere that single proprietorships are generally associated with lower growth where legal protection is weak and firms are exposed to a high degree of risk which is therefore concentrated in the hands of one person.

In sum, introduction of a threshold in the long-run growth equation alters the relationship between the explanatory variables and firm growth for firms on either side of the threshold. While altering the magnitude of certain effects in comparison with the model with no threshold, the estimated coefficients also suggest different growth effects for firms above and below the threshold, as expected under the original hypothesis.

6.2 Short-run Growth Threshold Estimation

The availability of two periods of firm data implies that a short-run growth thresholds model can be estimated by panel analysis. The advantages of panel data over cross-section or time-series are widely acknowledged and include the ability to model economic relationships taking into account the heterogeneity of individuals with similar observable characteristics. Firm heterogeneity related to underlying managerial ability or firm structure, which manifests itself in varying firm efficiency or productivity levels, is likely to affect firm growth patterns, even though the periods covered a short in the life-cycle of a firm.

If unobserved heterogeneity is correlated with the explanatory variables, OLS will be biased as with omitted variables. One solution is to take first differences and estimate using OLS, thus removing any bias caused by time-invariant unobserved heterogeneity: the fixed effects model. Two potential problems arise due to measurement error in the explanatory variables which may lead to bias towards zero depending on the level of variance due to measurement error, and due to endogenous explanatory variables which may lead to inconsistency. Nonetheless, "in general, the fixed effects estimator is to be preferred to the random effects estimator unless we can be certain that we can measure all of the time-invariant factors possible correlated with the other regressors" (Johnston and DiNardo, 1997).

If models such as the Jovanovic (1989) model are correct and efficiency levels are uncovered as firms age then firm heterogeneity will be correlated to some extent with firm age, recommending the use of fixed effects. Similarly, if firm heterogeneity relates to "reputation" as proposed by Sleuwaegen and Goedhuys, (2002), this is related to both firm size and formal registration and again thus correlated with the proposed explanatory variables for firm growth. Firm-specific risk in the form of idiosyncratic productivity and demand shocks are then captured in the error term.

Three specifications are applied using similar explanatory variables to the long-run analysis but excluding variable with little change between the two periods. Taking firm-specific effects into account, the short-run growth threshold effect is similarly located to that found for long-run growth. It is estimated at 17 workers under specification (1) and 18 under the other two specifications, very close to the 18 workers and 19 worker estimated thresholds in the three long-run specifications.[20]

Using the estimated coefficients, a likelihood ratio test is carried out for the presence of a threshold effect with p-values calculated using bootstrapped residuals with 1000 replications. The null hypothesis of no threshold can be rejected with 11.0 percent confidence under specification (1) and 9.4 percent, and 8.7 percent under specifications (2) to (3), respectively. Although not highly significant according to the conventional 5 percent cut-off point, these values still provide evidence of a growth threshold effect.

Table 6.3 provides the estimated coefficients from the fixed effects short-run threshold model. As under the long-run models, firm size is negatively associated with firm growth, or more specifically, an increase in firm size is associated with a reduction in firm growth rates, for firms above and below the estimated thresholds. The estimate is statistically significant for those firms below the

[20] Note that under all short-run specifications, the log-likelihood value is the same for $\gamma = 15, 16, 17$ (and 18 under specifications (2) to (3)). The highest value is chosen given that the threshold dummy operates on firms with employment up to and including the threshold value. In effect, this implies that the coefficient estimates are the same for these values of threshold.

threshold at the one percent significance level under (1) and (2) and at the five percent significance level under (3), implying a slowing effect as a firm approaches the threshold from below, precisely the effect predicted under the hypothesised model. The size of the threshold effect (the differences between coefficients for firms above and below the threshold) falls with the inclusion of additional variables although as the results in column (3) indicate, the negative growth effect for firms above the threshold becomes statistically significant at the ten percent significance level.

Table 6.3 Fixed Effects Short-Run Growth with Threshold

	(1)		(2)		(3)	
	T = 1 if γ≤17		T = 1 if γ≤18		T = 1 if γ≤18	
	T=0	T=1	T=0	T=1	T=0	T=1
Dln(empl)	-0.082	-0.712	-0.239	-0.574	-0.247	-0.531
	[0.066]	[0.190]***	[0.162]	[0.208]***	[0.140]*	[0.210]**
D(Single Prop'ship)	-0.249	-1.386	-0.217	-1.367	-0.197	-1.423
	[0.116]**	[0.156]***	[0.145]	[0.175]***	[0.127]	[0.169]***
D(Tax & Regul. Burdens)			0.053	-0.119	0.067	-0.123
			[0.040]	[0.058]**	[0.039]*	[0.059]**
D(Foreign & Import Competition)					-0.215	-0.008
					[0.085]**	[0.162]
Observations	92		83		83	
R-Squared	0.33		0.4		0.45	
F: T-terms = 0	48.99		0		0	
P>F	0		0		0	

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%

Specifications (1) to (3) also include a variable for firms which become single proprietorships, with statistically significant coefficients for firms above and below the threshold under specification (1), although statistically significant only for those below the threshold for all other specifications. Single proprietorships are therefore negatively associated with firm growth, whether or not a firm is above or below the threshold. However, firms below the threshold which are single proprietorships have a considerably lower growth rate than those above threshold, reflecting their likelihood to stay small. This is a potential reflection of the risk inherent in trying to expand with ownership concentrated in the hands of one person although it may also simply reflect a small-business strategy of non-expansion.

Under specifications (2) and (3), tax and regulatory burdens are introduced. The estimated coefficients show opposing sighs for firms above and below the threshold although the larger effect is again the negative association with firm growth for firms below the threshold (this is also the more statistically significant relationship). Interestingly, whereas tax and regulatory burdens were found to be positively associated with the long-run growth of firms starting life below the threshold, in the short-term the association is negative. Given the dynamic nature of the analysis here, this may imply that as firms feel the burden increasing they either slow their growth and remain below the threshold or are required to increase growth to get passed the point where the burden is too great to survive. It may therefore be *despite* tax and regulatory constraints that those firms above the threshold grow.

Column (3) introduces foreign and import competition as a firm's principal competitor into the estimated model. Here the threshold effect is small (if not zero), with firms both above and below the threshold having lower growth rates where foreign firms and imports are their principal competitors.

Although based on a small sample, the short-run threshold regression model appears to provide further evidence in support of the hypothesised growth paths discussed in Section 3.

6.3 Crossing the Threshold

Given that a threshold effect does not necessarily imply a discontinuity, interest now turns to those firms that crossed the threshold. The transition probability matrices presented below give the probability of being in the size class identified by the column headings in 2005, having started in the size class given by the row headings.

Table 6.4 Long-run Threshold Transition Matrices

Threshold = 18

	Exit05	Below05	Above05	Unknown05	Total	N
Below_i	0.15	**0.49**	0.36	0.03	1.00	61
Above_i	0.17	0.07	**0.76**	0.03	1.00	94
Unknown_i	0.71	0.00	0.29	0.00	1.00	7
N	30	37	95	5		162

Threshold = 19

	Exit05	Below05	Above05	Unknown05	Total	N
Below_i	0.16	**0.48**	0.37	0.03	1.00	63
Above_i	0.16	0.08	**0.76**	0.03	1.00	92
Unknown_i	0.71	0.00	0.29	0.00	1.00	7
N	30	37	95	5		162

For those firms which began life below the threshold of 18 workers, 15 percent exited, 49 percent remained below the threshold, and 36 percent passed the threshold, perhaps confirming the interpretation above that the positive tax and regulations coefficient reflects growth in spite of tax and regulatory burdens. For the higher threshold of 19 workers, 48 percent remained below the threshold while 37 percent crossed over. The shares of firms to have made the threshold transition are higher than expected, signifying that a considerable share of firms still make the upwards leap in the long-run, even if threshold effects exist.

As would be expected, the majority of firms which began above the threshold remained there under both threshold estimates. Although a number of firms did reduce in size to below the thresholds, a higher share exited (17 percent and 16 percent, respectively) than those which reduced in size (7 percent and 8 percent, respectively).

Table 6.5 reports the marginal effects from a probit model, where the dependent variable takes the value one if a firm began below the size threshold and ended above it, and zero otherwise.[21] The model to be estimated takes the following form:

$$\Pr(C = 1|\mathrm{z_i}) = \Phi(\theta' z_i)$$

where $C = 1$ if a firm crosses the threshold and $C = 0$ otherwise; z_i is a selection of explanatory variables associated with growth excluding the threshold variable firm size; and $\Phi(.)$ is the cumulative distribution function of the standard normal distribution. The results are reported in Table 6.5. Columns (1) and (2) relate to the threshold estimated under long-run specifications (1) and (2), both estimated at 18 workers, while columns (3) and (4) refer to long-run specification (3).

In attempting to explain firm mobility across the growth threshold, firm age provides the only statistically significant estimated coefficients. Age is positively associated with transitions across the threshold up to the age of approximately 17 to 18 years under all specifications, after which age is negatively associated with threshold transitions. This is indicative of the relatively large share of older firms that remained small over their lifetime but also that firms which make the leap, do so in early life. The longer a firm remains small the more likely it is to remain small. This is consistent with the hypothesis that the increase in output required to make crossing the threshold worthwhile is too large to undertake for certain less efficient firms.[22]

[21] Firms which started above the size threshold and stayed there are thus treated as "non-crossers" although they may have grown. If only those firms which started life below the threshold are included, the sample size is too small for meaningful analysis.

[22] With a longer dataset this process of what leads firms to cross the threshold and when might be modelled in terms of a Poisson process. Lack of data removes that possibility here.

Table 6.5 Long-run Threshold Crossers

	(1)	(2)	(3)	(4)
ln(firm age)	1.629	1.596	1.707	1.699
	[0.581]***	[0.617]***	[0.611]***	[0.646]***
ln(firm age)^2	-0.289	-0.283	-0.3	-0.298
	[0.094]***	[0.100]***	[0.098]***	[0.104]***
Tax & Regul.		0.029		0.038
Constraints		[0.020]		[0.022]*
Single		-0.011		-0.022
Proprietorship		[0.057]		[0.060]
Manager		0.062		0.032
Second. Educ.⁺		[0.051]		[0.059]
Recent		0.05		0.065
Investment⁺		[0.055]		[0.056]
Observations	125	125	125	125
Chi-Squared	24.082	32.231	23.939	31.739
P	0.001	0	0.001	0.000

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. ⁺ discrete change of dummy variable from 0 to 1. Sectoral dummies included but not reported.

As shown in columns (2) and (4), the only other variable to have a slight statistical association with firm threshold transitions is the tax and regulatory burden, statistically significant only at the ten percent significance level for specification (4). Those firms reporting the highest levels of tax and regulatory burden are those with the highest probability of having made the transition from start-up to the present, suggesting that those firms which cross the threshold do so despite increasing tax and regulatory burdens. Alternatively it may reflect firms which have been "spotted" by the authorities for whom growth may be the only method of survival.

The legal form of the firm is not found to be statistically associated with crossing the threshold although the negative estimated coefficient would be consistent with the previous results. Similarly manager education and investments have positive estimated coefficients as would be expected although again these are not statistically significant.

Perhaps of most interest in this analysis are those other factors not found to be important in explaining firm transitions across the threshold. Firm transitions are not found to be associated with export firms, nor with credit access, internally-financed investment, the introduction of new products, product diversification, market share and competition effects, all of which fail to help explain which firms which make the threshold transition. While this may reflect the small sample, it may also be taken as an indication of other factors at work in determining firm growth paths.

In the short-run, given the considerably shorter time-span, only seven firms made the leap across the estimated threshold in the periods 2001-2002, 2002-2004 or 2004-2005. Table 6.6 presents the transition matrices representing firm placements below or above the estimated threshold in all periods for the two threshold estimates. Given the different periods under analysis, upwards of ninety percent of firms stay in their position relative to the threshold for the periods 2001 to 2002 and 2004 to 2005, respectively, with only marginally more firms crossing the threshold upwards than downwards, eliminating the possibility of a probit analysis.

Table 6.6 Short-Run Threshold Transition Matrices

	Threshold = 17					Threshold = 18				
		Below02	Above02	Total	N		Below02	Above02	Total	N
Below01		**0.92**	0.08	1.00	25		0.92	**0.08**	1.00	26
Above01		0.05	**0.95**	1.00	93		0.07	0.93	**1.00**	92
Unknown01		0.50	0.50	1.00	4		0.75	0.25	1.00	4
Total		0.25	0.75	1.00	122		0.27	0.73	1.00	122
	Closed04	Below04	Above04	Total		Closed04	Below04	Above04	Total	
Below02	0.13	**0.70**	0.17	1.00	30	0.18	0.70	**0.12**	1.00	33
Above02	0.28	0.04	**0.67**	1.00	92	0.27	0.04	0.69	**1.00**	89
Total	0.25	0.20	0.55	1.00	122	0.25	0.22	0.53	1.00	122
		Below05	Above05	Total			Below05	Above05	Total	
Below04		**0.96**	0.04	1.00	25		0.96	**0.04**	1.00	27
Above04		0.03	**0.97**	1.00	67		0.02	0.98	**1.00**	65
Total		0.28	0.72	1.00	92		0.02	0.98	1.00	92

Although only amounting to seven firms, none of those firms to have crossed the threshold were exporters, the majority had not invested, none had formal credit, only one had informal credit, and none had introduced new products in the years prior to the survey. All crossers were entirely domestically privately owned and had a domestic firm as their principal client.

More than half of those firms which crossed the short-run threshold were in the form of partnerships, the majority had an educated manager and reported a lower average tax and regulatory burden than those which did not cross. This then corresponds with the results found from estimating the location of the threshold, although those which crossed had also had a higher average number of inspections in the year prior to the survey than non-crossers.

7. Conclusions

This paper investigates the presence of threshold effects in firm growth paths using data from Mozambican manufacturers. Building on empirical evidence that developing country firm behaviour differs from that in developed countries, and on the recent literature on informality which views the informal economy as simply the lower-size end of the enterprise population, it is hypothesised that firm growth paths are characterised by threshold effects.

The analysis attempts to find econometric evidence of a firm growth threshold effect in long and short-run firm growth to determine how the factors associated with growth vary between firms above and below the threshold and to highlight differences between long and short-run growth threshold effects. Given the difficulties of carrying out inference in the presence of a nuisance threshold parameter, estimation is carried out using the threshold regression model with inference based on the methods proposed by Hansen (1996, 1999, 2000), for calculating valid p-values and confidence intervals for threshold estimates.

Threshold effects are found to exist for long and short-run firm growth in Mozambique. The estimated threshold sizes are also similar over the long and short-run while the estimated coefficients on the explanatory variables are broadly consistent with the hypothesis of slowing growth rates as firms approach the threshold from below. In addition, the results imply differing tax and regulatory burdens for firms above and below the threshold, different effects from investment and differing long-run growth for firms with European managers. In addition, single proprietorships are found to be associated with slower growth rates, particularly for firms below the threshold.

The presence of threshold effects suggests that although some firms follow developed economy firms in their growth path, others remain small without growing or exiting. This is likely to contribute to the overwhelming number of very small enterprises which dominate developing economies. The implications of having threshold effects in the firm growth path are potentially large. Barriers to firm graduation or incentives to remain small clearly inhibit firms from expanding to fulfil their growth potential, requiring much greater prospective benefits from growth than would otherwise be the case, with potential consequences for employment growth and for market selection, given the implicit protection offered to firms above the threshold point.

The results also suggest that empirical findings on developed economy firm behaviour are not directly transferable to developing economies, thus also implying the need for different, or at least additional, tools for understanding developing country growth. In particular it seems that the asymmetric application of rules and institutional participation imply firm-level effects, in particular as risk factors relating to firm performance emerge as being more important for firms than supply-side constraints.

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A. Appendix

Figure A.1 reproduces the log-likelihood values for threshold values from 0 to 50 for three long-run growth specifications estimated using OLS with heteroscedasticity-robust standard errors (given in Table 6.2). Under the specifications in columns (1) and (2) the maximum log-likelihood is attained at $\gamma = 18$, while for specification (3) the maximum log-likelihood is for $\gamma = 19$.

Figure A.1 Log-likelihood Values by Threshold Parameter Estimates (γ)

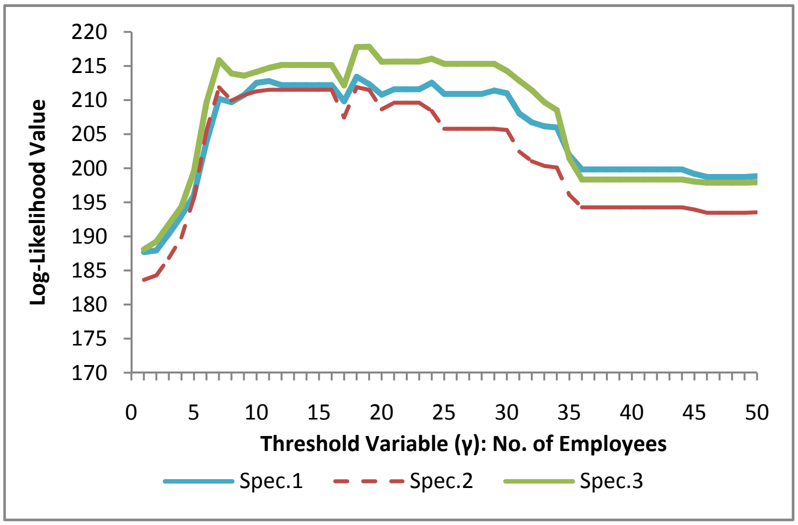
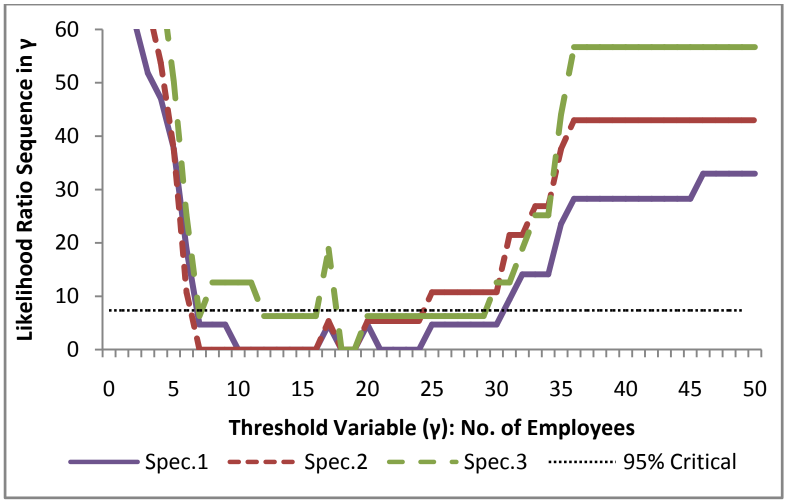


Figure A.2 provides a graphical illustration of the Hansen's (2000) heteroscedasticity controlled likelihood ratio statistic under the three long-run growth specifications and confidence intervals for these threshold estimates, via the inclusion of a line at the 95 percent asymptotic confidence level as estimated by Hansen (2000). As in Figure A.1, the visual evidence suggests that a threshold effect might exist between firms with around 7 and around 30 employees.

Figure A.2 Long-run Likelihood Ratios by Threshold Parameter (γ)



As represented in Figure A.3, allowing for heteroscedasticity the confidence intervals for the short-run growth threshold parameter estimates are considerably narrower than for the long-run growth case, suggesting a greater level of precision.

Figure A.3 Short-run Likelihood Ratios by Threshold Parameter (γ)