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## Firm growth: Empirical analysis

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# PAPERS on Economics & Evolution



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# 1002

**Firm growth: empirical analysis**

**by**

**Alex Coad  
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# Firm growth: empirical analysis

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February 24, 2010

## Abstract

Recent research has led to the empirical regularity that firm growth rate distributions are heavy tailed. This finding implies that a few firms experience spectacular growth rates and decline, but that most firms have marginal growth rates. The literature on high growth firms shows that high growth firms are the central drivers of job creation in the economy but that these firms are neither clustered in high technology sectors nor are these firms necessarily young and small. The evidence on the determinants of firm growth confirms that firm growth is difficult to predict. The finding that firm growth is well approximated by a random process does not only reflect the heterogeneity at the firm level but is also associated with the low persistence of growth rates over time.

This paper is a first draft for an entry in the Handbook on the Economics and Theory of the Firm (M. Dietrich and J. Krafft, eds) Edward Elgar - Comments are welcome.

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## 1 Introduction

Firm growth and decline is at the core of economic dynamics. There is interest in the determinants of firm growth, both for individual businesses (who might be interested in sales growth) and also policy-makers (who are interested in job creation). With the availability of representative and comprehensive data sets the empirical literature on firm growth flourished. As a result, much work has been done, usually taking the form of regressions in which the growth rate of a firm is the dependent variable, and attempts are made to explain this in terms of a long list of other variables. This new literature on firm growth shows that firm growth is highly idiosyncratic and difficult to predict. At the same time new empirical regularities were discovered, such as the finding that growth rate distributions follow a ‘tent-shaped’ pattern.

The survey starts with definitions of firm growth used in the empirical literature, before discussing the growth rate distribution and research into the determinants of growth rates. We also discuss the contribution of fast-growth firms to economic growth.

## 2 Measuring firm growth

The number of possible indicators of firm size is rather vast. Most commonly employment, total sales are used in empirical analysis (Delmar, 1997). Sometimes asset growth is used as growth indicator. However, measuring growth in assets may be problematic for measuring firm size in industries where intangible assets are important for the process of economic growth and where firms in the sample have very different capital intensities. While sales growth may mirror best the short- and long-term changes in the firm and may be the most common indicator to measure growth by managers and entrepreneurs, employment has advantages as an indicator of firm growth. First, sales may overstate the size of the firm as sales does not only reflect the value-added of a company but also input prices. Second, measuring size in terms of employment reduces measurement problems compared to financial measures such as sales, as it does not require deflation. Thus measuring firm size in employment is useful in multi-industry and cross-country analyses. Third, for measuring the growth of small firms employment may be more robust to the manipulation of reported sales and profits. Cressy (2006) notes that small businesses are notorious for concealing true profits from the tax authorities for income or corporation tax purposes. On the other hand, indivisibilities are substantial for very small firms with only a few employees.

There are two basic approaches to measure growth: absolute or relative. Measures of absolute growth examine the actual difference in firm size. Absolute growth is used relatively frequently in the literature on the growth of small entrepreneurial firms, while growth rates are predominantly used in the industrial organization and the labour economics literature. Growth rates refer to relative changes in size. The most common way of measuring proportional growth is by taking log-differences of size. Proportional growth is measured as:

$$g_{i,t} = \frac{S_{i,t} - S_{i,t-1}}{S_{i,t-1}} = \frac{S_{i,t}}{S_{i,t-1}} - 1$$

where  $S_{i,t}$  is the size of firm  $i$  at time  $t$ . Taking logs we obtain:

$$\log(g_{i,t}) = \log(S_{i,t}) - \log(S_{i,t-1}). \quad (1)$$

An advantage of using log-differences vs. growth in percentage terms is that econometric results are less affected by heteroscedasticity. Measuring growth in absolute or relative terms can lead to different results (Almus, 2002; Shepherd and Wiklund, 2009). Measures of absolute and proportional growth are biased towards larger and smaller firms, respectively. To reduce the impact of firm size on the growth indicator Birch (1987) and Schreyer (2000) used a combination of both the relative and absolute growth rates. This growth indicator, also known as the ‘Birch index,’ can be presented as:

$$m = (E_{it} - E_{it-1}) \left( \frac{E_{it}}{E_{it-1}} \right) \quad (2)$$

where  $E_{i,t}$  is the employment of firm  $i$  at time  $t$ .

Firms can grow organically through expansion of their activities or by acquiring already existing firms. Growth by organic expansion and growth by acquisition are likely to be different both in terms of the processes underlying the types of growth and the economic implications (Davidsson and Wiklund, 2000). In a study of high-growth firms Davidsson and Delmar (2006) show that for younger and smaller high-growth firms most of the growth is organic, while for larger and older firms most of the expansion comes from growth by acquisition.

This short survey shows that there is not one single best way of measuring growth in terms of size indicator and growth measure. The choice of the appropriate way of measuring firm growth depends on the industry under consideration and the research question (Davidsson and Wiklund, 2000). In the remainder of this survey we focus primarily on the literature using relative growth rates. Hence the term growth in this chapter will refer to a proportionate change in some firm-level variable like employment or sales.

### 3 The Growth rate distribution

Having discussed how growth rates are measured, we now investigate the properties of the growth rate distribution. A relatively recent finding is that the Laplace (or symmetric exponential) distribution is a good approximation to the empirical density (Stanley, Amaral, Buldyrev, Havlin, Leschhorn, Maass, Salinger, and Stanley, 1996; Bottazzi and Secchi, 2006). While most firms hardly grow at all, a handful of firms experience very large growth rates.

Figure 1 shows the distribution of the growth rates of sales (left) and employment (right). Most firms have a growth rate close to zero, while a small number of firms experience accelerated growth and decline. The familiar ‘tent-shaped’ distribution of growth rates has been found in datasets from a number of countries, industries and years, making it a robust feature of the firm growth process. Indeed, even in a recession in a declining industry, there will always be some firms growing fast and others simultaneously experiencing fast decline.

When firm growth rates are calculated as growth rates, small firms are observed to grow particularly fast, with a higher growth rate variance than for larger firms. For example, it is easier for a firm of 5 employees to experience a growth rate of 100% (i.e. grow to 10 employees in the following year), than for a firm of 500 employees to grow by 100% by taking on an additional 500 employees. As a result, the growth rate distributions observed in samples of small firms are even more heavy-tailed than the

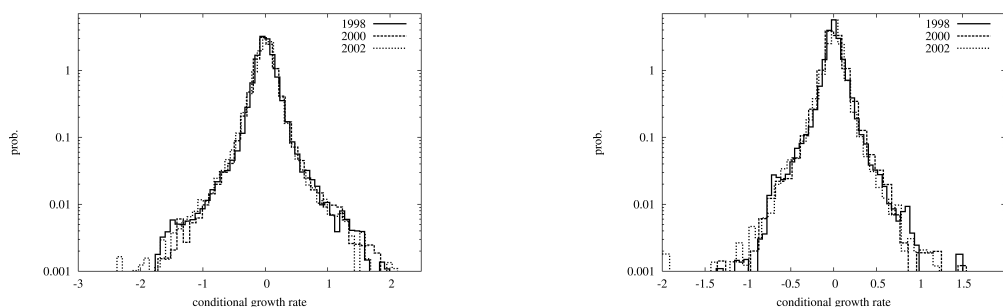


Figure 1: Growth rate distributions.

Left: distribution of sales growth rates of French manufacturing firms (Bottazzi, Coad, Jacoby, and Secchi, 2010). Right: distribution of employment growth rates of French manufacturing firms (Coad, 2007a). Note the log scale on the  $y$ -axis.

Laplace (Fu, Pammolli, Buldyrev, Riccaboni, Matia, Yamasaki, and Stanley, 2005; Coad and Hözl, 2009).

Higson, Holly, and Kattuman (2002), Higson, Holly, Kattuman, and Platis (2004) and Döpke, Funke, Holly, and Weber (2005) study the evolution of the cross sectional distribution of the growth rate of sales for large US, UK and German firms over the business cycle. They observe that the distribution remains heavy tailed but that the moments of the distribution of sales growth have cyclical patterns. The mean and kurtosis are procyclical while standard deviation and skewness are countercyclical. By performing an analysis on growth quantiles they are able to explain the countercyclical variations. Similar findings were obtained by Hözl and Huber (2009) for the distribution of job creation rates in Austria. They confirm that firms experiencing extreme growth events are largely unaffected by the business cycle while firms located at the center of the growth rate distribution react strongest to the business cycle. In addition Hözl and Huber (2009) show that that job creation and job destruction react in an asymmetric way to cyclical variation. In upswings a larger share of firms changes employment levels than in downswings.

## 4 Gibrat's Law

In this section we begin by presenting Gibrat's stochastic model of firm growth that has proven to be a useful benchmark for empirical work. We then discuss empirical investigations into Gibrat's Law, which holds that growth rates are independent of firm size. While Gibrat's Law assumes that annual growth rates are independent, we present evidence that growth rates are slightly autocorrelated over time.

### 4.1 Gibrat's model

Empirical investigations into firm growth have been guided by a simple stochastic model devised by Gibrat (1931), who observed the lognormal firm size distribution<sup>1</sup>

<sup>1</sup>For surveys of the firm size distribution, see de Wit (2005) and (Coad, 2009, Chapter 2).

and then proposed a model of firm growth capable of reproducing this distribution.

Gibrat's model of firm growth can be presented as follows. Let  $x_t$  be the size of a firm at time  $t$ , and let  $\varepsilon_t$  be random variable representing an iid idiosyncratic, multiplicative growth shock over the period  $t - 1$  to  $t$ , with mean  $\bar{\varepsilon}$ . We have

$$x_t - x_{t-1} = \varepsilon_t x_{t-1} \quad (3)$$

which can be developed to obtain:

$$x_t = (1 + \varepsilon_t)x_{t-1} = x_0(1 + \varepsilon_1)(1 + \varepsilon_2) \dots (1 + \varepsilon_t) \quad (4)$$

It is then possible to take logarithms in order to approximate  $\log(1 + \varepsilon_t)$  by  $\varepsilon_t$  to obtain<sup>2</sup>

$$\log(x_t) \approx \log(x_0) + \varepsilon_1 + \varepsilon_2 + \dots + \varepsilon_t = \log(x_0) + \sum_{s=1}^t \varepsilon_s \quad (5)$$

In the limit, as  $t$  becomes large, the  $\log(x_0)$  term will become insignificant, and we obtain:

$$\log(x_t) \approx \sum_{s=1}^t \varepsilon_s \quad (6)$$

Central Limit Theorem implies that  $\log(x_t)$  is normally distributed, which means that firm size (i.e.  $x_t$ ) is lognormally distributed.

Gibrat's model therefore 'explains' growth events in terms of purely random shocks. This model has become the workhorse of empirical research into firm growth, because random growth is taken as a null hypothesis in attempts to discover factors that systematically affect firm growth rates. Although empirical work has made progress in our understanding of the determinants of growth rates, Gibrat's model remains a useful benchmark of the growth process for a population of firms.

## 4.2 Size and age

Gibrat's stochastic model of firm growth led to what is known as Gibrat's Law, which holds that firm growth rates are independent of firm size. Gibrat's law is often observed to fail, under closer examination, because of a negative dependence of growth rates on size: smaller and younger firms have higher expected growth rates than older and larger firms (some classic references include Mansfield 1962, Singh and Whittington 1975, Hall 1987, Evans 1987a,b, Hart and Oulton 1996, see also Lotti, Santarelli, and Vivarelli 2003 and Coad 2009, Chapter 4 for surveys). However, some authors have suggested that a negative dependence of growth rates on size holds only for samples of small firms, while growth rates are independent of size for large firms above a certain size threshold (Hart and Oulton, 1996). Given the close relationship between firm size and firm age, researchers have also considered the effect of firm age on expected growth rate. A firm's age has also been observed to have an influence on its growth, with the majority of studies reporting that older firms experience slower growth (see among others Evans 1987a and Dunne and Hughes 1994). Lotti,

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<sup>2</sup>This logarithmic approximation is only justified if  $\varepsilon_t$  is 'small' enough (i.e. close to zero), which can be reasonably assumed by taking a short time period (Sutton, 1997).

Santarelli, and Vivarelli (2008) show that Gibrat's law cannot be rejected once they account for learning and selection processes of young small firms.<sup>3</sup> Caves (1998) concludes his survey of the topic by writing that, above a certain size threshold, the negative relation between size and growth disappears.

### 4.3 The persistence of high growth

One difficulty in investigating Gibrat's Law, and measuring the impact of size on growth rates, is the fact that annual growth rates are autocorrelated (Chesher, 1979). Some early studies focusing on samples of large firms found a positive autocorrelation in annual growth rates, in the order of around +30% (Ijiri and Simon, 1967; Singh and Whittington, 1975). More recently, however, work on larger samples has found autocorrelation that is smaller in magnitude (Kumar, 1985; Dunne and Hughes, 1994), and often even taking negative values (Goddard, Wilson, and Blandon, 2002; Bottazzi, Cefis, Dosi, and Secchi, 2007). Capasso, Cefis, and Frenken (2009) highlight the heterogeneity of growth behavior by pointing out that some persistent high-growth firms coexist with firms that have one-time extreme growth events. More specifically, it seems that the growth of small firms is a rather erratic phenomenon characterised by negative autocorrelation in annual growth rates, whereas the expansion of larger firms is much smoother, displaying positive autocorrelation (Coad, 2007a). Indeed, small firms that grew very fast in the previous period are particularly unlikely to repeat this growth performance (Coad, 2007a; Coad and Hözl, 2009). For longer time horizons the autocorrelation of growth rates vanishes. Controlling for growth rate autocorrelation does not lead us to reject the negative relationship between size and growth rate, however.

## 5 Determinants of firm growth

Gibrat's model of firm growth presented in Section 4.1 is provocative in the sense that it sets a challenge to empirical researchers to find regularities in firm growth rates that would allow us to go beyond this purely random benchmark. We have already seen how growth rates vary with firm size and age. In this section we summarize the other main factors that have been put forward as determinants of firm growth, such as innovation and financial performance.

### 5.1 Innovation and growth

A number of theoretical models have posited a positive relationship between innovation and firm growth. Empirical work into firm-level innovation has investigated these intuitions, usually measuring innovation in terms of R&D expenditure, number of patents owned by the firm, or in terms of responses to innovation questionnaires such as the CIS surveys. Empirical work on the matter has had difficulty confirming the theoretical intuitions, however. On average, innovation doesn't have much of an

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<sup>3</sup>In a similar vein Pfaffermayer (2007) provides evidence for the fact that the predicted variance in firm size decreases for younger firms once sample selection is taken into account. For the older age cohorts the hypothesis of no change in the variance either cannot be rejected or increasing variances are found in accordance with a Gibrat's law behaviour.



impact for firm growth, and some studies fail to find a significant effect of innovation on subsequent growth of sales (Bottazzi, Dosi, Lippi, Pammolli, and Riccaboni, 2001; Geroski, Machin, and Walters, 1997). One explanation for this lack of empirical confirmation can be given by referring to the growth rate distributions discussed in Section 3 – we observed that the average firm doesn't grow by very much, and so it might not be useful to search for the determinants of growth of the average firm. Instead, we should go beyond the average to look at the determinants of growth for the fastest growing firms. Empirical results from quantile regressions has shown that, while innovation has a limited impact on the sales growth rates of average firms, it is much more important for the fastest-growing firms (Coad and Rao 2008; Hözl 2009; Goedhuys and Sleuwaegen 2009, see also Stam and Wennberg 2009). This characterization of the relationship between innovation and firm growth is consistent with the characterization of innovation as a highly uncertain activity, with the returns to innovation being remarkably unequal (some firms benefit greatly from innovation while many others are less fortunate).

Another facet of the relationship between innovation and firm growth concerns the phenomenon of technological unemployment – whether innovative firms have a lower demand for labour because they apply new technologies (such as robots) to reduce their labour requirements. The aggregate analysis of the impact of technical change on employment is particularly tricky, however. There may well be many indirect feedback effects operating through numerous 'substitution channels' – for instance, new technologies may lead to changes in employment elsewhere in the economy (upstream sectors), and they may affect demand by lowering prices, or increasing wages and investment (more on this can be found in Spiezia and Vivarelli 2000). That said, investigations at the firm-level have generally found a positive influence of innovation on employment growth. Many authors have found it useful to distinguish between product innovation, which is usually associated with employment creation via increased demand, and process innovation, which is often characterised as labour-saving. While process innovation is usually found to be associated with employment growth at the firm-level, the effect of process innovation is less clear, being associated with job destruction in some cases (Harrison, Jaumandreu, Mairesse, and Peters, 2005; Hall, Lotti, and Mairesse, 2008).

## 5.2 Profits and growth

A large number of theoretical models take it for granted that the more profitable firms will grow while less profitable firms will decline (for some prominent examples, see Friedman 1953 and Nelson and Winter 1982). In this view, selection pressures operate to redistribute market share to the more profitable firms. Indeed, one would expect that profitable firms have not only the *means* to finance expansion, but also the *motivation* to grow, since they can obtain a larger amount of profits from a larger sales base. It is puzzling, therefore, that empirical work only offers weak support to this idea. Growth rates do not seem to increase with profits. It is also surprising that this issue has not received much attention in empirical work despite the theoretical interest in the relationship.

To begin with, it has been observed that, while profit rates are heterogeneous across firms, they display a high degree of persistence Mueller (1977); Dosi (2007), while firm growth rates do not display much persistence. This in itself leads us to question the expected relationship between profits and growth (Geroski and Mazzu-

cato, 2002). Further investigation based on regression analysis has generally shown that firm growth rates cannot be explained in terms of financial performance, whether the latter is measured in terms of profit rates (Coad, 2007b; Bottazzi, Secchi, and Tamagni, 2008) or growth rates of the amount of profits (Coad, 2010; Coad and Rao, 2010). While there may be a statistically significant relationship between financial performance and growth, the magnitude of the effect is so low that it would be a valid approximation to view the two variables as independent. Furthermore, advanced econometric techniques also show that profits have a negligible *causal* effect on firm growth rates (Coad, 2007b; Moneta, Entner, Hoyer, and Coad, 2010). Instead, it appears that growth has more of a positive effect on profits, than does profits on growth (Coad, 2007b, 2010).

This puzzling absence of the expected relationship between profits and firm growth seems to us to be one of the most pressing challenges for empirical work on firm growth. Whence this chasm between theoretical intuitions and empirical findings? It seems that financial performance has little effect on growth (measured in terms of either employment or sales) even in subsamples of younger or older firms, in subsamples of shrinking and growing firms, and also when specific industries and years are considered. Just as fluctuations in market value are difficult to predict, it is also difficult to predict firm growth. (However, although firm growth and market value are both indicators of relative performance, firm growth is not strongly related to market value (Geroski, Machin, and Walters, 1997)). More work would be welcome in making the empirical results match the theory, and also of course in making the theory match the data.

### 5.3 Productivity and growth

The relationship between productivity and growth has also featured in a number of theoretical contributions, in particular models of evolutionary flavour that essentially posit that an economy's productive resources are reallocated from less productive to more productive firms.<sup>4</sup> For example, Metcalfe (1994) presents a model in which firm growth is related to productivity, while the extended model in Metcalfe (2007) explains growth not only in terms of productivity but also growth aspirations.

Productivity and profitability are two closely related variables, and empirical work finds a close relation between the two (Bottazzi, Secchi, and Tamagni, 2008). It might come as no surprise, therefore, to observe that productivity has only a negligible influence on firm growth rates (Bottazzi, Secchi, and Tamagni, 2008).

Some results from international comparisons suggest a slightly higher positive relationship between productivity and growth in the US than in Europe, which can be interpreted in terms of a more efficient market selection effect in the US (Aghion, Bartelsman, Perotti, and Scarpetta, 2008).

### 5.4 Other determinants of firm growth

#### 5.4.1 Firm-level variables

A number of other factors have been identified and investigated as being associated with firm growth rates. Some of these factors concern the personality of the en-

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<sup>4</sup>Note however that some authors suggest that selection forces operate on firms with reference to profitability rather than productivity (Foster, Haltiwanger, and Syverson, 2008).

trepreneur. For example, the education of the entrepreneur has been observed to have a positive effect on a firm's growth rate (McPherson, 1996; Mead and Liedholm, 1998). The sex of the entrepreneur may also play a role, because firms led by female entrepreneurs have been observed to experience slower growth (see Mead and Liedholm 1998 for a survey).

Some other characteristics of the firm have been linked to growth rates. Evidence suggests that higher growth rates can be expected for multiplant firms (Variyam and Kraybill, 1992; Coad, 2008), for limited liability firms (Harhoff, Stahl, and Woywode, 1998), and also for exporting firms (Robson and Bennett, 2000). On the other hand, government-owned firms seem to grow more slowly (Beck, Demirguc-Kunt, and Maksimovic, 2005). The effect of foreign ownership is ambiguous and depends on the type of FDI (foreign direct investment; either greenfield or acquisition), learning effects and country of origin of the firm (Bellak, 2004).

It is also interesting to consider that managerial growth aspirations do not go very far in explaining variation in firm growth rates across firms. Wiklund and Shepherd (2003) find a small positive relationship between growth aspiration and growth rate, but the magnitude of this effect rises somewhat if growth aspirations are interacted with the entrepreneur's education and experience. Stam and Wennberg (2009) find that growth aspirations are positively and significantly associated with the growth of low-tech firms, but not for high-tech firms. These results indicate that even a strong desire for growth is not a sufficient requirement for actually achieving high growth rates. Instead, growth would appear to be the combination of both a readiness to grow and also the availability of growth opportunities and managerial resources (Penrose, 1959).

#### 5.4.2 Industry-level variables

At the industry level, Audretsch (1995) reports a positive correlation between the minimum efficient scale (MES) and the growth of new firms. The degree of competition faced by firms is not always observed to have an impact on growth rates (Geroski and Gugler, 2004). Interestingly enough, Sutton (2007) shows that the growth rate of an industry leader is virtually independent of the growth rate of the second largest firm in the same industry.

#### 5.4.3 Macroeconomic variables

The interaction between firm level growth dynamics and macroeconomic developments over the business cycle has received considerable attention over the last two decades. Modern business cycle theory highlights the importance of the distribution of variables at the microeconomic level for macroeconomic dynamics (e.g. Caballero and Hammour 1994). The availability of micro-data allowed to make inferences about the structure and nature of industrial dynamics over the business cycle. The main lesson from this literature is that heterogeneity at the firm level dominates. Employment adjustment at the firm and plant level is lumpy and occasional (see for example Davis, Haltiwanger, and Schuh 1996b). Nilsen and Schiantarelli (2003) provide evidence that fixed costs to employment adjustment do not vary with firm size. Therefore, smaller firms have lower adjustment frequencies than larger firms and react less strongly to changes in macroeconomic conditions. This has also confirmed by Hölzl and Huber (2009). Hardwick and Adams (2002) find some evidence

that smaller firms appear to grow relatively faster during booms, whereas larger firms grow faster during recessions and recoveries.

The evidence regarding secular trends in industrial dynamics is mixed. While Comin and Philippon (2006); Comin and Mulani (2006) document an increase in microeconomic volatility over the last decades for the US, Davis, Haltiwanger, Jarmin, and Miranda (2007) show that there is an important distinction between publicly traded and privately held firms. For the privately held firms that constitute the majority of US firms, Davis, Haltiwanger, Jarmin, and Miranda (2007) find a decline in the growth rate dispersion. Hölzl and Huber (2009) provide evidence that the microeconomic volatility increased in Austria.

Systematic comparative evidence across countries on the growth of firms is scarce. However, such evidence is necessary in order to assess the importance and working of institutions and regulation on the processes of firm growth. Geroski and Gugler (2004) show that the growth behaviour of large firms is not affected by the country of origin of the firms. Bartelsman, Haltiwanger, and Scarpetta (2009) document that while entry and exit dynamics and survival patterns seem to follow quite similar patterns across EU countries and the US, there are remarkable differences regarding the average post-entry performance of surviving firms across the US and EU-15 countries. Surviving US firms have on average a two or three time higher growth rate than European firms measured over a period of 7 years from entry. Aghion, Fally, and Scarpetta (2007) show that the development of the financial sector has an effect on average post-entry performance.

#### 5.4.4 Discussion

To summarize, then, many different factors have been included as explanatory variables in growth rate regressions. Although in many cases the effects might be statistically significant, we are still far from providing a thorough explanation of the growth rates experienced by firms. In statistical terms, this is made evident by the low  $R^2$  statistics obtained from regressions featuring growth rates as the dependent variable. The  $R^2$  usually takes values of around 5%, although in some cases it may reach up to 20-30% (see Coad 2009, Table 7.1 for a survey).

The limited success achieved in finding the determinants of growth rates reflects the difficulties in generalising across firms. Firms are indeed heterogeneous and differ from each other in many ways, including their growth patterns. However, even within firms it is difficult to find the determinants of growth rates. Longitudinal data reveals that the majority of the variance in growth rates is within individual firms over time, rather than between different firms. Geroski and Gugler (2004) decompose the variance of growth rates into within-variance and between-variance, and find that most of the variation (i.e. about 60%) is within individual firms over time. As a consequence, the challenge for future work is to explain growth rates in terms of variables that vary considerably for individual firms over time.

## 6 Fast growing firms

A large part of the empirical work on firm growth comes from the entrepreneurship and small firms literature. The growth of young firms is often associated with improved chances of survival as well as learning effects and productivity growth associated with the firms approaching an efficient scale of operations. These advantages

associated with growth are less important for larger firms. Within this field of research much attention has been attached to the phenomenon of high growth firms, also called gazelles. These have also received increasing attention from policy makers over the last decade. The special interest on these firms is motivated by the fact that they are perceived as important drivers of economic dynamics, diffusion of innovations and employment generation. In popular discussions of the superior innovative performance and job creation of innovative small firms, there are many references to high technology firms such as Google, Apple and Microsoft.<sup>5</sup> But the available evidence shows that high growth firms are found in all sectors of the economy and that there is no clustering in specific industries.

## 6.1 High-growth firms and employment generation

The research on the economic importance of fast growing firms grew out of the controversy regarding the contribution of small firms to job creation. Birch (1979, 1981) claimed that small and medium sized firm contributed a disproportionately large share to overall job creation in the US. These findings have been challenged most prominently by Davis, Haltiwanger, and Schuh (1996a,b) who claimed that these results were obtained by using a methodology subject to the regression fallacy that made it unsuitable for drawing conclusions about the relationship between employer size and job creation. Davis, Haltiwanger, and Schuh (1996a,b) found that small firms and plants had higher gross rates of job creation but lower rates of net job creation than large firms. The issue of methodology boils down to a vision of the competitive process (e.g. Schreyer 2000; Davidsson, Lindmark, and Olofsson 1998). The discussion primarily focused on the allocation of firms to size classes. In contrast to the methodology used by Birch (1987), which assigned firms to size classes according to their base-year size, Davis et al. (1996b) proposed using the firms average size for classification. Kirchoff and Greene (1998) have made a case that the appropriate methodology for assessing the dynamics of job generation and understanding the process of economic growth is to analyze the new employment created over time by cohorts of newly formed firms.

Henrekson and Johansson (2010) provide a survey of 19 studies that use a variety of methods to identify high growth firms.<sup>6</sup> They find despite all differences in method and measurement results that are remarkably robust to the details of definition of high growth firms, time period and coverage of firms. The following stylized facts emerge:

1. Gazelles, i.e. the few most rapidly growing firms create most new jobs within cohorts of firms of the same age.
2. In relation to aggregate numbers, such as total job growth in the economy, the results are less clear-cut. For some countries (especially the US), studies find

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<sup>5</sup>Note however that these are not examples of small firms but large firms! Had they remained small firms, they would have not have received as much attention. Indeed, the interest in the job creation of small firms is in those small firms that quickly stop being small.

<sup>6</sup>Some methods include, for example, the 10 % fastest growing firms (Schreyer, 2000) using the Birch index, firms doubling sales turnover in real terms between 1990 and 1997 (Littunen and Tohomu, 2003), firms growing more than 50 % between 1985 and 1999 (Halabisky, Dreessen, and Parsley, 2006) or average growth in employees greater than 20 % p.a. over a three-year period (Deschryvere, 2008).

that gazelles are the central driver of overall job generation, while other studies (especially for Scandinavian countries) find more moderate effects.<sup>7</sup>

3. Although most gazelles are SMEs, there is also an important subset of large gazelles. Acs, Parsons, and Tracy (2008) report for the US that gazelles account for the lion's share of employment and revenue growth in the economy. Job creation is almost evenly split between small firms (< 500 employees) and large firms (> 500 employees).
4. Gazelles tend to be younger than the average firm in the industry. However, Acs, Parsons, and Tracy (2008) report for the US that less than 10 percent of high impact firms were born in the previous four-year period, a fraction that is declining with firm size. They also found that the average high impact firm is around 25 years old when they make a significant impact on the economy.
5. There is no evidence to support the view that gazelles are overrepresented in high-tech industries. Gazelles exist in all industries. If anywhere, high growth firms are overrepresented in knowledge-intensive service industries (Almus, 2002; Henrekson and Johansson, 2010). Acs, Parsons, and Tracy (2008) compare the sectoral shares of US gazelles over three four-year periods and conclude that the percent of high growth firms varies significantly over time. This shows that being a high growth firm is primarily an economic and not a strictly technological phenomenon (Hölzl, 2009). Examples such as Red Bull and Starbucks show that innovative management can be an important source of competitive advantage.
6. Being a gazelle is a temporary phenomenon in the life of an enterprise (Hölzl, 2009), especially if they are small firms. Acs, Parsons, and Tracy (2008) and Coad and Hölzl (2009) report a significantly higher growth persistence for larger high growth firms. The available evidence shows that growth rate distribution is remarkable stable over time and the persistence of growth rates is low.

Overall the findings confirm that a small number of high-growth firms have a high impact on the economy. Overall job creation must be considered in the broader context of industrial dynamics. In order to provide some more intuition Table 1 reports the gross job creation, gross job destruction and net job creation for five-year periods for Austrian private sector employment. Gross job creation and destruction are derived from the net change in employment at the enterprise level between 1995 and 2000 (2000 and 2005). Firms that increased employment are allocated to gross job creation, and enterprises that decreased employment to gross job destruction. Firms that did not exist in 1995 (2000) are classified as entrants in the calculation of gross job creation. Firms that did exist in the year 1995 (2000) but no longer existed in the year 2000 (2005) are considered as exits. Entries accounted for more than 50 % of gross job creation and exits for more than 50 % of gross job destruction. Thus turbulence is a significant element in the process of job creation and job destruction. Surviving firms – those firms which exist in 1995 (2000) and survive to the end of the period in consideration – account for less than 50 % of gross job creation and gross job destruction.<sup>8</sup> If we consider the group of surviving firms, we find that the top 5 % of performers account for more than 75 % of the job creation of surviving firms

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<sup>7</sup>The numbers depend also on the method used to identify high growth firms.

<sup>8</sup>The contribution of firms that were set up later than 1995 (2000) and closed down before 2000 (2005) is not included in these numbers.

and the “bottom” 5 % for more than 70 % of the overall job destruction. Thus, both turbulence and gazelles are important for the creation of new jobs and that the job generation of surviving firms is heavily concentrated.

Table 1: The allocation of gross job creation and gross job destruction in the Austrian private sector between 1995 and 2000 and 1995 and 2005

	1995 – 2000	2000 – 2005	1995 – 2000	2000 – 2005
<i>Gross Job Creation</i>	<i>670,209</i>	<i>749,37</i>	<i>100.0</i>	<i>100.0</i>
Entries	350,070	434,019	52.2	57.9
Surviving firms	320,139	315,351	47.8	42.1
of which				
<i>top 5% Gazelles</i>	<i>248,847</i>	<i>242,461</i>	<i>37.1</i>	<i>32.4</i>
<i>Others</i>	<i>71,292</i>	<i>72,89</i>	<i>10.6</i>	<i>9.7</i>
<i>Gross Job Destruction</i>	<i>617,736</i>	<i>723,278</i>	<i>100.0</i>	<i>100.0</i>
Exits	320,113	463,978	51.8	64.1
Surviving firms	297,623	259,300	48.2	35.9
of which				
<i>bottom 5%</i>	<i>215,057</i>	<i>181,280</i>	<i>34.8</i>	<i>25.1</i>
<i>Others</i>	<i>82,566</i>	<i>78,020</i>	<i>13.4</i>	<i>10.8</i>
Net Job Creation	52,473	26,092		
of which				
<i>Surviving firms</i>	<i>22,516</i>	<i>56,051</i>		
<i>Turbulence</i>	<i>29,957</i>	<i>-29,149</i>		

Source: Hölzl, Huber, Kaniovski, and Peneder (2007)

Henrekson and Johansson (2010) claim on this basis that it is “misleading to narrowly focus on a particular piece of this process and to claim that it alone contributes a disproportionately large share of net job growth” (p. 15). Instead, in their view the dynamics of reallocation are based on the entire process of industrial dynamics. However, this view stands somewhat in conflict with a perspective on “turbulence” that refers to the evidence that there is a large number of firms of suboptimal size that enter and exit the markets (e.g. Hölzl and Reinstaller 2009). Indeed many sectors are characterized by a fringe of firms operating at a suboptimal scale with a low likelihood of survival where revolving door firms are constantly entering and exiting the market. In this context Santarelli and Vivarelli (2007) call for a distinction between “turbulence” and true “entrepreneurship” and remind us that Schumpeter (1926) already observed that the entry of new firms is due to large majority of “imitators” and a tiny minority of innovators.

## 6.2 Which firms grow fast?

In general, it is difficult to make *ex ante* predictions about which firms will experience fast growth. The available evidence points in the direction that high growth firms have a competitive edge over average firms that grow marginally (if they grow at

all). Some combination of innovative behaviour, managerial capacities and growth inclination is the basis for the success of high growth firms. However, given the importance of the phenomenon it is surprising how little is known about what makes are the determinants of high growth firms.

Firm strategies might play an important role. The concept of entrepreneurial orientation (EO) in the strategy literature has been conceptualized as strategy comprising three dimensions, innovativeness, “risk taking,” and proactiveness, that require extensive investments by a firm (Covin and Slevin, 1991). Empirically entrepreneurial orientation has been shown to be an important factor for the success of small firms (Wiklund, 1999; Wang, 2008). Management capacities are likely important determinants for the differences in firm performance. However, as the evidence presented in section 5 shows persistence in profitability and productivity do not translate into persistent growth. This is also confirmed by Parker, Storey, and van Witteloostuijn (2010) in their study of a sample of 100 UK high growth firms. They found that there is no evidence that firms that were gazelles over a period of 5 years are also gazelles in a period 5 years later. Nevertheless Parker, Storey, and van Witteloostuijn (2010) advanced the explanation that management strategies are central. However, following static ‘best practices’ might be counterproductive, as routine application of ‘best practice’ strategies is unlikely to foster firm growth in changing economic environments. Moreno and Castillas (2008) emphasize in a similar way that the particularity of high growth firms is the nature and timing of the change process. High growth (especially in SMEs) is generally not a process of gradual growth but rather a process of radical change in the development of a firm. Sims (2006) identifies agility as the most important characteristic of gazelles. The findings of Bars, Boiteux, Clerc-Girard, and Janczak (2006) confirm this, they show that the competitive advantage of gazelles is the result of firm-specific and idiosyncratic competencies that allow the firm to learn and to act in a flexible way.

R&D is one of the elements of a flexible entrepreneurial strategy. The review of the evidence suggests that innovation success is the driver of growth, not the fact that firms invest in R&D (Coad and Rao, 2008; Hözl, 2009). The micro-evidence by Bars, Boiteux, Clerc-Girard, and Janczak (2006) who study high growth SMEs in the Lorraine region show that high growth firms are characterized by organizational innovation and incremental product innovations and not so much by the creation of new technologies. Most of the evidence regarding high growth firms comes from advanced industrialized countries, where R&D and innovation are important sources of competitive advantage. There are not many cross-country studies regarding high growth and possible differences in the sources of competitive advantage. In one of the few studies Hözl (2009) shows that the technological and economic position of a country has a substantial influence on the success and choice of innovation and R&D-based growth strategies. Firm growth in countries at the technological frontier seems to require firm strategies that focus on investment in innovation, while firms more distant from the technological frontier have the possibility to rely on other competitive advantages.

## 7 Conclusion

We began this survey by observing that the growth rate distribution is heavy tailed, a stylized fact that is remarkably robust across different datasets. The implication is



that in each industry and overall in the economy most firms have a growth rate close to 0%, while there are a few firms that experience spectacular rates of growth and decline. These differences in growth rates are not persistent however – fast growth in one period does in no way guarantee superior performance in the long run. In fact, firm growth rates are particularly difficult to predict. Persistent differences in productivity, profitability or innovative capacity do not translate into persistent differences in growth. Firm growth appears instead to be well approximated by a random process once one controls for size and age of the firms. This is also reflected in the fact that even though growth rate regressions may find statistically significant results, they nonetheless have a low  $R^2$  statistic. Although there are regularities at the population level, individual firms have idiosyncratic reasons for growing, and it is difficult to generalize across firms. Furthermore, there is great variation in growth rates over time even within individual firms. The finding that growth rates are predominantly random is not just due to heterogeneity between firms, but also because growth rates have little persistence over time and vary a lot even for individual firms over time.

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