

Goedhuys, Micheline; Sleuwaegen, Leo

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## High-growth entrepreneurial firms in Africa: A quantile regression approach

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Research Paper No. 2009/11

## **High-Growth Entrepreneurial Firms in Africa**

A Quantile Regression Approach

Micheline Goedhuys,<sup>1</sup> and Leo Sleuwaegen<sup>2</sup>

March 2009

### **Abstract**

This paper studies the growth performance of a large set of entrepreneurial firms in ten manufacturing sectors of eleven Sub-Saharan African countries. The focus of the paper is on identifying those entrepreneurs' attributes and firm characteristics that tend to generate a significant number of high-growth firms in these countries. To this end, we use a quantile regression, which provides a more complete estimation of the growth distribution of firms conditional on different attributes. The results indicate that especially firms that engage in product innovation, have their own transport means and are connected to the internet through their own website are characterized by higher growth rates and display a more skewed distribution to the right, hosting a higher number of high-growth firms. The effect of the last two variables, which relate to distance-bridging modes of infrastructure, points to the self-reinforcing growth effects .../.

**Keywords:** quantile regression, high-growth firms, firm growth, Africa

**JEL classification:** D92, O55

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<sup>1</sup> (corresponding author) UNU-MERIT, Maastricht, email: Goedhuys@merit.unu.edu; <sup>2</sup> Vlerick Leuven Gent Management School; Catholic University of Leuven, Leuven, leo.sleuwaegen@econ.kuleuven.be

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they generate in creating wider input and output markets. Education raises growth opportunities by affecting the lower quantiles, but does not appear to influence the upper quantiles. The estimated conditional growth distributions for the technology intensive machinery and electronics sectors show more extreme tails and a lower mean in comparison to the traditional industries, suggesting the more risky nature of doing business in these industries.

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## Acronyms

HGFs high-growth firms

ICS *World Bank Investment Climate Survey*

LDCs least developed countries

MES minimum efficient scale

SSA Sub-Saharan Africa

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UNU World Institute for Development Economics Research (UNU-WIDER)  
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

Typescript prepared by Liisa Roponen at UNU-WIDER

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## 1 Introduction

A thriving class of entrepreneurial firms is generally recognized as necessary for providing the potential for employment creation and wealth. It is even more important in the least developed countries (LDCs), many of which have gone through a period of conflict, to foster productive and high-growth entrepreneurship that can contribute to peace and transition (Naudé 2007; UNCTAD 2006). The growing share of the non-agricultural labourforce also highlights the need for employment creation in the productive sector, beyond the proliferation of marginal/informal trade and service activities that are traditionally associated with entrepreneurship in Africa. Strongly growing firms have the potential of employment creation, the creation of technological capabilities and physical and human capital formation.

Recently there have been several efforts to define and identify high-growth firms (HGFs) in the context of the advanced economies (e.g., Delmar, Davidsson and Gartner 2003; Acs, Parsons and Tracy 2008; Eurostat-OECD 2007). Also for developing countries, including Sub-Saharan Africa (SSA), a better understanding of the prevalence and incidence of HGFs is highly relevant. The need to gain better insights into the existence, characteristics and stimulating factors of high-growth firms in this region is pressing, but sharply contrasts with the patchy empirical evidence on this topic.

Almost all studies dealing with firm growth show a wide dispersion of growth rates across firms. Many unidentified and unobservable (firm-specific) factors are held responsible for these wide differences in growth performance of firms. However, since the seminal work of Jovanovic (1982), firm growth has been increasingly modelled as a learning process to explain why small and young firms grow faster, once they discover in confronting the market, that they can stand up to competition. The model has been successfully tested in the context of developed and developing countries. Studies focusing on developing countries have indicated that in addition to the learning process, the growth of firms is influenced by a larger set of other variables, including the specific characteristics of entrepreneurs and a wide range of constraining factors from both the demand and supply conditions in those countries (Sleuwaegen and Goedhuys 2002).

Empirical regression models have been able to explain how the growth of the firm is influenced by these variables. Typical for regression analysis, these studies show how the mean of the (conditional) distribution of firm growth rates changes systematically with these co-variates. The fact that these regression models explain little of the variation in firm growth rates—leaving the large role to the so-called erratic or stochastic component of firm growth—has often been overlooked. Moreover, the classical regression studies assume that deviations from the mean of the conditional distribution are distributed in the same way, whatever the values of the co-variates. As emphasized by Koenker and Hallock (2001), the classical regression approach boils down to a location shift model, assuming that the co-variates affect only the location of the conditional distribution of growth rates, and not the scale or shape of it (Koenker 2005).

This paper makes less restrictive assumptions in analysing the complete conditional distribution of firm growth rates. By using quantile regressions, we investigate to what extent certain co-variates may affect the conditional distribution of firm growth rates more fundamentally, by changing its location, scale and shape (Koenker and Bassett

1978; Buchinsky 1998; Koenker 2005). We are interested not only in the factors that systematically increase the ‘mean’ growth rates of firms, but also in the factors that tend to stretch the right tail of the conditional distribution of growth rates; in other words, factors that tend to generate a significant number of high-growth firms.

Indeed, if the aim is to stimulate the number of HGFs in the economy, an examination of the complete firm growth distribution contingent on the different firm characteristics and the demand and supply conditions appears more appropriate. If certain features generate a more stretched distribution, widening the upper tail, these factors can be as crucial in explaining the prevalence of high-growth firms in the economy as the factors that systematically affect the mean firm growth rate. Indeed, the results of our analysis indicate that after controlling for a set of growth enhancing factors, firms that engage in product innovation, have their own transport means, and are connected to the internet through their own website are characterized not only by higher growth rates, but also display a distribution of growth rates skewed to the right, hosting a higher number of HGFs. The influence of the last two variables points to the self-reinforcing growth effects generated by distance-bridging modes of infrastructure, which create wider input and output markets.

These results follow from analysing the prevalence and determinants of high-growth entrepreneurship in eleven SSA countries, eight of which are listed in the UN classification as ‘least developed countries’ (LDCs): Angola, Burundi, Rwanda, Congo, D. R., The Gambia, Guinea-Bissau, Guinea, Tanzania, and three other developing countries: Swaziland, Botswana and Namibia. These countries have received little attention in economics literature for a variety of reasons, including the small size of their economy, existing language barriers and scarcity of data and information. Some empirical studies, however, have been carried out to examine the barriers to growth of firms in Africa, investigating why firms fail to move up from a micro- or small- to a medium- or large-scale operation. The studies did not give specific attention to the group of high-growth firms, which in particular have the potential to create quality employment as technological capabilities develop. The availability of a wider set of harmonized firm-level data, collected by the *World Bank Investment Climate Survey* (ICS) allows us to better analyse the factors that foster high-growth African firms.

In section 2, the paper presents the findings of a rich empirical and theoretical literature on firm growth and identifies the factors that have been found to influence firm growth, with a special emphasis on studies particularly from Africa. Then, section 3 presents some basic evidence on the existence of HGFs in various African countries. This is done on the basis of the World Bank dataset used for the empirical analysis, which is first described (section 3.1), and following the definition of HGFs, which is elaborated in section 3.2. Section 4 subsequently estimates a growth model to identify the factors that affect growth at the various levels of growth distribution. Section 4.1 explains the two estimation techniques used: least squares assuming homoscedastic normal conditional growth distributions; and quantile regression, allowing for more general conditional growth distributions. Section 4.2 explains the construction of the variables while section 4.3 presents the estimation results. Section 5 interprets the findings and ends with a discussion of some of the limitations of this study.

## 2 Determinants of high-growth firms: insights from the literature

There are many unidentified and unobservable firm-specific factors that are responsible for the growth performance of firms. This is strongly recognized in the literature on firm growth that builds on Gibrat's (1931) 'law of proportionate effect', which in its strongest form implies that growth is completely random. A growing number of studies reject Gibrat's law of complete randomness of firm growth, and find that there are systematic observable factors, such as size, age, innovation, entrepreneur characteristics and resources, that do affect the growth of firms. A large set of classical regression studies offer evidence that the mean of the distribution of growth of firms changes systematically with the value of these observable factors. However, they pay no attention to possible interactions of these factors with the unobserved firm-specific factors that characterize the dispersion of growth performance of firms around the mean. An exception is Coad and Rao (2008) who, similarly to our work, use quantile regression to analyse the impact of innovativeness on the growth of US firms.

Indeed, if the aim of policymakers is to stimulate the number of high-growth firms in the economy, an examination of the firm growth distribution that is contingent on the different firm characteristics and demand and supply conditions appears more appropriate. For increasing the number of HGFs in the economy, altering the factors that have a stronger impact in the upper tail of the conditional distribution will likely be as effective as affecting the factors that shift the distribution upward.

In what follows we survey the literature in search of the factors that are likely to affect growth distribution in a variety of ways, with a special emphasis on findings from Africa. However, the literature so far has focused on factors that affect the mean of growth distributions. Our aim is to investigate whether these effects are the results of a pure location shift of the mean growth rate, or result from a more fundamental impact these factors have on the complete distribution of firm growth rates. We are particularly interested in identifying the factors that have a strong effect in the upper tail of the growth distribution, where high-growth firms are situated.

### 2.1 Firm size and age

A large body of empirical studies<sup>1</sup> find a significant negative relationship between firm growth and size (Mansfield 1962; Kumar 1985; Evans 1987; Dunne and Hughes 1994; Goddard, Wilson and Blandon 2002; Yasuda 2005; Calvo 2006) and between the variability in growth and firm size. The higher and erratic growth rates of smaller firms are related to the small size at which firms enter vis-à-vis the minimum efficient scale (MES), dictated by the technological conditions of the industry. Confronted with this scale cost-disadvantage, surviving small firms will grow rapidly to reach the MES, also allowing that above the MES, growth may be random.<sup>2</sup>

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<sup>1</sup> See Coad (2009) for a recent overview.

<sup>2</sup> Surveying the literature Caves (1998) indeed concludes that growth is independent of size above a certain size threshold. In a selection model by Audretsch (1995), conditional on survival, firms in industries with large-scale economies exhibit higher rates of growth than firms in industries where scale economies are relatively unimportant.

Similarly a negative relationship between firm growth and firm age is observed (e.g., Evans 1987; Variyam and Kraybill 1992; Dunne and Hughes 1994; Yasuda 2005; Calvo 2006) and between the variability in growth and firm age. Smaller and younger firms grow faster than larger, older ones, but the volatility in their growth rates is also higher, as are their hazard rates. This observation lends support for the insights provided by Jovanovic's (1982) passive 'Bayesian' learning model of firm growth. Firms enter the industry with different relative (fixed) efficiency levels. Once established in the industry, firms learn about their efficiency, especially in their first years, with the least efficient ones being forced to exit, while more efficient firms expand.

The size-age-growth relationships have also been successfully tested in the context of African firms. McPherson (1996), Goedhuys and Sleuwaegen (1999), Sleuwaegen and Goedhuys (2002), Biggs and Srivastava (1996), Bigsten and Gebreeyesus (2007) provide empirical evidence that younger and smaller firms have higher growth rates than larger and older companies. However, important non-linearities in the size-growth and age-growth relationships have also been found: Sleuwaegen and Goedhuys (2002) find a positive interaction effect between firm size and age on the growth of Ivorian firms, implying that firms starting at a larger size tend to regress more slowly in growth rate over time than smaller firms. Bigsten and Gebreeyesus (2007) note the age effect to be negative for Ethiopian firms in their early years of activity, yet turning positive for older firms, when firms are likely to benefit increasingly from reputation effects.

## **2.2 Innovation and capabilities**

In line with the resource-based view of the firm (Penrose 1959), there is broad theoretical reasoning that firm-specific investments in innovation and R&D raise competence and open up growth opportunities (Aghion and Howitt 1992; Geroski 2000; see Coad 2009 for a discussion). However, innovation in the early stage of the product lifecycle also raises uncertainty in the industry, as emphasized in the work by Gort and Klepper (1982). Empirical evidence on the innovation-growth relationship is mixed, primarily due to the time lag in translating new knowledge into new products or production processes to boost firm growth, and the measurement problems that complicate this research. For sales growth, a positive effect of innovation is found in developed economies (Geroski and Toker 1996; Roper 1997; Freel 2000). Coad and Rao (2008) discover a positive effect of innovativeness for high-growth firms in the upper tail of the distribution, not for the average firm's sales growth. For employment growth, the picture is more ambiguous. Product innovations generally have a positive impact on employment (Harrison et al. 2005 for four European countries; Benavente and Lauterbach 2008 for Chile; Calvo 2006 for Spain). But, process innovations may entail a labour-saving component and appear to have a negative (Harrison et al. 2005), positive (Calvo 2006) or have no impact on employment (Benavente and Lauterbach 2008 for Chile).

For developing countries, where a majority of firms are operating substantially below the technological frontier, firms' innovation efforts are primarily oriented towards absorbing, adapting, mastering and eventually improving technologies developed elsewhere. Several authors point to the importance of 'technological capabilities' of firms in developing countries with respect to the knowledge and skills—technical, managerial and institutional—necessary for firms to utilize equipment and technology efficiently (e.g., Enos 1992; Lall 1992; see also UNCTAD 1996 for an overview). Firms

build up these technological capabilities by engaging in a wide variety of activities, such as training of the workforce, investment in new vintage machinery and the use of ICT, technology licensing from abroad, aimed at introducing products and production processes that are new to the firm, and reinforcing the firm's competitive position.

There is less empirical evidence on the effect of capabilities on growth for African countries, where the empirical literature has more focused on the human capital and sociological features of the entrepreneur (Bigsten and Söderbom 2006). Human capital variables appear to be systematic variables affecting firm growth, especially in the many small African firms where the entrepreneur has a dominant role in the development of the firm.

### **2.3 Entrepreneur characteristics**

A rich literature, summarized by Van Der Sluis, van Praag and Vijverberg (2004) and including evidence from at least 20 African countries, has investigated the impact of *schooling* and experience on entrepreneurial performance. They find evidence supporting the idea that more educated entrepreneurs show superior entrepreneurial performance. The impact of education on entrepreneurship selection is mixed, since higher education not only raises managerial ability, but also increases outside options for paid wage employment. Similar results are noted for Côte d'Ivoire (Goedhuys and Sleuwaegen 2000), where lower levels of education and vocational training seemed to positively influence the likelihood of being entrepreneurs versus wage workers, but higher education was needed for post-entry firm growth.

A number of studies also investigate the role played by *ethnic minority* entrepreneurs and, in particular, how they succeed in using their minority community networks of trust to overcome credit and information constraints, thereby reaching superior levels of entrepreneurial success (e.g., Mengistae 1999; Ramachandran and Shah 1999; Fisman 2003; Biggs and Shah 2006). Also Hewitt and Wield (1997) mention Asian businesses in the Tanzanian industry with 'access to sources of technology, which are not so easily available to other Tanzanian industrialists'.

Also the *gender* factor has increasingly received attention in the entrepreneurship literature. Despite a number of exceptions, only a small proportion of entrepreneurs in manufacturing are women and their businesses experience lower growth (McPherson 1996; Mead and Liedholm 1998; Goedhuys and Sleuwaegen 2000), pointing to additional barriers for women to engage in formal manufacturing ventures.

### **2.4 Resources**

Finally, the growth of firms in Africa is particularly constrained by factors related to the low level of development in input markets (Sleuwaegen and Goedhuys 2002). Tybout (2000) investigates the size distribution of firms in LDCs and concludes that the proliferation of very small firms results from a particular business environment characterized by small market sizes, low levels of human capital, lack of access to inputs, and poor infrastructure such as roads, ports, communication facilities and provision of energy. Poor transportation networks directly affect the costs of servicing distant markets and they are particularly limiting in the least developed, more agrarian economies, where consumers are spread throughout the countryside, resulting in small



pockets of demand in geographically diffuse markets. In instances where infrastructure services are missing or unreliable, some firms must produce their own power, transport and/or communication services (Tybout 2000). In addition, overregulation and corruption, political instability, uncertain macroeconomic conditions increase the risk level associated with entrepreneurship.

From this follows that the provision of a good transportation and communications network and availability of the necessary equipment at the firm level are key elements for widening the relevant market in which firms can grow. The market widening process will produce self-reinforcing effects for growth. If low transport and communication costs can be combined with scale economies in production and distribution, unit costs will decline and render goods affordable for more customers. Similarly, if the firm can efficiently reach more customers, network effects in demand may likewise stimulate extra growth. We expect these self-reinforcing effects to be significant for shifting the growth distribution upwards, but also in interaction with the unobservable factors, including firm-specific competence, we expect these factors to stretch the growth distribution to the right.

The next section presents the dataset used and compares the prevalence of HGFs in Africa with some European countries.

### **3 The prevalence of high-growth entrepreneurial firms in SSA countries**

#### **3.1 Data source**

To investigate the existence of high-growth firms in Africa and to identify the factors that foster them, we use recently collected firm-level data from the *World Bank Investment Climate Survey* (ICS).<sup>3</sup> The objective of the ICS is to obtain firm-level data that allow analysing the conditions for investment and enterprise growth in the respective countries. The survey was conducted in 2006 in the eleven selected African countries, using a harmonized questionnaire. This allowed pooling the datasets of the various countries, which generated a sufficiently large number of firms for conducting more advanced econometric analyses. For the purpose of our analysis, the survey contains historical data on employment for 2002 and 2005, which enable us to examine growth over a three-year period. In addition, it has interesting information on the background of the entrepreneur, technological characteristics of the firm and institutional constraints to growth.

After pooling the data from the eleven African countries, additional criteria were imposed to construct a sample of firms appropriate to the specific analysis. First, we selected only firms with at least five workers (leaving out informal firms with little growth potential) and a maximum of 500 workers, to reduce the impact of a few outliers. Second, only entrepreneurial firms were retained, i.e., firms owned and controlled by private individuals with majority ownership. We dropped publicly listed firms, state-owned or state-controlled firms and those with the majority owner having less than 50 per cent ownership. Third, only firms active in manufacturing were retained

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<sup>3</sup> For more information on the methodology and data collected by the *World Bank Investment Climate Survey*, see [www.enterprisesurveys.org](http://www.enterprisesurveys.org).

while firms in services and retail were dropped. This was done because the questionnaire used for retail and services firms was more limited and crucial information on technological capabilities was not asked. Finally, a few firms dropped out because they had missing information on variables crucial to our analysis.

This resulted in a unique firm-level dataset of 947 entrepreneurial firms with five to 500 employees, active in several manufacturing industries in eleven understudied SSA countries. The majority of firms are active in food processing (235 firms), followed by wood, wood products and furniture (205 firms); garments (154 firms) and metal and metal products (104 firms). Table 1 presents the composition of the sample by industry and country. It also gives a few macroeconomic indicators on population, national income per capita and performance of the manufacturing sector over time, to illustrate the diversity that characterizes the countries under study.

Table 1  
Composition of the sample, by country and industry

	Angola	Botswana	Burundi	Congo, D.R.	Gambia, The	Guinea	Guinea-Bissau	Namibia	Rwanda	Swaziland	Tanzania	Total
Food	52	8	16	38	3	19	10	7	16	8	58	235
Garments	13	16	19	18	4	31	1	1	2	7	42	154
Textiles	1	0	0	0	0	3	0	1	0	4	1	10
Machinery & equipment	1	1	0	0	0	0	0	3	0	1	1	7
Chemicals	1	4	7	9	0	1	0	1	5	4	12	44
Electronics	0	0	0	1	0	0	0	0	0	0	1	2
Non-metallic mineral products	1	2	1	4	0	6	0	1	0	0	5	20
Wood (products)	34	12	16	22	6	22	18	16	5	1	53	205
Metal (products)	24	6	5	8	9	14	4	9	3	1	21	104
Other manufacturing	18	23	17	16	5	9	6	24	7	17	24	166
Total	145	72	81	116	27	105	39	63	38	43	218	947
Macroeconomic indicators <sup>(a)</sup>												
Population <sup>(b)</sup> (in mil.)	15	2	7	56	1	9	2	2	9	1	38	
GNI/capita <sup>(c)</sup>	930	4,360	90	110	280	160	410	2,380	210	1,660	320	
Average annual % growth manufacturing												
1990-2000	-0.36	4.3	-8.0	-13.4	0.9	4.1	-2.0	2.6	-6.0	2.9	2.7	
2000-04	11.3	1.6	n.a.	n.a.	4.2	2.0	14.6	6.7	5.8	1.8	7.6	

Notes: <sup>(a)</sup> Source for macroeconomic indicators: World Bank (2006);

<sup>(b)</sup> data are for 2004;

<sup>(c)</sup> Given in US\$, 2004.

### 3.2 Defining high-growth firms in Africa

In order to trace high-growth entrepreneurship from the sample data, a variety of approaches can be used to define HGFs in the first place. The Global Entrepreneurship Monitor (2007), for instance, which includes South Africa, advances a very simple criterion for high-growth entrepreneurs, defining them as ‘established entrepreneurs who currently employ 20 or more employees’ (Autio 2007: 8), irrespective of how many years it took to reach this size. The idea behind this mere size criterion is that many firms never reach the size of 20 employees, and those that do, can be considered ‘high growth’.

Most approaches, however, develop a definition of HGFs based on growth rates. Two broad approaches can be identified for defining HGFs, one targeting a certain percentage or number of firms and defining as ‘high growth’, for example, 10 per cent of the highest growing firms. The other approach defines a level of growth above which firms can be defined as high growth, such as a 60 per cent growth in employment over three years, as is done by Hoffmann and Junge (2006). If the objective is to identify firms that grow the most and the conditions that affect this growth, then the second approach is preferable (Ahmad and Gonnard 2007). For our purpose of understanding the driving forces behind high-growth entrepreneurship in several African LDCs, this second approach is particularly appealing.

Following the second approach, high-growth firms are generally defined according to growth criterion in terms of employment, turnover, value added or a combination of these factors, as is done in the recent work by Acs, Parsons and Tracy (2008)<sup>4</sup> and Delmar, Davidsson and Gartner (2003). In order to account for the effect that very small businesses have dominant growth rates, the growth rate criterion either consists of an indicator combining the absolute growth with the relative growth rate, as done in the pioneering work by Birch (1987), or it is combined with a minimum size threshold at the beginning of the growth period.

Based on this latter approach, a simple definition recently proposed by OECD for the development of crosscountry indicators of HGFs, and presented in the Eurostat-OECD *Manual on Business Demography Statistics* (2007) considers as high-growth firms (Eurostat-OECD 2007: 61) as follows:

- ‘All enterprises with an average annualized growth greater than 20 per cent per annum, over a three year period [...]. Growth can be measured by the number of employees or by turnover’.
- ‘Ten employees in the beginning of the growth period’ is suggested as provisional size threshold.

The choice of the threshold levels for both growth rate and initial size is however an arbitrary one, based on convention more than on evidence (Eurostat-OECD 2007).

From the perspective of African countries, the use of employment as the measure of growth is very appropriate and socially relevant. It also limits the problems related to turnover and value added measures, which are expressed in monetary units, and may be affected by price changes in different countries. The threshold levels of initial size and growth rate may have to be relaxed somewhat. Due to the small size of entrepreneurial firms in many African economies, the threshold level of initial size in our study is set at more than five employees. The threshold level of the growth rate over the three-year period 2002-05 is set to a minimum average of 10 per cent per annum:

High-growth firms    >10 per cent annually, over the period 2002-05  
                                 > 5 employees 2002.

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<sup>4</sup> For instance Acs, Parsons and Tracy (2008) use a combination of two criteria: a 100 per cent turnover growth and an employment growth qualifier—the product of absolute and relative growth—larger than two, over a four year period, to define ‘high-impact firms’.

Given that high-growth businesses are typically young, an additional criterion related to the age of the firm is sometimes introduced. As such, following the guidelines of Eurostat-OECD (2007) 'gazelles' can be defined as a subset of high-growth firms, differentiated on the basis of age, where age is set by convention for the OECD as five years. In what follows we also investigate the existence of high-growth firms and gazelles, as the subset of high-growth businesses started in the period 2001-05, defined as:

Gazelles                      >10 per cent annually, over the period 2002-05  
                                         > 5 employees 2002  
                                         Established after 2000.

### **3.3 Differences across countries and industries**

Following the definition developed above, 205 out of 947 are high-growth firms, having increased employment by at least 30 per cent and having started with at least five employees (see Table 2). Only one-fourth of these are young firms, 'gazelles', established after 2000. Hence, the majority of high-growth firms in our sample are not the newest ventures: they have a mean age of eleven years, or thirteen when the gazelles are not included. HGFs seem to be well represented in food processing, the industry in which many African countries have a comparative advantage. A higher proportion of high-growth firms is found also in textiles and machinery and equipment, but the small number of firms in these industries does not allow us to draw any meaningful conclusions. Surprisingly, HGFs are found in small LDCs such as Rwanda, The Gambia, Guinea and Angola, and less in the richer economies of Botswana, Namibia and Swaziland.

Is the prevalence of HGFs in Sub-Saharan Africa comparable to other countries? Since we do not have data on the whole population of firms, but are limited to the evidence of the sample, we cannot answer this question fully. However, some evidence can be provided by using the country comparison by Hoffmann and Junge (2006), as presented by Ahmad and Gonnard (2007), and by applying a similar definition to our sample. They present proportions of HGFs for 17 developed economies, using as criteria: (i) growth exceeding 60 per cent over three years (over 20 per cent growth per annum), and (ii) firms with more than 15 employees. The proportion of firms in our sample that matches these criteria is shown in column 5 of Table 2. On average, 5.9 per cent of the firms are HGFs, a figure that compares favourably to Germany, Austria, Italy, the Netherlands, Norway and Poland, each with less than 2 per cent, and is equivalent to Japan, Switzerland, UK and US with HGFs representing 5-6 per cent. Only Korea exceeds with a 9.7 per cent share of HGFs.

Similarly, based on a 20 per cent yearly growth rate for three years and the ten-employee threshold, Petersen and Ahmad (2007) find the share of HGFs to vary between 3-5 per cent in several European countries. Applying a comparable definition to our sample generates an average of 8.7 per cent for HGFs. Clearly, the high rates for Africa may be inflated by the omission of the criterion of an annual minimum growth rate of 20 per cent (our criterion implied a minimum rate of 60 per cent over three years) and the use of sample data, but there is clear evidence that high-growth entrepreneurship is observed in LDCs, and its occurrence may not differ much from that observed in the OECD countries.

Table 2  
Proportions of HGFs in the sample

	High-growth <sup>(a)</sup>		Gazelles <sup>(b)</sup>		Hoffmann HGF <sup>(c)</sup>	Total no. of firms
	No.	%	No.	%	%	
Food	61	25.7	18	7.6	7.2	237
Garments	28	17.8	7	4.5	2.5	157
Textiles	3	27.3	1	9.1	0.0	11
Machinery & equipment	2	28.6	0	0.0	14.3	7
Chemicals	7	15.9	0	0.0	6.8	44
Electronics	0	0.0	0	0.0	0.0	2
Non-metallic mineral products	5	25.0	0	0.0	5.0	20
Wood (product), furniture	45	22.0	14	6.8	6.8	205
Metal (products)	17	16.4	4	3.9	1.9	104
Other man	37	22.2	7	4.2	8.4	167
Angola	37	25.5	16	11.0	6.2	145
Botswana	14	19.4	3	4.2	8.3	72
Burundi	11	13.6	3	3.7	3.7	81
Congo, D. R.	19	16.4	2	1.7	2.6	116
Gambia, The	9	33.3	4	14.8	3.7	27
Guinea	28	25.9	8	7.4	7.4	108
Guinea-Bissau	6	15.4	1	2.6	7.7	39
Namibia	11	17.5	1	1.6	7.9	63
Rwanda	16	42.1	3	7.9	13.1	38
Swaziland	9	20.0	3	6.7	2.2	45
Tanzania	45	20.5	7	3.2	5.5	220
Total	205	21.5	51	5.6	5.9	954

Notes: (a) Definition of HGFs: >30% employment growth over 2002-05 and >5 employees in 2002;  
(b) Definition of gazelles: HGFs, established in the period 2001-05;  
(c) Definition of HGFs following Hoffmann and Junge (2006): >60% employment growth over 2002-05 and >15 employees in 2002.

#### 4 Empirical analysis of the determinants of high-growth firms

In analysing the factors that generate high-growth firms, we do not limit the analysis by defining high-growth firms according to a strict arbitrary criterion on the required minimum level of growth. As we made clear in the previous section, using a strict criterion would have a strong *a priori* industry and country bias and therefore shows only a partial or biased view of the underlying process.<sup>5</sup> Instead, by using quantile regression, we opted for a more flexible approach in looking for the factors that significantly shift growth distribution upwards and/or generate growth distributions skewed to the right, generating a higher number of HGFs, whatever criteria is applied to their definition.

<sup>5</sup> Such analysis could consist of conducting a probit or logit regression explaining the incidence of HGFs—defined by arbitrary criteria—by a set of determining factors, as is done in Almus (2000).

## 4.1 Estimation methods

In line with earlier work, we model the growth of firms as a function of firm size and age and allow for the influence of a relevant set of factors that are related to the characteristics of the entrepreneur, the technological characteristics of the firm, and firm resources to deal with constraints originating from poor infrastructure, insecurity, transportation deficiencies and financial constraints. In addition, country-specific factors such as those related to the macroeconomic environment, country-specific demand conditions, performance of national innovation systems, or cultural differences are also expected to affect the growth perspectives of firms. The same holds for industry-wide influences that may affect firms active in the same industry, across nations.

Hence, the *model* corresponds to the following basic specification:

$$\begin{aligned} \text{Firm growth} = & a_0 + a_1 (\text{Employment 2002}) + a_2 (\text{Employment 2002})^2 + a_3 (\text{Firm age}) \\ & + a_4 (\text{Firm Age})^2 + a_5 (\text{Employment 2002}) * (\text{Firm age}) \\ & + \Sigma b (\text{Entrepreneur characteristics}) + \Sigma c (\text{Technological characteristics}) \\ & + \Sigma d (\text{Resources}) + \Sigma e (\text{Country dummies}) \\ & + \Sigma f (\text{Industry dummies}) + \varepsilon \end{aligned}$$

where the dependent variable corresponds to an average annual employment growth rate over the period 2002-05. The coefficients  $a_0$  to  $a_5$  are estimated, as are the coefficient vectors  $b$ ,  $c$ ,  $d$ ,  $e$ ,  $f$ , corresponding to a set of variables (see section 4.2) capturing respectively entrepreneur characteristics, technological characteristics, resources and country and industry dummies,  $\varepsilon$  is the stochastic error term.

Two different *estimation techniques* are applied in testing the model: least squares (LS) regression and quantile regression (QR). The LS estimator measures the effects of explanatory variables at the mean firm growth, assuming a well shaped normal distribution of growth around the mean. LS thus assumes that the explanatory variables (related to entrepreneur, firm and institutional characteristics) affect only the location of the conditional distribution of the firm growth rates, thus leaving the scale or shape of the firm growth distribution intact. If we represent the dependent variable firm growth by  $g$  and the explanatory variables, including the constant term, by a vector  $X$ , the LS estimator results from minimizing the sum of squared residuals, i.e., from minimizing the criterion function:

$$\sum_{i=1}^N (g_i - X_i b)^2$$

where  $i$  stands for the observations 1 to  $N$ ,  $b$  is the vector of estimated coefficients. LS thus estimates the mean effects of explanatory variables  $X_i$  on firm growth.

Quantile regression estimates the effects of the different explanatory variables at the different quantiles of the growth distribution, in our case deciles. Since the high-growth firms are located in the extreme tail of the conditional growth distributions, we are particularly interested in those factors that affect the upper deciles. Instead of

minimizing the sum of squared residuals, quantile regression coefficients result from minimizing the criterion function:

$$\sum_{i=1}^N \rho |g_i - X_i b| I(g_i \leq X_i b) + \sum_{i=1}^N (1 - \rho) |g_i - X_i b| I(g_i > X_i b)$$

where  $I(\cdot)$  is an indicator function taking the value of 1 if the condition in brackets is met and 0 otherwise, i.e.,  $I(g_i \leq X_i b) = 1$  if  $g_i \leq X_i b$  and  $I(g_i \leq X_i b) = 0$  if  $g_i > X_i b$  (as explained in Goedhuys Janz and Mohnen 2008).

The left term thus is a weighted sum of all negative residuals, i.e., the slower growing firms, while the right term is the weighted sum of all positive residuals, i.e., the fast growing firms.

$\rho$  is a weighting factor ranging from 0 to 1. In the special case where  $\rho = 0.5$ , both terms are equally weighted and minimizing the criterion function leads to the 50-per cent quantile. This constitutes the well-known least absolute deviation (LAD) which is less affected by outliers than other estimators such as the LS estimator.

If  $\rho = 0.10$ , the negative residuals in the left term have a lower weight than the positive residuals in the right term of the expression. Minimizing the criterion function will then lead to estimated coefficients whereby 90 per cent of the residuals are negative; by definition the 90 per cent quantile or upper decile of HGFs. Low growth firms can be examined setting  $\rho = 0.90$ . The positive residuals in the right term have lower weight than the negative residuals. Minimizing the criterion function will lead to estimated coefficients where 90 per cent of the residuals are positive, i.e., the distribution is evaluated at the 10 per cent quantile of first decile or slow growing firms.

## 4.2 Variables

The World Bank Investment Climate Survey contains a rich set of data to estimate the equation developed above. The dependent variable is the average annual employment growth rate, over the period 2002-05, calculated as the logarithm of employment in 2005, minus the log of employment in 2002, divided by three. Firm size is measured by employment in 2002, in logarithmic terms. Firm age is measured in 2006, also in logarithmic terms.

The first set of binary variables captures important characteristics of the entrepreneur. One variable for entrepreneurs of Lebanese, Indian, Middle Eastern or Asian origin is included, and one for entrepreneurs of European origin, the reference being entrepreneurs of African origin. There is a binary variable for female entrepreneurs. Influence of the educational background is captured by a binary variable equalling one if the manager has a graduate or postgraduate degree or diploma from a tertiary college; and one binary variable for managers who received higher education abroad.

Variables related to technological capabilities include binary variables for exporting firms, firms licensing technology from foreign-owned companies, firms offering formal training to the workforce and firms using a website to interact with clients and suppliers.

Table 3  
Reported constraints to the growth of businesses

	Major constraint	Constraint 2	Constraint 3	Constraint 4
Angola	Finance	Electricity	Crime	Corruption
Botswana	Finance	Macroeconomics	Skills	Land
Burundi	Electricity	Finance	Political instability	Macroeconomics
Gambia, The	Electricity	Finance	Taxes	Land
Guinea-Bissau	Finance	Electricity	Taxes	Political instability
Guinea	Electricity	Macroeconomics	Finance	Transport
Congo, R. D.	Electricity	Finance	Macroeconomics	Political instability
Namibia	Finance	Corruption	Macroeconomics	Taxes
Rwanda	Electricity	Taxes	Finance	Transport
Swaziland	Informal sector practice	Crime	Corruption	Finance
Tanzania	Electricity	Taxes	Finance	Informal sector practice

Product innovation is measured by a binary variable equalling one if firms introduced any new<sup>6</sup> or significantly improved products onto the market in the period 2002-05. Similarly, process innovation is captured by a binary variable for firms that introduced any new or significantly improved production processes, including methods of supplying services and ways of delivering products.

Finally, firms are confronted with growth barriers, the most constraining ones being the frequent electricity cuts and financial hardships. Entrepreneurs were asked to indicate the factors that most severely hampered the growth of the firm. These, as reported by the entrepreneurs, are presented in Table 3. Financial constraints, electricity cuts and political instability and macroeconomic adversity, corruption, crime, and transportation are among the most severe growth hampering factors, in line with the findings given in Tybout (2000).

Confronted with these obstacles, some firms may possess resources to invest in substitutes to relax the constraint. Four dummy variables are included to test whether these investments open up growth opportunities for the firms. These are: (i) whether the firm has a generator to substitute for inefficient electricity provision; (ii) whether they invest in their own security to deal with crime; (iii) whether they provide their own transportation facilities for shipments to customers, and (iv) whether they have access to flexible forms of bank credit through an overdraft facility.

Finally, the other frequently mentioned growth limitations, such as political instability, corruption and macroeconomic conditions, are country- or industry-specific, and captured by country and industry dummy variables.

Table 4 gives an overview of the definition of the variables and presents some summary statistics. The Appendix shows their correlation matrix.

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<sup>6</sup> 'New', defined as new-to-the-firm, largely captures the diffusion of technologies, and differs from new-to-the-market innovations that may be patentable.



Table 4  
Definition of variables and summary statistics

	Definition	Mean value (std dev.)
Dependent variables		
Firm growth	Average annual employment growth over the period 2002-05, calculated by $(\ln(\text{employment 2005}) - \ln(\text{employment 2002}))/3$	0.08 (0.15)
Entrepreneur characteristics		
D-European	= 1 for entrepreneurs of European origin	0.08
D-Asian/Middle Eastern	= 1 for entrepreneurs of Lebanese, Indian, Middle Eastern or Asian origin	0.13
D-Female	= 1 for female entrepreneurs	0.24
D-Higher education	= 1 if the manager has a graduate or postgraduate degree or diploma from tertiary college	0.41
D-Higher education abroad	= 1 if the manager has received higher education abroad	0.06
Firm characteristics		
Firm age	Age of the firm in 2006, in logarithmic terms	2.34 (0.64)
Employment	Number of employees in 2002, in log.	2.61 (1.12)
D-Exporting	= 1 if the firm exports in 2005	0.15
D-Technology licensing	= 1 if the firm uses technology licensed from a foreign-owned company	0.09
D-Website	= 1 if the firm uses a website to interact with clients and suppliers	0.12
D-Formal training	= 1 for a firm offering formal training to employees	0.28
D-Product innovation	= 1 if the firm has introduced any new or significantly improved products to the market (2002-05)	0.57
D-Process innovation	= 1 if the firm has introduced any new or significantly improved production processes, including methods of supplying services and ways of delivering products	0.43
D-Own generator	= 1 if the firm has its own generator	0.48
D-Own security	= 1 if the firm invests in security (alarms, guards)	0.58
D-Own transportation	= 1 if the firm uses own transport to make shipments to customers	0.43
D-Overdraft facility	= 1 if the firm has an overdraft facility with a formal bank	0.21

Note: = 1 implies the variable is a dummy variable equalling one if the condition is met, zero otherwise; For dummy variables, the proportion of firms is mentioned in the last column, for continuous variables the mean value is given, with standard deviation in parentheses. Mean firm age and size are 13 years of age and 31 employees in 2002, respectively.

### 4.3 Estimation results

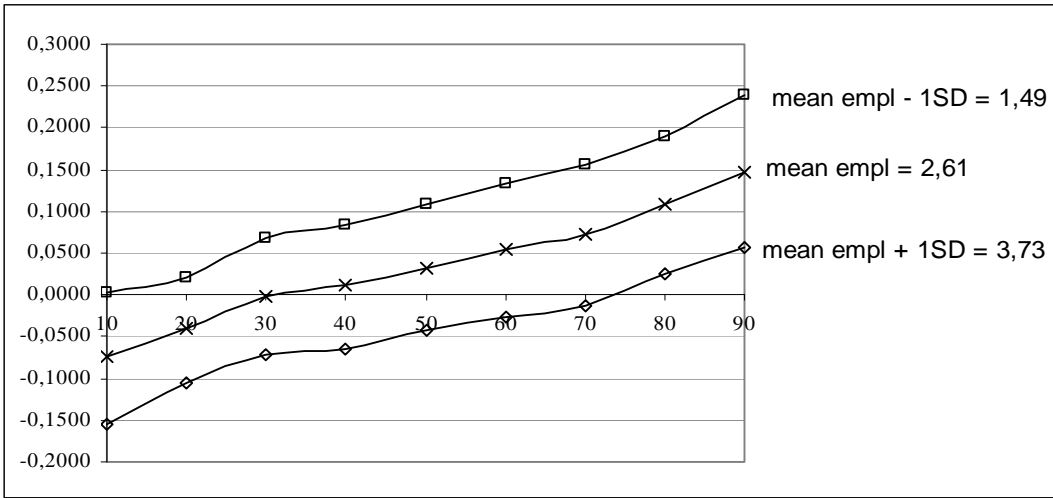
The estimation results are presented in Table 5. The first column gives the results of the least squares estimation, in other words the estimation of the ‘mean’ effects, or more precisely the marginal effect of the explanatory variables at the mean of the growth distribution. Columns 2-10 present the results of the quantile regression: the marginal effects at various deciles of the distribution. The reference group consists of firms in Tanzania, active in food processing, owned by male African entrepreneurs. Figure 1 shows for the reference case the size and age variables valued at their sample means, the corresponding values of the deciles of the growth distribution, varying from about -0.07 to +0.15 in the upper decile.

The results of the least squares estimation of the growth equation show that firm growth is negatively related to firm age, indicating that learning effects seem to be at work for young firms, as suggested by Jovanovic's learning models. However, while the least squares estimation assumes that all firms are similarly affected, it is clear that the negative age effect is found in the upper decile, compressing the growth distribution.

The relationship between firm size and firm growth is equally negative, implying that small firms grow faster than larger ones, a finding consistent with the results from other studies on both developing and developed countries. This negative relationship has become a stylized fact in the industrial economics literature. The LS estimation also reveals important non-linearities, as the squared size variable is positive and statistically significant. In addition to the growth rates for an average size firm, Figure 1 shows, for the reference case, the growth rates for a larger and a smaller value of firm size at the different quantiles. The upper curve shows the growth patterns for smaller firms (one standard deviation smaller), while the lower curve represents those for larger firms (one standard deviation larger). The effect of size on growth rate does not differ too drastically over the different quantiles (the curves are largely parallel), with a slightly more important effect in the upper decile.

Of particular interest are the effects of entrepreneur and firm characteristics on employment growth. The capabilities embodied in the entrepreneur appear to be related to the growth of the average firm. Entrepreneurs of Asian origin, show employment growth levels exceeding those of African entrepreneurs by about 3 percentage points. The effect appears to be concentrated around the median and lower tail of the distribution. This is in line with other studies on African minority entrepreneurs, which find these to exhibit superior firm performance, due to the advantages of minority networks that help them to share information and resources needed for doing business. The conditional growth distribution for European entrepreneurs tends to be more skewed to the right, hosting more high-growth firms, but using conventional t-tests, the difference fails to reach significance.

Figure 1  
 Estimated growth rate for the reference case, at various percentiles  
 and for various levels of employment (size)



Notes: Estimations are done at mean firm age (log(firm age)=2.34); and at the mean value of employment in logarithmic terms, and one standard deviation below and above the mean value. These values in logarithmic terms are 1.49, 2.61 and 3.73 and correspond to 4, 13 and 42 employees, respectively.

Table 5  
Results of the LS and QR estimation of the firm growth equation

Dep: firm growth 2002-05	LS	QR10	QR20	QR30	QR40	QR50	QR60	QR70	QR80	QR90
Employment 2002	-0.164*** (0.020)	-0.168*** (0.023)	-0.148*** (0.023)	-0.169*** (0.019)	-0.173*** (0.011)	-0.195*** (0.017)	-0.219*** (0.019)	-0.222*** (0.023)	-0.241*** (0.027)	-0.254*** (0.052)
Employment 2002, squared	0.006** (0.003)	0.012** (0.005)	0.014*** (0.004)	0.019*** (0.003)	0.020*** (0.002)	0.024*** (0.002)	0.026*** (0.002)	0.025*** (0.003)	0.029*** (0.003)	0.033*** (0.007)
Firm age	-0.100** (0.046)	0.089 (0.066)	0.010 (0.062)	-0.076* (0.046)	-0.073*** (0.026)	-0.059 (0.039)	-0.075* (0.041)	-0.108** (0.050)	-0.144*** (0.052)	-0.179* (0.092)
Firm age, squared	0.002 (0.010)	-0.030** (0.015)	-0.012 (0.013)	0.009 (0.010)	0.008 (0.006)	0.006 (0.008)	0.006 (0.008)	0.011 (0.010)	0.018* (0.011)	0.026 (0.020)
Firm age*employment 2002	0.022*** (0.006)	0.015** (0.007)	0.008 (0.007)	0.003 (0.006)	0.001 (0.004)	0.001 (0.005)	0.005 (0.006)	0.007 (0.007)	0.007 (0.007)	-0.000 (0.010)
Entrepreneur characteristics										
D-Asian/Middle Eastern	0.034** (0.014)	0.033** (0.016)	0.041** (0.017)	0.026** (0.013)	0.028*** (0.008)	0.023* (0.012)	0.029** (0.013)	0.027* (0.015)	0.013 (0.016)	-0.001 (0.026)
D-European	0.024 (0.016)	0.001 (0.018)	-0.002 (0.018)	0.007 (0.014)	0.000 (0.009)	-0.005 (0.014)	-0.004 (0.015)	0.014 (0.018)	0.028 (0.019)	0.015 (0.035)
D-Female	-0.007 (0.011)	-0.022* (0.012)	-0.012 (0.013)	-0.007 (0.010)	-0.002 (0.006)	0.000 (0.009)	0.015 (0.010)	0.013 (0.012)	0.014 (0.012)	0.000 (0.021)
D-Higher education	0.024** (0.010)	0.009 (0.012)	0.029** (0.012)	0.028*** (0.010)	0.025*** (0.006)	0.017* (0.009)	0.009 (0.009)	0.009 (0.011)	0.009 (0.012)	0.006 (0.020)
D-Higher education abroad	0.008 (0.020)	0.031 (0.024)	-0.007 (0.022)	0.010 (0.018)	0.002 (0.011)	0.017 (0.017)	0.020 (0.017)	0.016 (0.021)	0.008 (0.023)	-0.030 (0.035)
Technological activity										
D-Exporting	0.020 (0.013)	0.021 (0.014)	-0.001 (0.015)	-0.003 (0.012)	-0.003 (0.007)	-0.008 (0.011)	0.002 (0.012)	0.003 (0.014)	-0.005 (0.015)	0.002 (0.025)
D-Technology licensing	0.002 (0.016)	-0.022 (0.018)	-0.029 (0.019)	-0.027* (0.015)	-0.010 (0.009)	-0.008 (0.013)	-0.008 (0.014)	-0.015 (0.017)	-0.029 (0.018)	-0.030 (0.031)
D-Product innovation	0.024** (0.011)	-0.008 (0.012)	-0.000 (0.013)	-0.005 (0.010)	0.004 (0.006)	0.012 (0.009)	0.015 (0.010)	0.022* (0.012)	0.042*** (0.013)	0.062** (0.024)
D-Process innovation	-0.015 (0.011)	0.008 (0.012)	0.010 (0.013)	0.013 (0.010)	0.001 (0.006)	-0.000 (0.010)	0.000 (0.010)	-0.005 (0.013)	-0.024* (0.014)	-0.032 (0.026)
D-Formal training	0.023** (0.010)	0.014 (0.012)	0.012 (0.012)	0.010 (0.010)	0.015*** (0.006)	0.013 (0.009)	0.008 (0.009)	0.009 (0.011)	-0.004 (0.012)	-0.003 (0.020)
D-Website	0.025* (0.015)	0.013 (0.016)	0.037** (0.017)	0.019 (0.013)	0.012 (0.008)	0.013 (0.012)	0.019 (0.014)	0.028* (0.016)	0.035** (0.017)	0.018 (0.026)
Institutional factors										
D-Own generator	0.022** (0.010)	0.026** (0.012)	0.017 (0.012)	0.020** (0.009)	0.019*** (0.005)	0.020** (0.008)	0.021** (0.009)	0.018* (0.011)	0.018 (0.011)	0.014 (0.019)
D-Own security	0.005 (0.010)	0.008 (0.011)	-0.000 (0.012)	0.004 (0.009)	0.006 (0.005)	0.010 (0.008)	0.008 (0.009)	0.009 (0.011)	0.015 (0.011)	0.019 (0.020)
D-Own transportation	0.020** (0.010)	0.015 (0.012)	0.013 (0.013)	0.017* (0.010)	0.017*** (0.006)	0.027*** (0.009)	0.027*** (0.009)	0.025** (0.011)	0.038*** (0.012)	0.050** (0.020)
D-Overdraft facility	0.023* (0.012)	0.004 (0.014)	-0.011 (0.014)	-0.004 (0.011)	0.001 (0.007)	-0.001 (0.010)	-0.003 (0.011)	-0.007 (0.013)	-0.007 (0.014)	0.007 (0.023)

Table 5 (cont'd)  
Results of the LS and QR estimation of the firm growth equation

	LS	QR10	QR20	QR30	QR40	QR50	QR60	QR70	QR80	QR90
Country dummies										
Botswana	0.013 (0.019)	-0.009 (0.021)	-0.001 (0.022)	-0.008 (0.018)	-0.010 (0.010)	-0.020 (0.016)	-0.014 (0.017)	-0.008 (0.021)	-0.004 (0.022)	0.024 (0.033)
Burundi	-0.037** (0.017)	-0.002 (0.018)	0.012 (0.019)	-0.003 (0.016)	-0.009 (0.009)	-0.012 (0.014)	-0.013 (0.015)	-0.014 (0.018)	-0.019 (0.019)	-0.034 (0.034)
Gambia, The	0.020 (0.026)	0.023 (0.028)	0.051* (0.031)	0.034 (0.025)	0.018 (0.013)	0.024 (0.022)	0.013 (0.024)	0.026 (0.029)	0.036 (0.029)	0.006 (0.041)
Guinea-Bissau	-0.026 (0.022)	-0.055** (0.026)	-0.056** (0.027)	-0.056*** (0.021)	-0.050*** (0.012)	-0.043** (0.019)	-0.042** (0.020)	-0.014 (0.024)	-0.024 (0.026)	0.045 (0.045)
Guinea	-0.010 (0.015)	-0.031 (0.019)	0.011 (0.018)	0.003 (0.014)	-0.002 (0.008)	-0.011 (0.013)	-0.010 (0.014)	-0.004 (0.016)	-0.019 (0.018)	-0.005 (0.031)
Congo, D.R.	-0.019 (0.014)	-0.019 (0.016)	-0.022 (0.017)	-0.037*** (0.013)	-0.036*** (0.008)	-0.022* (0.012)	-0.014 (0.013)	-0.013 (0.016)	-0.010 (0.017)	-0.005 (0.029)
Namibia	0.002 (0.020)	0.019 (0.023)	0.030 (0.025)	0.029 (0.018)	0.023** (0.011)	0.012 (0.016)	0.005 (0.018)	0.009 (0.022)	0.010 (0.022)	0.009 (0.041)
Rwanda	0.037 (0.023)	-0.008 (0.025)	0.038 (0.027)	0.028 (0.021)	0.052*** (0.012)	0.053*** (0.019)	0.046** (0.020)	0.042* (0.025)	0.049* (0.027)	0.061 (0.044)
Swaziland	0.028 (0.023)	0.008 (0.024)	-0.008 (0.027)	-0.008 (0.021)	-0.007 (0.012)	-0.027 (0.019)	-0.012 (0.021)	0.036 (0.024)	0.013 (0.027)	-0.021 (0.046)
Industry dummies										
Garments	-0.009 (0.015)	0.011 (0.015)	0.005 (0.017)	0.007 (0.014)	0.009 (0.008)	0.007 (0.013)	-0.000 (0.013)	0.003 (0.016)	-0.008 (0.017)	-0.036 (0.030)
Textiles	-0.012 (0.043)	-0.008 (0.048)	-0.030 (0.039)	-0.025 (0.041)	-0.015 (0.023)	-0.018 (0.035)	-0.046 (0.038)	-0.015 (0.047)	-0.031 (0.041)	-0.095 (0.089)
Machinery and electronics	-0.090** (0.044)	-0.397*** (0.022)	-0.092** (0.045)	-0.010 (0.037)	-0.020 (0.023)	0.014 (0.036)	0.011 (0.038)	-0.009 (0.044)	-0.006 (0.043)	0.111*** (0.039)
Chemicals	0.002 (0.021)	0.005 (0.025)	0.005 (0.024)	0.002 (0.019)	0.001 (0.012)	-0.005 (0.018)	0.000 (0.019)	0.008 (0.023)	-0.014 (0.025)	-0.032 (0.043)
Mines	-0.002 (0.030)	0.023 (0.038)	0.011 (0.034)	0.016 (0.027)	0.009 (0.016)	0.004 (0.024)	0.003 (0.027)	-0.000 (0.032)	0.006 (0.036)	0.008 (0.053)
Wood	-0.009 (0.013)	-0.007 (0.015)	0.011 (0.015)	0.006 (0.012)	0.021*** (0.007)	0.013 (0.011)	0.013 (0.012)	0.008 (0.014)	0.011 (0.015)	0.007 (0.028)
Metal	-0.022 (0.016)	-0.007 (0.017)	0.006 (0.018)	-0.002 (0.014)	-0.007 (0.009)	0.008 (0.013)	0.003 (0.014)	-0.013 (0.017)	-0.024 (0.018)	-0.040 (0.032)
Other manufacturing	-0.003 (0.014)	0.001 (0.015)	0.000 (0.016)	-0.001 (0.012)	0.002 (0.007)	0.001 (0.012)	0.006 (0.012)	0.001 (0.015)	-0.006 (0.015)	0.028 (0.027)
Constant	0.495*** (0.061)	0.141* (0.073)	0.229*** (0.073)	0.392*** (0.057)	0.418*** (0.033)	0.444*** (0.052)	0.524*** (0.055)	0.594*** (0.069)	0.691*** (0.072)	0.810*** (0.124)
Observations	947	947	947	947	947	947	947	947	947	947
R-squared	0.29	0.14	0.07	0.11	0.16	0.17	0.19	0.21	0.22	0.26

Note: Standard errors in parentheses; \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.



In line with the literature discussed before, better educated entrepreneurs, with a graduate or postgraduate degree, raise the employment growth levels by 2 percentage points versus those with lower education. Quantile regression results suggest that the education effect impacts mainly on the lower part of the distribution, reducing the number of slowly growing firms. Training, on the other hand, has an effect concentrated around the mean and median of the distribution. No statistical differences are observed for the female entrepreneurs compared to their male competitors, except in the lowest decile. Firms of entrepreneurs who received a part of their education abroad, or had licensed technology, do not appear to grow differently from other enterprises.

More striking, firms that introduced new products or significantly improved products to the market grow stronger by 2 percentage points according to the LS estimation of the model. But, it is clear from the quantile regression that the disparity is much larger for the higher quantiles of the growth distribution where product innovation is associated with a 6 percentage-point rise in employment growth at the 90 percentile. Process innovation, apparently not affecting employment growth of the mean firm according to the least squares regression, influences firm growth in the upper tail of the growth distribution: at the 80 and 90 percentiles, it depresses growth rates by 2.4 percentage points and 3.2 percentage points, respectively. The effect of automated production process at the expense of employment could be observed here. These findings are in line with other studies that note a positive impact of product innovation and a negative impact (Harrison et al. 2005) or no impact (Benavente and Lauterbach 2008) of process innovation on employment growth. These authors argue that productivity increases resulting from process innovation may be compensated by ultimate price reductions in the goods, or they may be used defensively. Others (e.g., Klepper 1996) argue that in maturing industries when the number of producers declines, process innovation is more common among the survivors. It is clear that the measure of firm performance matters here and, as such, growth measured according to sales instead of employment might well reveal a different picture.

The effect of the transportation means is particularly interesting. The effect strongly supports the self-reinforcing economies it creates for growing firms. Firms that can expand their operations and thus lower unit costs by doing so, will benefit from even stronger growth if they have the transport facilities to widen their markets and reach more customers. The quantile regression results show that for firms with their own transport facilities, the growth distribution shifts to the right and becomes more skewed, generating more firms with high growth rates. This, to a lesser extent, also holds for the availability of a website, the virtual means of bridging distances and communicating with customers and suppliers.

Electricity supplemented with the possession of a generator has a more equal effect on the location and shape of the distribution curve, causing mean growth to increase by about 2 per cent. For overdraft credit facilities, only an average effect is observed following the results of the least squares regression.

Finally, the estimated effects for the country dummies that control for elements common to all firms in the same country indicate lower growth rates at the mean or at the lower quantiles in the quantile regression for countries where political instability was mentioned as one of the top four constraining factors (cf., Table 3). The industry effects point to a more stretched conditional growth distribution for the technology intensive machinery and electronics sectors with a lower mean in comparison to the traditional industries, suggesting a higher risk of doing business in those industries in SSA (see Table 5).

## 5 Discussion

Previous studies have examined firm growth as a systematic process within a well-defined supply demand growth framework. However, they generally overlook the wide dispersion of growth rates across firms characterizing firm growth. In this paper we have taken a different perspective and focus on the country, industry, firm and institutional factors influencing the mean level as well as the dispersion of firm growth rates in a wide set of SSA countries. The results yield some powerful insights on the factors affecting not only the location but also skewness of the conditional growth distributions, in relation to a set of firm characteristics and resources.

Firms that actively service their product markets—by successfully introducing new or significantly improved products and investing in own transportation for delivery or linking with clients through their own websites—show distributions skewed to the right. This implies that among these firms, the likelihood of a significant number of HGFs is much higher than among those lacking the resources to undertake this pro-active stance. If the aim of policymakers is to stimulate the number of high-growth firms, improving conditions to ease the access of firms to this infrastructure appears to be a very effective approach.

Similarly, our results point out that the provision of a good transportation network and availability of transportation are key elements in widening the relevant markets in which firms can grow. If low transport costs can be combined with scale economies in production, a self-reinforcing growth process may occur so that production in larger volume would reduce unit costs and render goods affordable for the more distant customers. Indeed, previous studies indicate that only a few firms in SSA countries produce on an efficient scale (Goedhuys and Sleuwaegen 2003). Bigsten and Söderbom (2006) acknowledge that the poorly developed transport infrastructure and unavailability of efficient transport are among the main reasons for the prevalence of small manufacturing firms in Africa, as it creates small pockets of demand that generate small-scale localized producers. This is confirmed by Eifert, Gelb and Ramachandran (2005) who show that African firms, in comparison to those in Asia, suffer from high indirect costs—costs for transport, logistics, telecom, water, electricity, land and buildings, marketing, accounting, security, and bribes—which depress their productivity.

Interestingly, a number of firm-specific human capital variables, including higher education of the manager, training of the labourforce, do not have a stretching effect, but a compressing effect instead on the distribution. Education is an important growth shifting variable for the ‘typical’ firm, causing a shift in the mean growth rate. This is also true for the possession of a generator that enables a firm to counter electricity cuts, as well as for flexible credit facilities for financing business operations. Hence, to stimulate the growth of firms in general, public intervention should aim to raise capabilities, through an improved educational system that upgrades the skills of both the entrepreneurs and the labourforce. At the same time, it is clear that electricity cuts and financial constraints have industry-wide effects, hence policies tackling these obstacles to firm development may also shift the entire employment growth distribution of firms.

Finally, it is important to point to some of the limitations of this study. First, the period over which growth is analysed is relatively short. A follow-up on the growth performance of firms over a longer period of time is therefore desirable. If extended



panel data become available, further analysis should investigate if there is a persistence of growth among the HGFs. Second, by expressing growth in terms of employment, there is a bias towards labour-intensive activities that overlooks most of the growth dynamics in value creation through the introduction of new processes, for instance, by means of licensing and other technology transfer mechanisms. Unfortunately, reliable and comparable value added data and other financial statistics are hard to collect for a wide representative set of firms in SSA countries. Case-study research presents itself as a useful complement to our study and should provide additional insights on the mechanisms of growth of African firms, including the many unobservable factors explaining the wide dispersion of growth rates found among those firms.

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Correlation matrix on core variables

	Growth	Firm age	Employe	D-Europe	D-Asian	D-Female	D-higher	D-educab	D-export	D-licensi	D-website
Growth	1.0000										
Firm age	-0.2582	1.0000									
Employment	-0.3960	0.2963	1.0000								
European	-0.0026	0.0479	0.1946	1.0000							
Asian/M.E.	-0.0370	0.1006	0.3449	-0.0579	1.0000						
Female	0.0383	-0.0398	-0.0294	0.0125	-0.0674	1.0000					
Higher edu	-0.0433	0.1157	0.4315	0.1622	0.2665	0.0337	1.0000				
Educ abroad	-0.0360	0.0786	0.2470	0.0964	0.1564	-0.0153	0.2874	1.0000			
D-exporting	-0.0125	0.0573	0.2694	0.1061	0.1107	-0.0049	0.1795	0.1381	1.0000		
D-licensing	-0.0372	0.0421	0.2143	0.0853	0.1394	-0.0314	0.1536	-0.0248	0.0655	1.0000	
D-website	-0.0080	0.0716	0.3368	0.1791	0.1852	0.0135	0.2716	0.1007	0.2350	0.1813	1.0000
D-training	-0.0133	0.0859	0.2689	0.0699	0.0903	0.0594	0.2226	0.1285	0.1382	0.1510	0.2292
D-product	0.0864	0.0047	0.0471	0.0305	0.0323	0.1215	0.0481	-0.0129	0.0945	0.1263	0.1121
D-process	-0.0118	0.0632	0.1864	0.0037	0.0545	0.0744	0.1428	0.0436	0.1038	0.2030	0.1380
D-generator	-0.0077	0.0567	0.2579	0.0361	0.1997	-0.0253	0.1802	0.0661	0.0509	0.0960	0.2070
D-security	-0.0639	0.0814	0.3671	0.1396	0.1502	0.1126	0.2742	0.1217	0.1390	0.1873	0.2166
D-transport	0.0072	0.0764	0.3390	0.0961	0.2638	0.0532	0.2795	0.1460	0.1332	0.1567	0.2370
D-overdraft	-0.0300	0.1079	0.3642	0.1711	0.1217	0.0758	0.2675	0.1791	0.1875	0.1137	0.1479

	D-traini	D-produc	D-proces	D-genera	D-securi	D-transp	D-overdr
D-training	1.0000						
D-product	0.1295	1.0000					
D-process	0.1811	0.5768	1.0000				
D-generator	0.0294	0.1069	0.1209	1.0000			
D-security	0.1759	0.1120	0.2415	0.1256	1.0000		
D-transport	0.0989	0.1183	0.2397	0.1828	0.3252	1.0000	
D-overdraft	0.1100	0.0587	0.1755	0.0304	0.2800	0.3042	1.0000



