Firm Growth: A Survey*

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Abstract

We survey the phenomenon of the growth of firms drawing on literature from economics, management, and sociology. We begin with a review of empirical 'stylised facts' before discussing theoretical contributions. Firm growth is characterized by a predominant stochastic element, making it difficult to predict. Indeed, previous empirical research into the determinants of firm growth has had a limited success. We also observe that theoretical propositions concerning the growth of firms are often amiss. We conclude that progress in this area requires solid empirical work, perhaps making use of novel statistical techniques.

JEL codes: L25, L11

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Contents

1 Introduction

The aim of this survey is to provide an overview of research into the growth of firms, while also highlighting areas in need of further research. It is a multidisciplinary survey, drawing on contributions made in economics, management and also sociology.

There are many different measures of firm size, some of the more usual indicators being employment, total sales, value-added, total assets, or total profits; and some of the less conventional ones such as 'acres of land' or 'head of cattle' (Weiss, 1998). In this survey we consider growth in terms of a range of indicators, although we devote little attention to the growth of profits (this latter being more of a financial than an economic variable).

There are also different ways of measuring growth rates. Some authors (such as Delmar et al., 2003) make the distinction between relative growth (i.e. the growth rate in percentage terms) and absolute growth (usually measured in the absolute increase in numbers of employees). In this vein, we can mention the 'Birch index' which is a weighted average of both relative and absolute growth rates (this latter being taken into account to emphasize that large firms, due to their large size, have the potential to create many jobs). This survey focuses on relative growth rates only. Furthermore, in our discussion of the processes of expansion we emphasize positive growth and not so much negative growth.[1]

In true Simonian style,[2] we begin with some empirical insights in Section 2, considering first the distributions of size and growth rates, and moving on to look for determinants of growth rates. We then present some theories of firm growth and evaluate their performance in explaining the stylised facts that emerge from empirical work (Section 3). In Section 4 we consider the demand and supply sides of growth by discussing the attitudes of firms towards growth opportunities as well as investigating the processes by which firms actually grow (growth by 'more of the same', growth by diversification, growth by acquisition). In Section 5 we examine the differences between the growth of small and large firms in greater depth. We also review the 'stages of growth' models. Section 6 concludes.

2 Empirical evidence on firm growth

To begin with, we take a non-parametric look at the distributions of firm size and growth rates, before moving on to results from regressions that investigate the determinants of growth rates.

[1] For an introduction to organizational decline, see Whetten (1987).
[2] See in particular Simon (1968).

2.1 Size and growth rates distributions

A suitable starting point for studies into industrial structure and dynamics is the firm size distribution. In fact, it was by contemplating the empirical size distribution that Robert Gibrat (1931) proposed the well-known 'Law of Proportionate Effect' (also known as 'Gibrat's law').

We also discuss the results of research into the growth rates distribution. The regularity that firm growth rates are approximately exponentially distributed was discovered only recently, but offers unique insights into the growth patterns of firms.

2.1.1 Size distributions

The observation that the firm-size distribution is positively skewed proved to be a useful point of entry for research into the structure of industries. (See Figures 1 and 2 for some examples of aggregate firm size distributions.) Robert Gibrat (1931) considered the size of French firms in terms of employees and concluded that the lognormal distribution was a valid heuristic. Hart and Prais (1956) presented further evidence on the size distribution, using data on quoted UK firms, and also concluded in favour of a lognormal model. The lognormal distribution, however, can be viewed as just one of several candidate skew distributions. Although Simon and Bonini (1958) maintained that the "lognormal generally fits quite well" (1958: p611), they preferred to consider the lognormal distribution as a special case in the wider family of 'Yule' distributions. The advantage of the Yule family of distributions was that the phenomenon of arrival of new firms could be incorporated into the model. Steindl (1965) applied Austrian data to his analysis of the firm size distribution, and preferred the Pareto distribution to the lognormal on account of its superior performance in describing the upper tail of the distribution. Similarly, Ijiri and Simon (1964, 1971, 1974) apply the Pareto distribution to analyse the size distribution of large US firms.

Efforts have been made to discriminate between the various candidate skew distributions. One problem with the Pareto distribution is that the empirical density has many more middle-sized firms and fewer very large firms than would be theoretically predicted (Vining, 1976). Other research on the lognormal distribution has shown that the upper tail of the empirical size distribution of firms is too thin relative to the lognormal (Stanley et al., 1995). Quandt (1966) compares the performance of the lognormal and three versions of the Pareto distribution, using data disaggregated according to industry. He reports the superiority of the lognormal over the three types of Pareto distribution, although each of the distributions produces a best-fit for at least one sample. Furthermore, it may be that some industries (e.g. the footwear industry) are not fitted well by any distribution.

More generally, Quandt's results on disaggregated data lead us to suspect that the regularities of the firm-size distribution observed at the aggregate level do not hold with sectoral disaggregation. Silberman (1967) also finds significant departures from lognormality in his analysis of 90 four-digit SIC sectors. It has been suggested that, while the firm size distribution has a smooth regular shape at the aggregate level, this may merely be due to a statistical aggregation effect rather than a phenomenon bearing any deeper economic meaning (Dosi et al, 1995; Dosi, 2007). Empirical results lend support to these conjectures by showing that the regular unimodal firm size distributions observed at the aggregate level can be decomposed into much 'messier' distributions at the industry level, some of which are visibly multimodal (Bottazzi and Secchi, 2003; Bottazzi et al., 2005). For example, Bottazzi and Secchi (2005) present evidence of significant bimodality in the firm size distribution of the worldwide pharmaceutical industry, and relate this to a cleavage between the industry leaders and fringe competitors.

Other work on the firm-size distribution has focused on the evolution of the shape of the distribution over time. It would appear that the initial size distribution for new firms is particularly right-skewed, although the log-size distribution tends to become more symmetric as time goes by. This is consistent with observations that small young firms grow faster than their larger counterparts. As a result, it has been suggested that the log-normal can be seen as a kind of 'limit distribution' to which a given cohort of firms will eventually converge. Lotti and Santarelli (2001) present support for this hypothesis by tracking cohorts of new firms in several sectors of Italian manufacturing. Cabral and Mata (2003) find similar results in their analysis of cohorts of new Portuguese firms. However, Cabral and Mata interpret their results by referring to financial constraints that restrict the scale of operations for new firms, but become less binding over time, thus allowing these small firms to grow relatively rapidly and reach their preferred size. They also argue that selection does not have a strong effect on the evolution of market structure.

Although the skewed nature of the firm size distribution is a robust finding, there may be some other features of this distribution that are specific to countries. Table 1, taken from Bartelsman et al. (2005), highlights some differences in the structure of industries across countries. Among other things, one observes that large firms account for a considerable share of French industry, whereas in Italy firms tend to be much smaller on average. (These international differences cannot simply be attributed to differences in sectoral specialization across countries.)

2.1.2 Growth rates distributions

It has long been known that the distribution of firm growth rates is fat-tailed. In an early contribution, Ashton (1926) considers the growth patterns of British textile firms and observes

Table 1: The importance of small firms (i.e. firms with fewer than 20 employees) across broad sectors and countries, 1989-94

	Absolute number (%)			Share of employment (%)			Ave. No. Employees per firm		
	Total economy	Manufacturing	Business services	Total economy	Manufacturing	Business services	Total economy	Manufacturing	Business services
US	86.7	69.9	87.9	16.6	5.8	20.6	26.4	80.3	21.4
Western Germany	87.9	77.9	90.2	23.6	11.3	33.8	17.0	39.1	11.5
France	78.6	73.6	78.8	13.9	17.0	12.1	33.5	32.1	35.7
Italy	93.1	87.5	96.5	34.4	30.3	46.3	10.5	15.3	6.8
UK	-	74.9	-	-	8.3	-	-	40.7	-
Canada	-	-	-	-	-	-	12.7	40.5	12.0
Denmark	90.0	74.0	90.8	30.2	16.1	33.4	13.3	30.4	12.7
Finland	92.6	84.8	94.5	25.8	13.0	33.0	13.0	27.8	9.9
Netherlands	95.8	86.7	96.8	31.2	16.9	41.9	6.5	18.3	5.3
Portugal	86.3	70.5	92.8	27.7	15.7	39.8	16.8	31.0	11.4

Source: Bartelsman et al. (2005: Tables 2 and 3).

Notes: the columns labelled 'share of employment' refer to the employment share of firms with fewer than 20 employees.

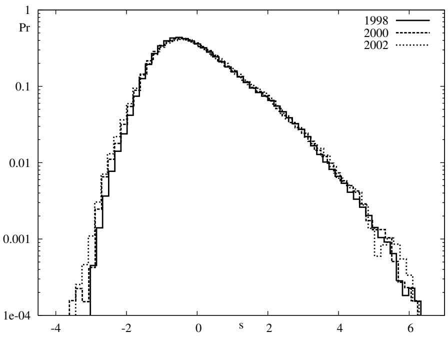

Figure 1: Kernel estimates of the density of firm size (total sales) in 1998, 2000 and 2002, for French manufacturing firms with more than 20 employees. Source: Bottazzi et al., 2005.

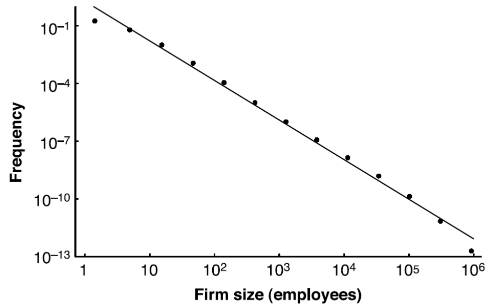

Figure 2: Probability density function of the sizes of US manufacturing firms in 1997. Source: Axtell, 2001.

that "In their growth they obey no one law. A few apparently undergo a steady expansion…With others, increase in size takes place by a sudden leap" (Ashton 1926: 572-573). Little (1962) investigates the distribution of growth rates, and also finds that the distribution is fat-tailed. Similarly, Geroski and Gugler (2004) compare the distribution of growth rates to the normal case and comment on the fat-tailed nature of the empirical density. Recent empirical research, from an 'econophysics' background, has discovered that the distribution of firm growth rates closely follows the parametric form of the Laplace density. Using the Compustat database of US manufacturing firms, Stanley et al. (1996) observe a 'tent-shaped' distribution on log-log plots that corresponds to the symmetric exponential, or Laplace distribution (see also Amaral et al. (1997) and Lee et al. (1998)). The quality of the fit of the empirical distribution to the Laplace density is quite remarkable. The Laplace distribution is also found to be a rather useful representation when considering growth rates of firms in the worldwide pharmaceutical industry (Bottazzi et al., 2001). Giulio Bottazzi and coauthors extend these findings by considering the Laplace density in the wider context of the family of Subbotin distributions (beginning with Bottazzi et al., 2002). They find that, for the Compustat database, the Laplace is indeed a suitable distribution for modelling firm growth rates, at both aggregate and disaggregated levels of analysis (Bottazzi and Secchi 2003a). The exponential nature of the distribution of growth rates also holds for other databases, such as Italian manufacturing (Bottazzi et al. (2007)). In addition, the exponential distribution appears to hold across a variety of firm growth indicators, such as Sales growth, employment growth or Value Added growth (Bottazzi et al., 2007). The growth rates of French manufacturing firms have also been studied, and roughly speaking a similar shape was observed, although it must be said that the empirical density was noticeably fatter-tailed than the Laplace (see Bottazzi et al., 2005).[3]

[3]The observed subbotin b parameter (the 'shape' parameter) is significantly lower than the Laplace value of 1. This highlights the importance of following Bottazzi *et al.* (2002) and considering the Laplace as a special

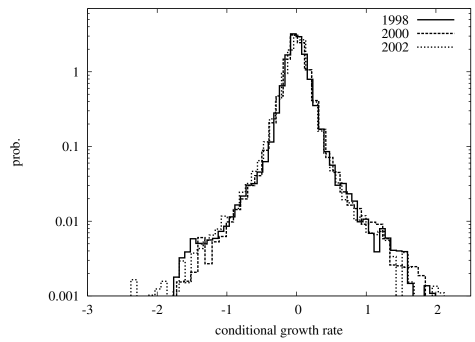

Figure 3: Distribution of sales growth rates of French manufacturing firms. Source: Bottazzi et al., 2005.

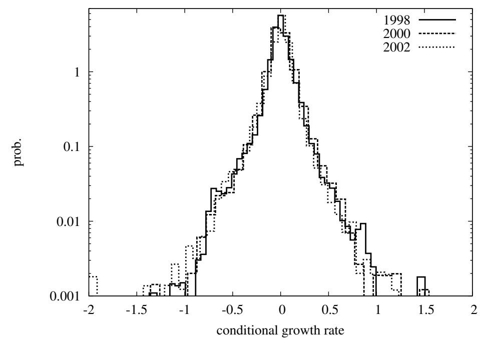

Figure 4: Distribution of employment growth rates of French manufacturing firms. Source: Coad, 2006b.

Research into Danish manufacturing firms presents further evidence that the growth rate distribution is heavy-tailed, although it is suggested that the distribution for individual sectors may not be symmetric but right-skewed (Reichstein and Jensen (2005)). Generally speaking, however, it would appear that the shape of the growth rate distribution is more robust to disaggregation than the shape of the firm size distribution. In other words, whilst the smooth shape of the aggregate firm size distribution may be little more than a statistical aggregation effect, the 'tent-shapes' observed for the aggregate growth rate distribution are usually still visible even at disaggregated levels (Bottazzi and Secchi, 2003a; Bottazzi et al., 2005). This means that extreme growth events can be expected to occur relatively frequently, and make a disproportionately large contribution to the evolution of industries.

Figures 3 and 4 show plots of the distribution of sales and employment growth rates for French manufacturing firms with over 20 employees.

Although research suggests that both the size distribution and the growth rate distribution are relatively stable over time, it should be noted that there is great persistence in firm size but much less persistence in growth rates on average (more on growth rate persistence is presented in Section 2.2.4). As a result, it is of interest to investigate how the moments of the growth rates distribution change over the business cycle. Indeed, several studies have focused on these issues and some preliminary results can be mentioned here. It has been suggested that the variance of growth rates changes over time for the employment growth of large US firms (Hall, 1987) and that this variance is procyclical in the case of growth of assets (Geroski et al., 2003). This is consistent with the hypothesis that firms have a lot of discretion in their growth rates of assets during booms but face stricter discipline during recessions. Higson et al. (2002, 2004) consider the evolution of the first four moments of distributions of the growth of sales, for large US and UK firms over periods of 30 years or more. They observe that higher moments of the distribution of sales growth rates have significant cyclical patterns. In

case in the Subbotin family of distributions.

particular, evidence from both US and UK firms suggests that the variance and skewness are countercyclical, whereas the kurtosis is pro-cyclical. Higson et al. (2002: 1551) explain the counter-cyclical movements in skewness in these words:

> "The central mass of the growth rate distribution responds more strongly to the aggregate shock than the tails. So a negative shock moves the central mass closer to the left of the distribution leaving the right tail behind and generates positive skewness. A positive shock shifts the central mass to the right, closer to the group of rapidly growing firms and away from the group of declining firms. So negative skewness results."

The procyclical nature of kurtosis (despite their puzzling finding of countercyclical variance) emphasizes that economic downturns change the shape of the growth rate distribution by reducing a key parameter of the 'spread' or 'variation' between firms.

2.2 Gibrat's Law

Gibrat's law continues to receive a huge amount of attention in the empirical industrial organization literature, more than 75 years after Gibrat's (1931) seminal publication.

We begin by presenting the 'Law', and then review some of the related empirical literature. We do not attempt to provide an exhaustive survey of the literature on Gibrat's law, because the number of relevant studies is indeed very large. (For other reviews of empirical tests of Gibrat's Law, the reader is referred to the survey by Lotti et al (2003); for a survey of how Gibrat's law holds for the services sector see Audretsch et al. (2004).) Instead, we try to provide an overview of the essential results. We investigate how expected growth rates and growth rate variance are influenced by firm size, and also investigate the possible existence of patterns of serial correlation in firm growth.

2.2.1 Gibrat's model

Robert Gibrat's (1931) theory of a 'law of proportionate effect' was hatched when he observed that the distribution of French manufacturing establishments followed a skew distribution that resembled the lognormal. Gibrat considered the emergence of the firm-size distribution as an outcome or explanandum and wanted to see which underlying growth process could be responsible for generating it.

In its simplest form, Gibrat's law maintains that the expected growth rate of a given firm is independent of its size at the beginning of the period examined. Alternatively, as Mansfield (1962: 1030) puts it, "the probability of a given proportionate change in size during a specified period is the same for all firms in a given industry – regardless of their size at the beginning of the period."

More formally, we can explain the growth of firms in the following framework. Let x_t be the size of a firm at time t, and let ε_t be random variable representing an idiosyncratic, multiplicative growth shock over the period $t-1$ to t. We have

$$x_t - x_{t-1} = \varepsilon_t x_{t-1} \tag{1}$$

which can be developed to obtain

$$x_t = (1+\varepsilon_t)x_{t-1} = x_0(1+\varepsilon_1)(1+\varepsilon_2)\dots(1+\varepsilon_t) \tag{2}$$

It is then possible to take logarithms in order to approximate $\log(1+\varepsilon_t)$ by ε_t to obtain[4]

$$\log(x_t) \approx \log(x_0) + \varepsilon_1 + \varepsilon_2 + \ldots + \varepsilon_t = \log(x_0) + \sum_{s=1}^{t} \varepsilon_s \tag{3}$$

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

$$\log(x_t) \approx \sum_{s=1}^{t} \varepsilon_s \tag{4}$$

In this way, a firm's size at time t can be explained purely in terms of its idiosyncratic history of multiplicative shocks. If we further assume that all firms in an industry are independent realizations of i.i.d. normally distributed growth shocks, then this stochastic process leads to the emergence of a lognormal firm size distribution.

There are of course several serious limitations to such a simple vision of industrial dynamics. We have already seen that the distribution of growth rates is not normally distributed, but instead resembles the Laplace or 'symmetric exponential'. Furthermore, contrary to results implied by Gibrat's model, it is not reasonable to suppose that the variance of firm size tends to infinity (Kalecki, 1945). In addition, we do not observe the secular and unlimited increase in industrial concentration that would be predicted by Gibrat's law (Caves, 1998). Whilst a 'weak' version of Gibrat's law merely supposes that expected growth rate is independent of firm size, stronger versions of Gibrat's law imply a range of other issues. For example, Chesher (1979) rejects Gibrat's law due to the existence of an autocorrelation structure in the growth shocks. Bottazzi and Secchi (2006a) reject Gibrat's law on the basis of a negative relationship between growth rate variance and firm size. Reichstein and Jensen (2005) reject Gibrat's law

[4] This logarithmic approximation is only justified if ε_t is 'small' enough (i.e. close to zero), which can be reasonably assumed by taking a short time period (Sutton, 1997).

after observing that the annual growth rate distribution is not normally distributed.

2.2.2 Firm size and average growth

Although Gibrat's (1931) seminal book did not provoke much of an immediate reaction, in recent decades it has spawned a flood of empirical work. Nowadays, Gibrat's 'Law of Proportionate Effect' constitutes a benchmark model for a broad range of investigations into industrial dynamics. Another possible reason for the popularity of research into Gibrat's law, one could suggest quite cynically, is that it is a relatively easy paper to write. First of all, it has been argued that there is a minimalistic theoretical background behind the process (because growth is assumed to be purely random). Then, all that needs to be done is to take the IO economist's 'favourite' variable (i.e. firm size, a variable which is easily observable and readily available) and regress the difference on the lagged level. In addition, few control variables are required beyond industry dummies and year dummies, because growth rates are characteristically random.

Empirical investigations of Gibrat's law rely on estimation of equations of the type:

$$\log(x_t) = \alpha + \beta \log(x_{t-1}) + \epsilon \tag{5}$$

where a firm's 'size' is represented by x_t, α is a constant term (industry-wide growth trend) and ϵ is a residual error. Research into Gibrat's law focuses on the coefficient β. If firm growth is independent of size, then β takes the value of unity. If β is smaller than one, then smaller firms grow faster than their larger counterparts, and we can speak of 'regression to the mean'. Conversely, if β is larger than one, then larger firms grow relatively rapidly and there is a tendency to concentration and monopoly.

A significant early contribution was made by Edwin Mansfield's (1962) study of the US steel, petroleum, and rubber tire industries. In particular interest here is what Mansfield identified as three different renditions of Gibrat's law. According to the first, Gibrat-type regressions consist of both surviving and exiting firms and attribute a growth rate of -100% to exiting firms. However, one caveat of this approach is that smaller firms have a higher exit hazard which may obfuscate the relationship between size and growth. The second version, on the other hand, considers only those firms that survive. Research along these lines has typically shown that smaller firms have higher expected growth rates than larger firms. The third version considers only those large surviving firms that are already larger than the industry Minimum Efficient Scale of production (with exiting firms often being excluded from the analysis). Generally speaking, empirical analysis corresponding to this third approach suggests that growth rates are more or less independent from firm size, which lends support to Gibrat's law.

The early studies focused on large firms only, presumably partly due to reasons of data availability. A series of papers analyzing UK manufacturing firms found a value of β greater than unity, which would indicate a tendency for larger firms to have higher percentage growth rates (Hart (1962), Samuels (1965), Prais (1974), Singh and Whittington (1975)).

However, the majority of subsequent studies using more recent datasets have found values of β slightly lower than unity, which implies that, on average, small firms seem to grow faster than larger firms. This result is frequently labelled 'reversion to the mean size' or 'mean-reversion'.[5] Among a large and growing body of research that reports a negative relationship between size and growth, we can mention here the work by Kumar (1985) and Dunne and Hughes (1994) for quoted UK manufacturing firms, Hall (1987), Amirkhalkhali and Mukhopadhyay (1993) and Bottazzi and Secchi (2003) for quoted US manufacturing firms (see also Evans (1987a, 1987b) for US manufacturing firms of a somewhat smaller size), Gabe and Kraybill (2002) for establishments in Ohio, and Goddard et al. (2002) for quoted Japanese manufacturing firms. Studies focusing on small businesses have also found a negative relationship between firm size and expected growth – see for example Yasuda (2005) for Japanese manufacturing firms, Calvo (2006) for Spanish manufacturing, McPherson (1996) for Southern African micro businesses, and Wagner (1992) and Almus and Nerlinger (2000) for German manufacturing. Dunne et al. (1989) analyse plant-level data (as opposed to firm-level data) and also observe that growth rates decline along size classes. Research into Gibrat's law using data for specific sectors also finds that small firms grow relatively faster (see e.g. Barron et al. (1994) for New York credit unions, Weiss (1998) for Austrian farms, Liu et al. (1999) for Taiwanese electronics plants, and Bottazzi and Secchi (2005) for an analysis of the worldwide pharmaceutical sector). Indeed, there is a lot of evidence that a slight negative dependence of growth rate on size is present at various levels of industrial aggregation. Although most empirical investigations into Gibrat's law consider only the manufacturing sector, some have focused on the services sector. The results, however, are often qualitatively similar – there appears to be a negative relationship between size and expected growth rate for services too (see Variyam and Kraybill (1992), Johnson et al. (1999)) Nevertheless, it should be mentioned that in some cases a weak version of Gibrat's law cannot be convincingly rejected, since there appears to be no significant relationship between expected growth rate and size (see the analyses provided by Bottazzi et al. (2005) for French manufacturing firms, Droucopoulos (1983) for the world's largest firms, Hardwick and Adams (2002) for UK Life Insurance companies, and Audretsch et al. (2004) for small-scale Dutch services). Notwithstanding these latter studies, however, we acknowledge that in most cases a negative relationship between firm size and growth is observed. Indeed,

[5] We should be aware, however, that 'mean-reversion' does not imply that firms are converging to anything resembling a common steady-state size, even within narrowly-defined industries (see in particular the empirical work by Geroski et al. (2003) and Cefis et al. (2006)).

it is quite common for theoretically-minded authors to consider this to be a 'stylised fact' for the purposes of constructing and validating economic models (see for example Cooley and Quadrini (2001), Gomes (2001) and Clementi and Hopenhayn (2006)). Furthermore, John Sutton refers to this negative dependence of growth on size as a 'statistical regularity' in his revered survey of Gibrat's law (Sutton, 1997: 46).

A number of researchers maintain that Gibrat's law does hold for firms above a certain size threshold. This corresponds to acceptance of Gibrat's law according to Mansfield's third rendition, although 'mean reversion' leads us to reject Gibrat's Law as described in Mansfield's second rendition. Mowery (1983), for example, analyzes two samples of firms, one of which contains small firms while the other contains large firms. Gibrat's law is seen to hold in the latter sample, whereas mean reversion is observed in the former. Hart and Oulton (1996) consider a large sample of UK firms and find that, whilst mean reversion is observed in the pooled data, a decomposition of the sample according to size classes reveals essentially no relation between size and growth for the larger firms. Lotti et al. (2003) follow a cohort of new Italian startups and find that, although smaller firms initially grow faster, it becomes more difficult to reject the independence of size and growth as time passes. Similarly, results reported by Becchetti and Trovato (2002) for Italian manufacturing firms, Geroski and Gugler (2004) for large European firms and Cefis et al. (2006) for the worldwide pharmaceutical industry also find that the growth of large firms is independent of their size, although including smaller firms in the analysis introduces a dependence of growth on size. It is of interest to remark that Caves (1998) concludes his survey of industrial dynamics with the 'substantive conclusion' that Gibrat's law holds for firms above a certain size threshold, whilst for smaller firms growth rates decrease with size.

Concern about econometric issues has often been raised. Sample selection bias, or 'sample attrition', is one of the main problems, because smaller firms have a higher probability of exit. Failure to account for the fact that exit hazards decrease with size may lead to underestimation of the regression coefficient (i.e. β). Hall (1987) was among the first to tackle the problem of sample selection, using a Tobit model. She concludes that selection bias does not seem to account for the negative relationship between size and growth. An alternative way of correcting for sample selection is by applying Heckman's two-stage procedure. This is the methodology used by Harhoff et al. (1998), who also observe that selection bias has only a small influence on the Gibrat coefficient. In short, the "problem of sample selection does not seem to significantly affect the relationship between growth rate and size of firm" (Marsili, 2001: 15). The possibility of heteroskedasticity is also frequently mentioned, although it can be corrected for quite easily, for example by applying White's (1980) procedure. In any case, heteroskedasticity does not introduce any asymptotic bias in the coefficient estimates. Serial correlation in growth rates can lead to biased estimates, although Chesher (1979) proposes a simple framework for dealing with this. Finally, Hall (1987) investigates whether 'errors-in-variables' may be influencing the regression results, but concludes that measurement error does not appear to be an important factor.

2.2.3 Firm size and growth rate variance

Hymer and Pashigian (1962) were among the first to draw attention to the negative relationship between growth rate variance and firm size. If firms can be seen as a collection of 'components' or 'departments', then the overall variance of the growth rate of the firm is a function of the growth rate variance of these individual departments. In many cases, the variance of the firm's growth rate will decrease with firm size. For example, in the case there these departments (i) are of approximately equal size, such that the size of the firm is roughly proportional to the number of components; and (ii) have growth rates that are perfectly independent from each other, then Central Limit Theorem leads us to expect a decrease in growth rate variance that is proportional to the inverse square root of the firm's size. However, Hymer and Pashigian (1962) were puzzled by the fact that the rate of decrease of growth rate variance with size was lower than the rate that would be observed if large firms were just aggregations of independent departments. At the same time, they found no evidence of economies of scale. They saw this as an anomaly in a world of risk-averse agents. Why would firms want to grow to a large size, if there are no economies of scale, and if the growth rate variance of a large firm is higher than the corresponding variance of an equivalent group of smaller firms? Subsequent studies did not attempt to answer this question, but they did bear in mind the existence of a negative relationship between growth rate variance and firm size. As a consequence, empirical analyses of Gibrat's law began to correct for heteroskedasticity in firm growth rates (e.g. Hall (1987), Evans (1987a,b), Dunne and Hughes (1994), Hart and Oulton (1996), Harhoff et al. (1998)).

In recent years efforts have been made to quantify the scaling of the variance of growth rates with firm size. This scaling relationship can be summarized in terms of the following power law: $\sigma(g_i) \sim e^{\beta s_i}$; where $\sigma(g_i)$ is the standard deviation of the growth rate of firm i, β is a coefficient to be estimated, and s_i is the size (total sales) of firm i. Values of β have consistently been estimated as being around -0.2 for US manufacturing firms (Amaral et al. (1997, 1998), Bottazzi and Secchi (2004)) and also for firms in the worldwide pharmaceutical industry (Bottazzi et al. (2001), Matia et al. (2004), Bottazzi and Secchi (2006a)). Lee et al. (1998) find that a scaling exponent of -0.15 is able to describe the scaling of growth rate variance for both quoted US manufacturing firms and the GDP of countries. For French manufacturing firms, the analysis in Bottazzi et al. (2005) yields estimates of β of around -0.07, although in the case of Italian manufacturing firms Bottazzi et al. (2007) fail to find any relation between growth rate variability and size.

The discussion in Lee et al. (1998: 3277) gives us a better understanding of the values taken by β, the scaling exponent. If the growth rates of divisions of a large diversified firm are perfectly correlated, we should expect a value of $\beta = 0$. On the other hand, if a firm can be viewed as an amalgamation of perfectly independent subunits, we expect a value of $\beta =$ -0.5. The fact that the estimated exponents are between these extreme values of 0 and -0.5 suggest that the constituent departments of a firm have growth patterns that are somewhat correlated.

Matia et al. (2004) and Bottazzi and Secchi (2006a) return to the scaling-of-variance puzzle by considering firms as being composed of a certain number of products that correspond to independent *submarkets*.[6] The average size of the submarkets increases with firm size, but the growth rates are independent across submarkets. These authors provide support for their model by examining evidence from the worldwide pharmaceutical industry, where a firm's portfolio of activities can be decomposed to a fine level of aggregation. As a result, "the explanation of the relationship between the variance of the growth rates distribution and the size of the firm based on the Central Limit Theorem is valid, as long as one considers the actual number of sub-markets a firm operates in, instead of assuming that this number is somehow proportional to the size of the firm" (Bottazzi and Secchi 2006a: 860).

2.2.4 Autocorrelation of growth rates

Early empirical studies into the growth of firms considered serial correlation when growth was measured over a period of 4 to 6 years. Positive autocorrelation of 33% was observed by Ijiri and Simon (1967) for large US firms, and a similar magnitude of 30% was reported by Singh and Whittington (1975) for UK firms. However, much weaker autocorrelation was later reported in comparable studies by Kumar (1985) and Dunne and Hughes (1994).

More recently, availability of better datasets has encouraged the consideration of annual autocorrelation patterns. Indeed, persistence should be more visible when measured over shorter time horizons. However, the results are quite mixed. Positive serial correlation has often been observed, in studies such as those of Chesher (1979) and Geroski et al. (1997) for UK quoted firms, Wagner (1992) for German manufacturing firms, Weiss (1998) for Austrian farms, Bottazzi et al. (2001) for the worldwide pharmaceutical industry, and Bottazzi and Secchi (2003) for US manufacturing. On the other hand, negative serial correlation has also been reported – some examples are Boeri and Cramer (1992) for German firms, Goddard et al. (2002) for quoted Japanese firms, Bottazzi et al. (2007) for Italian manufacturing, and Bottazzi et al. (2005) for French manufacturing. Still other studies have failed to find any

[6]Their model bears a certain similarity with the model in Amaral et al. (1998, 2001), who explain scaling of variance in terms of firms being composed of independent 'divisions' in a diversified firm, rather than independent 'submarkets'.

significant autocorrelation in growth rates (see Almus and Nerlinger (2000) for German start-ups, Bottazzi et al. (2002) for selected Italian manufacturing sectors, Geroski and Mazzucato (2002) for the US automobile industry, and Lotti et al. (2003) for Italian manufacturing firms). To put it mildly, there does not appear to be an emerging consensus.

Another subject of interest (also yielding conflicting results) is the number of relevant lags to consider. Chesher (1979) and Bottazzi and Secchi (2003) found that only one lag was significant, whilst Geroski et al. (1997) find significant autocorrelation at the 3rd lag (though not for the second). Bottazzi et al. (2001) find positive autocorrelation for every year up to and including the seventh lag, although only the first lag is statistically significant.

To summarize these regression-based investigations, then, it would appear that decades of research into growth rate autocorrelation can best be described as yielding "conflicting results" (Caves, 1998: 1950). It is perhaps remarkable that the results of the studies reviewed above have so little in common. It is also remarkable that previous research has been so little concerned with this question. Indeed, instead of addressing serial correlation in any detail, often it is 'controlled away' as a dirty residual, a blemish on the 'natural' growth rate structure. The baby is thus thrown out with the bathwater. On reason for this confusion could be that, if indeed there are any regularities in the serial correlation of firm growth, they are more complex than the standard specification would be able to detect (i.e. that there is no 'one-size-fits-all' serial correlation coefficient that applies for all firms). A fresh approach is needed.

The analysis in Bottazzi et al. (2002) begins with the observation that the mean autocorrelation coefficient for a given industry is either insignificantly different from zero, or else very small in magnitude. However, the authors go on to calculate firm-specific autocorrelation coefficients and observe that firms do in fact have idiosyncratic growth patterns that are not visible simply by looking at averages across firms. They create a purely random 'benchmark' case in which the growth rates of all firms are pooled together and then growth rates are extracted randomly to construct growth patterns for 'artificial firms'. Bootstrap resampling methods allow them to generate a distribution of autocorrelation coefficients for this random scenario. They then compare this stochastic benchmark with the empirical distribution of autocorrelation coefficients (see Figure 5 for the case of autocorrelation of employment growth). The differences between the distributions are supported by formal statistical tests (i.e. Kolmogorov-Smirnov tests). The authors conclude that firm growth patterns are indeed idiosyncratic, that they do have a memory process, and that there are indeed persistent asymmetries in growth dynamics across firms.

Coad (2006b) also explores the issue of heterogeneous growth profiles across firms and goes some way towards finding regularities in growth rate autocorrelation patterns. A firm's growth dynamics are seen to depend on two dimensions – a firm's size and its lagged growth

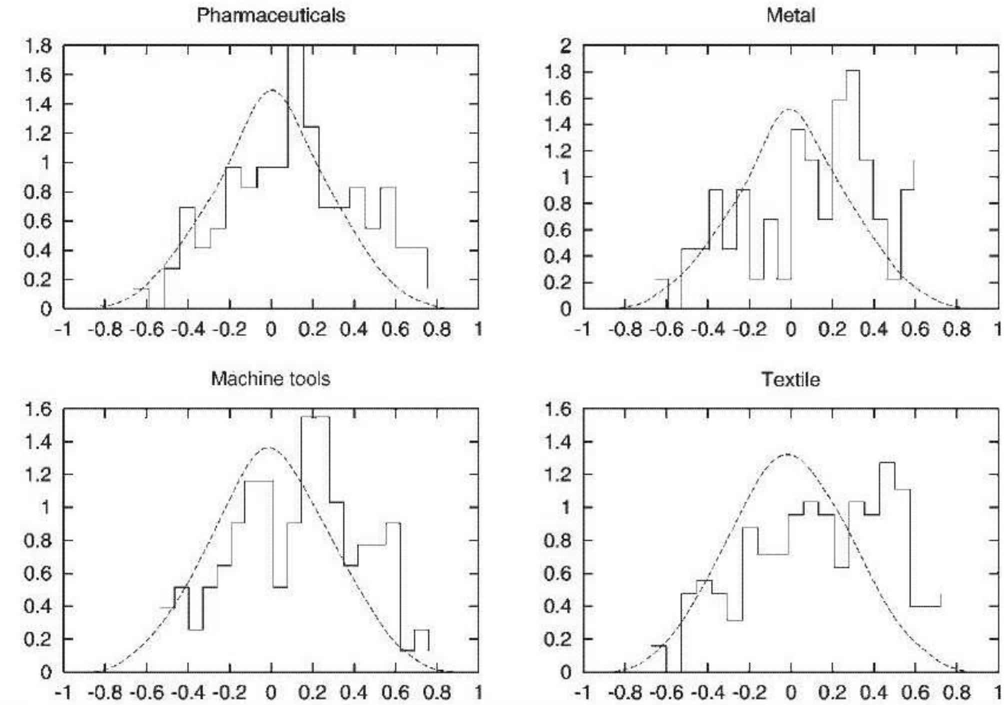

Figure 5: Observed empirical frequency for the autocorrelation coefficient of employment growth (steps function) and the associated 'benchmark' density distribution generated using bootstrapped time series (dotted line). Source: Bottazzi et al. (2002: Fig. 5).

rate. First of all, it is demonstated that smaller firms are more prone to experience negative autocorrelation, whilst larger firms have a tendency towards positive autocorrelation. This is consistent with propositions that small and large firms operate on a different 'frequency' or time scale, with the actions of large firms unfolding over a longer time horizon. This dependence of autocorrelation on firm size helps to explain why the studies reviewed above yielded different autocorrelation coefficients for databases with different firm-size compositions. Second, Coad (2006b) demonstrates that the autocorrelation coefficient depends on the *growth rate*. Firms whose growth rate is close to the average in one year are likely to not experience any autocorrelation in the following year. For those firms that experience extreme growth rates (either extreme positive or negative growth rates), however, these firms are likely to experience considerable negative autocorrelation. This is especially true for fast-growth small firms, whose growth patterns are particularly erratic (see also Garnsey and Heffernan (2005)). Large firms, however, display a smoother dynamics – they are likely to experience positive autocorrelation irrespective of their growth rate in the previous period.

2.3 Other determinants of firm growth

2.3.1 Age

The relationship between size and growth has received a great deal of attention in empirical work, as we discussed above in Section 2.2.2. Relatedly, the relationship between a firm's age and its growth rate has also been frequently investigated. Age and size are certainly closely related, and indeed, in some cases, they are both taken to represent what is essentially the same phenomenon (see e.g. Greiner's (1972) model). One of the earliest investigations of the influence of age on growth was made by Fizaine (1968), who examined the growth of establishments from the French region of Bouches-du-Rhone. She observed that age has a negative effect on the growth of establishments, and also that the variance of growth rates decreases with age. Fizaine (1968) also argued that the correct causality runs from age to growth, rather than from size to growth as supposed by many investigations into firm growth based on Gibrat's law (this argument was subsequently reiterated by Evans 1987b). Dunne et al. (1989) analyse US establishments and concur with Fizaine's findings that both the expected growth rate and also the growth variance decrease with age. Age is also observed to have a negative effect on growth at the firm level, as a large number of studies have testified – see *inter alia* Evans (1987a,b) for US manufacturing firms, Variyam and Kraybill (1992) for US manufacturing and services firms, Liu et al. (1999) for Taiwanese electronics plants, Geroski and Gugler (2004) for large European companies, and Yasuda (2005) for Japanese manufacturing firms.

Generally speaking, then, the negative dependence of growth rate on age appears to be a robust feature of industrial dynamics. This is not always observed, however. Das (1995) examines the growth of firms in a young, fast-growing industry in a developing economy (i.e. the computer hardware industry in India) and obtains the unusual results that that growth increases with age. Another exception to the general rule is in Barron et al. (1994), who observe a non-monotonic relationship between age and growth for New York Credit Unions. They observe that older firms grow faster than adolescent firms, although it is the very young firms that experience the fastest growth.

2.3.2 Innovation

Innovation and sales growth The relationship between innovation and sales growth can be described as something of a paradox – on the one hand, a broad range of theoretical and descriptive accounts of firm growth stress the important role innovation plays for firms wishing to expand their market share. For example, Carden (2005: 25) presents the main results of the McKinsey Global Survey of Business Executives, and writes that "[e]xecutives overwhelmingly say that innovation is what their companies need most for growth." Another survey focusing on SMEs (Small and Medium Enterprises) reports that investment in product innovation is the single most popular strategy for expansion, a finding which holds across various industries (Hay and Kamshad, 1994). Economic theorizing also recognizes the centrality of innovation in growth of firm sales (see for example the discussion in Geroski (2000, 2005) or the theoretical model in Aghion and Howitt (1992)). On the other hand, empirical studies have had difficulty in identifying any strong link between innovation and sales growth, and the results have often been modest and disappointing. Indeed, some studies fail to find any influence of innovation on sales growth at all. Commenting on the current state of our understanding of firm-level processes of innovation, Cefis and Orsenigo (2001) write: "Linking more explicitly the evidence on the patterns of innovation with what is known about firms growth and other aspects of corporate performance – both at the empirical and at the theoretical level – is a hard but urgent challenge for future research" (Cefis and Orsenigo, 2001: 1157).

A major difficulty in observing the effect of innovation on growth is that it may take a firm a long time to convert increases in economically valuable knowledge (i.e. innovation) into economic performance. Even after an important discovery has been made, a firm will typically have to invest heavily in product development. In addition, converting a product idea into a set of successful manufacturing procedures and routines may also prove costly and difficult. Furthermore, even after an important discovery has been patented, a firm in an uncertain market environment may prefer to treat the patent as a 'real option' and delay associated investment and development costs (Bloom and Van Reenen, 2002). There may therefore be considerable lags between the time of discovery of a valuable innovation and its conversion into commercial success.[7] Another feature of the innovation process is that there is uncertainty at every stage, and that the overall outcome requires success at each step of the process. In a pioneering empirical study, Mansfield et al. (1977) identify three different stages of innovation that correspond to three different conditional probabilities of success: the probability that a project's technical goals will be met (x); the probability that, given technical success, the resulting product or process will be commercialized (y); and finally the probability that, given commercialization, the project yields a satisfactory return on investment (z). The overall success of the innovative activities will be the product of these three conditional probabilities ($x \times y \times z$). If a firm fails at any of these stages, it will have incurred costs without reaping benefits. We therefore expect that firms differ greatly both in terms of the returns to R&D (measured here in terms of post-innovation sales growth) and also in terms of the time required to convert an innovation into commercial success. However, it is anticipated that innovations will indeed pay off on average and in the long term, otherwise commercial businesses would obviously have no incentive to perform R&D in the first place.

How then do firms translate innovative activity into competitive advantage?[8] Our gleaning of this literature of the influence of innovative activity on sales growth yields a sparse and rather motley harvest. (This may be due to difficulties in linking firm-level innovation data to other firm characteristics.) Mansfield (1962) considers the steel and petroleum sectors over a 40-year period, and finds that successful innovators grew quicker, especially if they were initially small. Moreover, he asserts that the higher growth rate cannot be attributed to their pre-innovation behavior. Another early study by Scherer (1965) looks at 365 of the largest US corporations and observes that inventions (measured by patents) have a positive effect on company profits via sales growth. Furthermore, he observes that innovations typically do not increase profit margins but instead increase corporate profits via increased sales at constant profit margins. Mowery (1983) focuses on the dynamics of US manufacturing over the period 1921-1946 and observes that R&D employment only has a significantly positive impact on firm growth (in terms of assets) for the period 1933-46. Using two different samples, he observes that R&D has a similar effect on growth for both large and small firms. Geroski and Machin (1992) look at 539 large quoted UK firms over the period 1972-83, of which 98 produced an innovation during the period considered. They observe that innovating firms (i.e. firms that produced at least one 'major' innovation) are both more profitable and grow faster than non-innovators. Their results suggest that the influence of specific innovations on sales growth are

[7] However, it is reasonable to assume that the time lag from innovation to superior firm-level performance is shorter when this latter is measured in terms of stock market valuation – this line of reasoning is pursued in Coad and Rao (2006c).

[8] This is not the place to consider how innovative activity affects other aspects of firm performance such as stock market success. For a survey of the literature on innovation and market value appreciation, see Coad and Rao (2006c). For a survey of the relationship between innovation and employment growth (i.e. the 'technological unemployment' literature, see the following section.

nonetheless short-lived (p81) – "the full effects of innovation on corporate growth are realized very soon after an innovation is introduced, generating a short, sharp one-off increase in sales turnover." In addition, and contrary to Scherer's findings, they observe that innovation has a more noticeable influence on profit margins than on sales growth. Geroski and Toker (1996) look at 209 leading UK firms and observe that innovation has a significant positive effect on sales growth, when included in an OLS regression model amongst many other explanatory variables. Roper (1997) uses survey data on 2721 small businesses in the U.K., Ireland and Germany to show that innovative products introduced by firms made a positive contribution to sales growth. Freel (2000) considers 228 small UK manufacturing businesses and, interestingly enough, observes that although it is not necessarily true that 'innovators are more likely to grow', nevertheless 'innovators are likely to grow more' (i.e. they are more likely to experience particularly rapid growth). Finally, Bottazzi et al. (2001) study the dynamics of the worldwide pharmaceutical sector and do not find any significant contribution of a firm's 'technological ID' or innovative position[9] to sales growth.

One observation that emerges from the preceding survey is that innovation can be measured in several ways, although the most common approach is to use R&D statistics or patent counts. However, each of these indicators has its drawbacks. R&D statistics are typically quite smoothed over time, which contrasts with the lack of persistence frequently observed in patent statistics. Furthermore, R&D expenditure is an innovative input and it gives only a poor indication of the value of the resulting innovative output that a firm can take to market. Patent statistics are very skewed in value, with many patents being practically worthless whilst a fraction of patents generate the lion's share of the economic value. Another limitation is that many previous studies have lumped together firms from all manufacturing sectors – even though innovation regimes (and indeed appropriability regimes) vary dramatically across industries.[10] To deal with these difficulties of quantifying firm-level innovative activity, the analysis in Coad and Rao (2006a,b) combines information on a firm's recent history of R&D expenditures as well as patenting activity to create a synthetic 'innovativeness'[11] variable for each firm-year. In this way we extract the common variance associated with each of these indicators while discarding the idiosyncratic noise and measurement error. We also focus on four two-digit 'complex technology' manufacturing industries that were hand-picked because of their relatively high intensities.

Using semi-parametric quantile regressions, we explore the influence of innovation at a

[9] They measure a firm's innovative activity by either the discovery of NCE's (new chemical entities) or by the proportion of patented products in a firm's product portfolio

[10] Patenting is an effective means of protecting innovations in the pharmaceutical industry, for example, although it is not very effective in the steel, glass or textile industries (Cohen et al., 2000). Therefore, it is problematic to compare one patent for a pharmaceutical firm with one patent for a steel, glass or textile firm.

[11] Note that our use of the word 'innovativeness' does not correspond to Mairesse and Mohnen's (2002) use of the same word.

range of points of the conditional growth rate distribution. Our results indicate that most firms don't grow very much, and their growth is hardly related to their attempts at innovation. Nevertheless, innovation is seen to be of critical importance for a handful of fast-growth firms. This emphasizes the inherent uncertainty in firm-level innovative activity – whilst for the 'average firm' innovativeness may not be very important for sales growth, innovativeness is of crucial importance for the 'superstar' high-growth firms. Standard regression techniques which implicitly give equal weights to both high-growth and low-growth firms, and that yield a summary point estimate for the 'average firm', are unable to detect this relationship.

Innovation and employment growth Whilst firm-level innnovation can be expected to have a positive influence on sales growth, the overall effect on employment growth is *a priori* ambiguous. Innovation is often associated with increases in productivity that lower the amount of labour required for the production of goods and services. In this way, an innovating firm may change the composition of its productive resources, to the profit of machines and at the expense of employment. As a result, the general public has often expressed concern that technological progress may bring about the 'end of work' by replacing men with machines. Economists, on the other hand, are usually more optimistic.

To begin with, it is useful to decompose innovation into product and process innovation. Product innovations are often associated with employment gain, because the new products create new demand (although it is possible that they might replace existing products). Process innovations, on the other hand, often increase productivity by reducing the labour requirement in manufacturing processes. Thus, process innovations are often suspected of bringing about 'technological unemployment'.

The issue becomes even more complicated, however, when we consider that there are not only direct effects of innovation on employment, but also a great many indirect effects operating through various 'substitution channels'. For example, the introduction of a labour-saving production process may lead to an immediate and localized reduction in employees inside the plant (the 'direct effect'), but it may lead to positive employment changes elsewhere in the economy via an increased demand for new machines, a decrease in prices, and increase in incomes, an increase in new investments, or a decrease in wages (see Spiezia and Vivarelli, 2000). As a result, the overall effect of innovation on employment needs to be investigated empirically.

Research into technological unemployment has been undertaken in different ways. As a consequence, the results emerging from different studies are far from harmonious – "[e]mpirical work on the effect of innovations on employment growth yields very mixed results" (Niefert 2005:9). Doms et al. (1995) analyse survey data on US manufacturing establishments, and observe that the use of advanced manufacturing technology (which would correspond to process innovation) has a positive effect on employment. At the firm-level of analysis, Hall (1987) observes that employment growth is related positively and significantly to R&D intensity in the case of large US manufacturing firms. Similarly, Greenhalgh et al. (2001) observe that R&D intensity and also the number of patent publications have a positive effect on employment for British firms. Nevertheless, Evangelista and Savona (2002, 2003) observe a negative overall effect of innovation on employment in the Italian services sector. When the distinction is made between product and process innovation, the former is usually linked to employment creation whereas the consequences of the latter are not as clear-cut. Evidence presented in Brouwer et al. (1993) reveals a small positive employment effect of product-related R&D although the combined effect of innovation is imprecisely defined. Relatedly, work by Van Reenen (1997) on listed UK manufacturing firms and Smolny (1998) for West German manufacturing firms shows a positive effect on employment for product innovations. Smolny also finds a positive employment effect of process innovations, whereas Van Reenen's analysis yields insignificant results. Harrison et al. (2005) consider the relationship between innovation and employment growth in four European countries (France, Italy, the UK and Germany) using data for 1998 and 2000 on firms in the manufacturing and services industries. Whilst product innovations are consistently associated with employment growth, process innovation appears to have a negative effect on employment, although the authors acknowledge that this latter result may be attenuated (or even reversed) through compensation effects. To summarize, therefore, we can consider that product innovations generally have a positive impact on employment, whilst the role of process innovations is more ambiguous (Hall et al., 2006).

2.3.3 Financial performance

Research into the relationship between financial performance and firm expansion has traditionally taken the view that any sensitivity between financial performance and investment signals the problem of 'financial constraints' and 'information asymmetries'. We begin by explaining how this interpretation became predominant. However, we prefer what we might call here an 'evolutionary' interpretation of the relationship between financial performance and growth. In any case, it is clear that financial performance is not a major determinant of firm growth rates.

Mainstream research into the expansion of firms has based itself on the q-theory of investment. (Note however that the literature does not elaborate upon the distinction between replacement investment and expansionary investment.)[12] If some initial assumption are sat-

[12]The author is not aware of any relevant empirical work that distinguishes replacement investment and expansionary investment. In the present discussion, we place more emphasis on the latter when we speak of 'investment'. In any case, the distinction between the two may not be very clear-cut in the first place, especially when we consider that firms tend to replace their exhausted capital stock with more recent vintages.

isfied (including the assumption that firms are rational profit-maximizers, and that financial markets are efficient), then a firm's growth prospects can be entirely summarized by the stock market's expectations concerning a firm's expected future profits. In other words, the only predictor of firm-level investment should be the marginal change in the ratio between the market value of the firm and the replacement value of the firm's existing assets. This latter ratio is known as marginal q. Empirical investigations of q models, such as Blundell et al. (1992), have not had great success, however. Tobin's q does not seem to explain a great deal of investment behavior. One possible interpretation is that profit-maximization on an infinite horizon is not a useful explanation for firm's investment decisions. Furthermore, and contrary to theoretical predictions, other variables are significant, such as lagged q, output, or cash flow.

Following on from the literature on the 'q-theory of investment', Fazzari et al. (1988) demonstrate that the investment behavior of US listed manufacturing firms depends not only on q but also on cash-flow. Starting from the assumption that firms are rational optimizers, they interpret any sensitivity of investment to cash flow as evidence that capital markets are imperfect, and that these 'optimal' firms cannot rely on external finance but instead they must finance their investment using internal funds. In their view, investment should not be related to cash flow, and if it is, this indicates that firms are receiving insufficient external finance for their investment plans. Although this 'financial constraints' interpretation of investment-cash flow sensitivities has been quite influential and has generated a large following, there are also several major flaws in this interpretation. Kaplan and Zingales (1997, 2000), for example, examine the firms that were classified *a priori* as financially constrained according to the methodology of Fazzari et al. (1988, 2000), but they find, upon closer inspection using annual reports, that these firms are actually in good financial standing.[13] Further evidence against the 'financial constraints' interpretation of investment-cash flow sensitivities is provided by Levenson and Willard (2000) who analyze survey data on small businesses in the US in 1987-88. They estimate that an upper bound of 6.36% of firms were credit-rationed. This leads them to conclude that "the extent of true credit rationing appears quite limited" (2000: 83).

The main prediction for firm expansion coming from the evolutionary approach (surveyed in Section 3.4) is that investment or firm growth can be expected to respond to financial performance. This is due to the principle of 'growth of the fitter'. In this view, firms fight for growth opportunities, they are in a continual struggle to grow, and only those with superior financial performance will be able to gain additional market share. Empirical research in this evolutionary context is sparse, however. Coad (2005) finds a statistically significant relationship between financial performance and sales growth for French manufacturing firms.

[13] One notable example mentioned by Kaplan and Zingales (2000) is that, in 1997, Microsoft would have been labelled as 'financially constrained' according to the classification schemes of Fazzari et al. (1988, 2000) even though it had almost $9 billion in cash, corresponding to eighteen times its capital expenditures!

Nevertheless, the magnitude of the coefficient is so small that he concludes "it may be more useful to consider a firm's profit rate and it's subsequent growth rate as entirely independent" (2005: 15). Bottazzi et al. (2006) find similar results in their analysis of Italian firms.

A common finding in these approaches, however, is that financial performance does not seem to be an important determinant of firm growth, whether this latter is measured in terms of investment or sales growth. Although the coefficients on financial performance are often statistically significant, there is a large amount of unexplained variation in growth rates. Firms appear to have a large amount of discretion in their growth behaviour.

A further discussion of financial performance and growth can be found in the survey in Coad (2007).

2.3.4 Relative productivity

It is perhaps quite natural to assume that the most productive firms will grow while the least productive will decrease in size. However, this assumption does not seem to be borne out by empirical work. A number of studies have cast doubt on the validity of the evolutionary principle of 'growth of the fitter', when relative productivity is taken as a proxy for fitness. One explanation for this is that while some firms become more productive through expansion, others become more productive through downsizing. An illustration of this is provided by Baily et al. (1996) who observe that, among plants with increasing labour productivity between 1977 and 1987, firms that grew in terms of employees were balanced out by firms that decreased employment. They find that about a third of labour productivity growth is attributable to growing firms, about a third to downsizing firms, and the remaining third is attributable to the processes of entry and exit. Similarly, Foster et al. (1998) also fail to find a robust significant relationship between establishment-level labour productivity or multifactor productivity and growth (see also the review in Bartelsman and Doms (2000: 583-584)). In addition, using a database of Italian manufacturing firms, Bottazzi et al. (2002, 2006) fail to find a robust relationship between productivity and growth. (Notwithstanding this latter result, Bottazzi et al. (2006) observe a strong positive relationship between productivity and profitability.) Perhaps more worrying is the evidence reported for US and UK manufacturing establishments in Disney et al. (2003: 683) revealing a *negative* between-effect in allocation of market share between establishments according to productivity.

While there is ample evidence suggesting that low productivity helps to predict exit (see e.g. Griliches and Regev (1995), Foster et al (1998)), productivity levels are not very helpful in predicting growth rates. Put differently, it appears that selection only operates via *elimination* of the least productive firms or establishments, while the mechanism of selection via *differential growth* does not appear to be functioning well. As a result, the mechanism of selection appears to be rather 'suboptimal' in the sense that its effectiveness is lower than it could conceivably be. For Baily and Farrell (2006), the lack of a positive relationship between relative productivity and growth corresponds to a lack of competition. In an ideal scenario, firms would compete for growth opportunities, and selective pressures would attribute these growth opportunities discriminating in favour of the most productive firms. In this way, there would be some sort of dynamic efficient reallocation at work, whereby an economy's scarce resources are redistributed to those firms that are able to employ them most efficiently. In reality, however, this mechanism does not seem to be operating. Instead, the evidence is consistent with the hypothesis that many of the more productive firms may not actually seek to grow, or may be unable to grow. As a consequence, the absence of selection via differential growth testifies of missed productivity growth opportunities for the economy as a whole. Whilst we can put forward here that stimulating the growth of high-productivity firms might constitute an objective for policy, it is evident that there are large question marks surrounding how such a policy intervention might be engineered.

2.3.5 Other firm-specific factors

A number of other firm-specific variables have been associated with growth rates. Ownership structure appears to be a relevant factor because there is evidence that multiplant firms have higher growth rates, on average, than single-plant firms. This appears to be the case for US small businesses (Variyam and Kraybill, 1992; Audretsch and Mahmood, 1994), large European corporations (Geroski and Gugler, 2004), and also Italian manufacturing firms (Fagiolo and Luzzi, 2006). In their analysis of West German firms, Harhoff et al. (1998) identify that subsidiary firms grow faster than non-subsidiaries in construction and trade industries, although no difference can be found for manufacturing and services. Furthermore, a plant-level analysis reveals that plants which belong to large companies are observed to have higher growth than stand-alone plants (Dunne et al., 1989). Whilst there is weak evidence that foreign-owned firms experience faster growth rates, government-owned firms seem to grow more slowly (Beck et al., 2005). A firm's legal status is also proposed as a determinant of its growth rate. Harhoff et al. (1998), among others, examine the growth of West German firms and observe that firms with limited liability have significantly higher growth rates in comparison to other companies. However, these firms also have significantly higher exit hazards. These results are in line with theoretical contributions, along the lines of Stiglitz and Weiss (1981), that emphasize that the limited liability legal form provides incentives for managers to pursue projects that are characterized by both a relatively high expected return and a relatively high risk of failure.

Another approach has been to consider the characteristics of the management. The 'managerial' theory (surveyed in Section 3.3) suggests that managers attach utility to the size and growth of their firms, such that they will pursue growth above the shareholder-value-maximizing level. This leads to the hypothesis that owner-controlled firms will have lower growth rates (and perhaps higher profits) than manager controlled firms. Whilst Radice (1971) and Holl (1975) find no support for this claim in their analyses of large UK firms, Hay and Kamshad (1994) find that owner-controlled SMEs have lower growth rates than non-owner-controlled SMEs. The human capital embodied in the proprietor has also been suspected of having an effect on firm growth, although the evidence is mixed. Whilst Almus (2002) identifies a positive effect of human capital (i.e. university degree or above) on growth for fast-growing German firms, Robson and Bennett (2000) fail to find a significant effect of skill level in explaining employment or profitability growth in their sample of UK small businesses. McPherson (1996) observes that the level of human capital embodied in the proprietor has a positive and significant influence on the growth of micro and small businesses in five Southern African nations. He also observes that firms owned by female persons have lower growth rates for the businesses in his sample.

It has also been shown that characteristics relating to the nature of the firm's activity have an influence on firm growth. The level of diversification appears to have a negative overall influence on the growth of large European corporations (Geroski and Gugler, 2004), although a positive and significant influence can be detected in the particular cases of advertising intensive industries (Geroski and Gugler, 2004) and the life insurance industry (Hardwick and Adams, 2002). Advertising intensity is another factor that is associated with sales growth, according to Geroski and Toker's (1996) analysis of leading UK firms. In addition, whilst previous firm-level analyses have mainly associated exporting activity to increases in productivity, some authors have identified a positive relationship between exports and firm growth (Robson and Bennett, 2000; Beck et al., 2005). The degree of centrality, or the amount of experience in a network of firms also contributes to a firm's (employment) growth rate, according to Powell et al. (1996).

Threshold effects of various kinds are also thought to dampen the growth of firms. In the past, when antitrust legislation was relatively obsessed with firm size *per se*, large firms sought to limit their growth to avoid antitrust intervention. Furthermore, large firms may be reluctant to implement a strategy of rapid growth (and especially forward integration) because of the threat of a reaction from competitors (see for example Penrose's (1960) biography of the Hercules powder company). In developed countries, there is often a size threshold above which firms face a sudden increase in firing costs. As a result, there may be a slight self-imposed restriction on growth for small firms whose size is close to this threshold. This usually affects firms whose size is somewhere in the range of 8-15 employees range, depending upon the country (see Schivardi and Torrini, 2004). In developing countries, firms can avoid or evade taxes by remaining small and informal. Larger firms, on the other hand, can effectively lobby governments to reduce their tax burden. As a result, the size distribution has a lot of weight corresponding to small firms and large firms, and with a 'missing middle' which testifies to the disadvantages associated with a medium-sized scale of operations (Tybout, 2000). In this case, small firms will tend to allay their growth aspirations, while medium-sized firms will have incentives to grow.

Still other determinants of firm growth can be mentioned here. Almus (2004) observes that German small firms have lower growth rates when there is "the shadow of death sneaking around the corner" (Almus, 2004: 199). Employment growth rates are observed to be significantly lower up to three years before a firm's exit. There is also some evidence that uncertainty may dampen a firm's investment. Guiso and Parigi (1999) present convincing evidence that uncertainty of demand plays a significant role in reducing firm-level investment in the case of Italian manufacturing firms. Their measure of demand uncertainty is constructed by referring to the subjective probability distribution of future demand for firm's products according to the firm's leading managers. Relatedly, Lensink et al. (2005) use survey data on Dutch SMEs to show that uncertainty has a mixed effect on investment. They observe that uncertainty increases the *probability* of investing (in the context of a binary 'invest or not' model), it is seen to reduce the overall *amount* of investment. Finally, Robson and Bennett (2000) show that the use of external business advice is also associated with superior growth. They also present evidence that firms with an 'established reputation' experience lower employment growth and higher turnover growth.

2.3.6 Industry-specific factors

There are several reasons to expect that the growth of firms varies across sectors. Firms in mature industries are likely to have lower average growth rates, *ceteris paribus*, because of the lower level of opportunity in mature industries. Firms in high-technology industries may have high growth rates due to the rapid pace of technological progress and the apparition of new products. Innovation regimes are also known to differ considerably across sectors (Pavitt, 1984), which may have an impact on the growth patterns of firms in different industries. In addition, it is reasonable to expect that the growth of firms is somehow linked to sector-specific degrees of competition and concentration. More generally, the population ecology literature (surveyed in section 3.5) emphasizes the prevalence of industry-specific factors in explaining growth of firms, because they share the same resource pool.

In most empirical research into firm growth, industry-specific factors are controlled away by using industry dummies that take into consideration the total combined influence of all industry-specific variables put together. The list of industry dummy variables are not usually reported alongside the main regression results, partly because of space limitations, and partly because these industry-specific effects are amalgamations of many industry-specific factors, which makes their interpretation difficult. In any case, the inclusion of industry-specific dummy variables does little to improve the overall explanatory power of the regression model (i.e. the R^2 statistic). However, some efforts have been made to identify the sources of industry-wide differences in firm growth rates. Audretsch (1995) report a positive correlation between the minimum efficient scale (MES) and growth of new firms. It appears that the post-entry growth rate of surviving firms tends to be spurred on by the extent to which there is a gap between the MES and the size of the firm. Similarly, Gabe and Kraybill's (2002) analysis of 366 Ohio establishments provides (albeit inconclusive) evidence that the growth of firms is positively associated with the average size of plants in the same 2-digit industry. Industry growth, perhaps unsurprisingly, is observed to have a positive effect on firm growth (Audretsch and Mahmood, 1994; Audretsch, (1995)). Geroski and Toker (1996) examine the growth of firms that are leaders in their respective industries and find that growth of industry sales has a positive effect on firm growth. Nonetheless, total industry innovation does not appear to have a significant effect. Furthermore, Geroski and Toker observe that the degree of market concentration is positively related to the growth of these firms. Finally, Geroski and Gugler (2004) consider the impact on firm growth of the growth of rivals, where rivals are defined as other firms in the same 3-digit industry. Firm growth seems to be negatively related to rival's growth, an observation that is especially true for differentiated good industries and advertising intensive industries.

2.3.7 Macroeconomic factors

Although it has been observed that more of the variation in firm growth rates is between industries rather than across countries (Geroski and Gugler, 2004), it is nonetheless instructive to continue our literature review by considering the influence of macroeconomic factors on firm growth rates.

Several studies have discussed how firm growth varies over the business cycle. In this vein, Higson et al. (2002, 2004) analyse US and UK firms over periods of 30 years and above and observe that the mean growth rate is indeed sensitive to macroeconomic fluctuations. Furthermore, higher moments of the growth rate distribution appear to be sensitive to the business cycle (more on this in Section 2.1.2). Hardwick and Adams (2002) investigate changes in the Gibrat Law coefficient over the business cycle (i.e. the coefficient β in equation (5)), and they obtain some evidence of a countercyclical variation of this coefficient. In other words, smaller firms appear to grow relatively faster during booms, whereas larger firms grow faster during recessions and recoveries.

Davis et al. (2006) investigate the existence of any long term trends in the dispersion (i.e. between-firm variation) and volatility (i.e. within-firm variation) of the growth of firms, using an extensive database on US businesses over the period 1976-2001. They present evidence of a large secular decline in both dispersion and volatility of firm growth rates. Although publicly traded firms have experienced a rise in volatility over this period, this is overwhelmed by declining volatility among privately held firms.

Gabe and Kraybill (2002) consider the role of regional factors in explaining the growth of plants in Ohio. However, both the county growth rate and a metropolitan area dummy do not appear to have a statistically significant effect on growth rates. Contrasting evidence can be found in McPherson (1996), however, who reports that Southern African small businesses grow faster in urban areas than in rural areas.

Bartelsman et al. (2005) explore differences in firm growth in developed countries, and observe that the post-entry growth of successful entrants is much higher in the USA than in Europe. In particular, they observe that "[a]fter 7 years of life, the average cohort of firms in manufacturing experience more than 60% growth in employment, while in European countries the increase is in the 5-35% range" (Bartelsman et al., 2005: 386). This is partly because new firms tend to be relatively smaller upon entry in the US, thus having a larger gap between their entry size and the industry minimum efficient scale (MES). The authors suggest that this difference in post-entry growth rates is due to institutional barriers to growth that are in place in Europe, such as the lack of market-based financial systems, relatively high administrative costs that may deter smaller firms at entry, and tighter hiring-and-firing restrictions.

Several interesting results relating to cross-country differences in firm growth rates can be found in the study by Beck et al. (2005), which analyzes a size-stratified firm-level survey database covering over 4000 firms in 54 countries. They observe that firms in richer, larger, and faster-growing countries have significantly higher growth rates. The growth rate of GDP is positively correlated with firm growth, which indicates that firms grow faster in an economy with greater growth opportunities. Inflation appears to have a positive impact on growth rates, although the authors admonish that this most likely reflects the fact that firm sales growth is given in nominal terms. Furthermore, indicators of financial and legal obstacles, as well as the prevalence of corruption, are obtained from the questionnaire data. These obstacles vary in importance across countries and are observed to be negatively correlated with firm growth rates.

3 Theoretical contributions

In the following we briefly present five distinct theoretical perspectives, discussing their predictions for firm growth and judging them according to the available empirical evidence. These five theories are the neoclassical theory (in particular, propositions based on the notion of an 'optimal size'), Penrose's (1959) 'theory of the growth of the firm', the managerial approach, evolutionary economics and its principle of 'growth of the fitter', and also the population ecology approach.

3.1 Neoclassical foundations – growth towards an 'optimal size'

Although the term 'neoclassical' encompasses a large and vaguely defined body of literature, for the purposes of our discussion on firm growth we consider that the main prediction emerging from the traditional neoclassical perspective is that firms are attracted to some sort of 'optimal size' (Viner, [1931] 1952). This optimal size is the profit-maximizing level of production, in which economies of large scale production are traded off against the costs of coordinating large bureaucratic organizations. In this view, firm growth is merely a means of attaining this 'optimal size', and it is of no interest *per se*. Once firms have reached their optimal size, they are assumed to grow no more.[14]

It is relevant to mention here the well-known transaction costs theory of the firm, which began with the Coase's (1937) seminal article. To summarize briefly, this theory considers that the optimal boundaries of the firm are determined in a trade-off between the advantages of coordination via authority in a hierarchy versus the advantages of coordination through the price mechanism. If transaction costs are relatively large, then firms will find it worthwhile to expand upstream or downstream in order to acquire strategic assets. In this way, the production chain can be coordinated by the use of authority in the context of a hierarchical organization. If transaction costs are low, however, the optimal boundaries of the firm are smaller because the firm can interact with suppliers and customers via the market mechanism. Factors affecting the desirability of integration are the frequency of transactions, uncertainty, the degree of asset specificity, and the possibility of opportunistic behaviour. We observe that the predictions made by the transaction costs literature most often concern growth by acquisition in the context of vertical integration (Kay, 2000). As a result, transaction cost economics appears to have a limited scope in explaining other aspects of firm growth.

Another variation on the optimal size theme is in Lucas (1978), who 'explains' the log-normal distribution of firm sizes by assuming a log-normal distribution of managerial talent. These managers are then assumed to be successfully matched to firms with a size that corresponds to their skill level. Large firms are large because their managers are particularly talented and can accomplish the difficult task of running a large organization with reasonable success. On the other hand, small firms are supposed to remain small because of the relative

[14] One might see a resemblance here with some theories to be found in the Vatican, which consider that people only have sex because they intend to reach an 'optimal' family size. . .

incompetence of their managers. Although managers of large firms would be happy to endorse this idea, we consider that the practical value of such a model is questionable.

The concept of an optimal size has received (and still receives) a great deal of attention, despite a blatant lack of empirical support. The notion of an industry-specific optimal size is at odds with observations on the wide support and the prominent skewness of the firm size distribution which can be found even at finely disaggregated levels of analysis. Even the concept of a firm-specific optimal size appears to be inconsistent with time-series analysis of the patterns of firm growth (Geroski et al., 2003; Cefis et al., 2006). In contrast, Gibrat's model of stochastic drift in firm size performs much better in empirical analysis of firm growth rates than do the neoclassical optimizing models we have mentioned. By way of conclusion to this section, therefore, we suggest that the notion of 'optimal size' is of little use in understanding why firms grow, and that it would be better to un-learn it quickly.

3.2 Penrose's 'Theory of the Growth of the Firm'

Penrose's (1959) seminal book contains several important contributions to our discussion on firm growth. We first present her idea of 'economies of growth' before moving on to the 'resource-based view' of the firm.

Penrose's (1959) fundamentally dynamic vision of firms holds that firm growth is led by an internal momentum generated by learning-by-doing. Managers become more productive over time as they become accustomed to their tasks. Executive functions that initially posed problems because of their relative unfamiliarity soon become routinized. As managers gain experience, therefore, their administrative tasks require less attention and less energy. As a result, managerial resources are continually being released. This excess managerial talent can then be used to focus on value-creating growth opportunities (and in particular, the training of new managers). Firms are faced with strong incentives to grow, because while "the knowledge possessed by a firm's personnel tends to increase automatically with experience" (1959: 76), there is a challenge to take full advantage of this valuable firm-specific knowledge.

It takes time and effort to successfully integrate new managerial resources within the firm, but once this is done these new recruits will be able to execute managerial tasks and, in turn, train managers themselves. In this way, a firm will grow in order to create value from its unused resources, which in turn will create new resources.[15] Growth in any period is nonetheless limited by the amount of available managerial attention. Managers who spend too much time focusing on the firm's expansion divert their attention from operating efficiency. As a result, above a certain point corresponding to what we might call an 'optimal growth rate'

[15] Jacques Lesourne puts it this way - "L'entreprise cherchera à employer ces ressources inutilisées, mais en le faisant en créera d'autres, en ne réussissant jamais à atteindre un état d'équilibre complet dans l'utilisation de ses resources" (Lesourne 1973: 92).

(Slater, 1980), increases in growth will lead to higher operating costs. Although 'economies of growth' provide incentives for firms to grow, fast-growing firms will have higher operating costs than their slower-growing counterparts. This latter proposition is commonly known as the 'Penrose effect'.

Another key concept in Penrose's theory of firm growth is that firms are composed of idiosyncratic configurations of 'resources'. These resources can play a role in ensuring durable competitive advantage if they are valuable, rare, inimitable and nonsubstitutable (Dierickx and Cool 1989; Eisenhardt and Martin, 2000). Examples of resources are brand names, in-house knowledge of technology, employment of skilled personnel, trade contracts, machinery, and efficient procedures (Wernerfelt, 1984).[16] A firm can decide upon the direction of a growth project by examining the strengths and weaknesses of it existing resource base (Barney, 1986). Economies of growth may emerge from exploiting the strengths associated with the unique collection of productive opportunities available to each firm. The indivisible and interdependent nature of these resources can also be seen to add impetus to a firm's growth (Coad, 2006a). In fast-changing markets, however, a firm's competitive advantage may erode if it relies too heavily on certain specific resources. In such circumstances, a firm's performance depends on its abilities to create or release resources and to reconfigure their resource portfolio. These abilities are known as 'dynamic capabilities' (Teece et al., 1997; Eisenhardt and Martin, 2000; Winter, 2003).

Penrose's vision of firm growth considers that firms grow because of 'economies of growth' that are inherent in the growth process, and not because of any advantage linked to size *per se*.[17] A firm's size is merely a by-product of past growth. Although there may be limits to firm growth, there is no limit to firm size *a priori*. Penrose's approach therefore contrasts greatly with the mainstream neoclassical perspective, in which firms only grow in order to reach an 'optimal size' in static equilibrium, and in which there are limits to firm size (on this last point, see for example the model in Williamson, 1967). It is perhaps because of this that Penrose's contribution has, unfortunately, been marginalized in the industrial organization literature – as Montgomery (1994: 167) notes, "[a]lthough The Theory of the Growth of the Firm was published in 1959, it has not had a strong impact on the direction of economic discourse." Nonetheless, Penrose's resource-based perspective has been quite influential in the strategic management literature.

[16]Other examples of 'resources' have also been put forward. Montgomery (1994) suggests that Disney's cast of animated characters can be viewed as a resouce, that has been observed to fuel diversification. Somewhat more unusual is Feldman's (2004: 304) affirmation that even emotions such as anger and frustration can be considered to be organization-specific 'resources'.

[17]Penrose's analysis considers that firms operate in a world of constant returns to scale.

3.3 Marris and 'managerialism'

The fundamental observation of the 'managerial' theory of the firm is that managers attach utility to the size of their firms (for pioneering work on the 'managerial' perspective, see Marris (1963, 1964) and also the books by Baumol (1959) and Williamson (1964)). A manager's compensation, bonuses, and other perquisites are very often increasing with firm size.[18] Furthermore, non-pecuniary incentives such as prestige, likelihood of promotion, social status, and power are also associated with firm size. As a result, firm size (and firm growth) are seen to be important factors in the 'managerial utility function', alongside the financial performance of the firm. For some firms, such as young small firms, the pursuit of growth maximization may coincide with that of profit maximization, so that a manager has no conflict of interest between his duties to shareholders and his own objectives (Mueller, 1969). In other cases, however, managers have to choose between fulfilling their mandate of profit-maximization (in service of shareholders) or pursuing their own interests of growth-maximization. According to the managerial theory, utility-maximizing managers are assumed to maximize the growth rate of the firm subject to the constraint of earning a satisfactory profit rate, which should be large enough to avoid being dismissed by shareholders or being taken over by stock-market 'raiders'.

In the influential managerial model developed by Marris (1963, 1964), firms are assumed to grow by diversification only. Above a certain level of growth, additional diversification has a lower expected profitability because managers have less time and attention to devote to the operating efficiency of existing activities and the development of new activities. The managerial theory has also been extended to the case of growth by conglomerate merger (Mueller, 1969). Mergers are a faster (and more expensive) way of growth than internal growth – so managerial arguments are *a fortiori* relevant for this type of growth.

Testing the 'managerial hypothesis' is a difficult task because the theoretical models (e.g. Marris, 1964) propose a non-linear hump-shaped relationship between growth rate and profit rate, with additional growth having a negative effect on profits only beyond a certain 'profit-maximizing' growth rate. Nonetheless, one basic prediction that emerges is that the growth rates of manager-controlled firm will be higher than those of owner-controlled firms, whilst profit rates are likely to be lower. Some early studies thus tried to find performance differences between owner-controlled and manager-controlled firms. The results, however, did not offer unequivocal support in favour of the theoretical predictions. Radice (1971) tests the hypothesis that owner-controlled firms have lower growth rates and higher profit rates than

[18] Commenting on the contemporary business climate of the 1960's, when managerial theories were first hatched, Mueller (1969: 644) ventures to say that "[m]anagerial salaries, bonuses, stock options, and promotions all tend to be *more* closely related to the size or changes in size of the firm than to its profits" [emphasis added].

management-controlled firms, using a sample of 89 large UK firms over the period 1957-67. Perhaps surprisingly, he observes that owner-controlled firms have both higher growth rates and profit rates. Holl's (1975) analysis also focuses on large UK firms, but he fails to detect any significant difference in performance between owner-controlled and manager-controlled firms. If SMEs are considered, however, there is some survey evidence that management-controlled firms have stronger preferences for growth than owner-controlled firms (Hay and Kamshad, 1994). More specifically, it appears that the largest difference between the strategies of management-controlled and owner-controlled firms concerns the area of geographical expansion.

Another body of research, predominantly from the financial economics literature, has investigated the managerial hypothesis by evaluating the performance of diversifying firms. This is a meaningful way of investigating managerialism because the original model proposed by Marris (1963, 1964) considers that growth takes place exclusively through diversification. The theoretical prediction, then, is that high levels of diversification are associated with lower performance. These studies are surveyed in more detail in Section 4.2.2, which focuses on growth by diversification. In general, diversification is often detrimental to overall financial performance, which provides some indirect support for the managerial hypothesis. This evidence comes from both 'event studies' of the stock market's response to diversification announcements, and also analysis of *ex post* profits of diversifying firms. Conversely, over-diversified firms that subsequently refocus are seen to improve their performance. Furthermore, growth by acquisition appears to be negatively related to a firm's financial performance (Dickerson et al., 2000).

3.4 Evolutionary Economics and the principle of 'growth of the fitter'

The modern economy is increasingly characterized by turbulent competition and rapid technical change, and as a consequence a dynamic theory of competitive advantage may well be more relevant to understanding the economics of industrial organization than the more neoclassical concepts of equilibrium and static optimization. Evolutionary economics has thus been able to make a significant impact on IO thinking, because it proposes a *dynamics first!* conceptualization of the economy. Evolutionary theory has its foundations in Schumpeter's vision of capitalism as a process of 'creative destruction', and borrows the notions of diversity creation and selection to account for the dynamics of economic development. Alchian's (1950) theoretical paper argues that the evolutionary mechanism of selection sets the economy on the path of progress, as fitter firms survive and grow whilst less viable firms lose market share and exit.[19] The notion of selection via differential growth is also a central theme in the books by Downie (1958) and Nelson and Winter (1982). Downie (1958) models industrial development by assuming that firms grow by reinvesting their earnings. Growth rates thus rise with profitability. Nelson and Winter's (1982) influential book contains a formal microfounded simulation model in which firms compete against each other in a turbulent market environment. In this model, firms can gain competitive advantage through either the discovery of cost-reducing innovations or by imitating the industry best practice. Firms that are more profitable are assumed to grow, whilst firms that are less successful are assumed to lose market share. Agent-based simulation modeling has since remained a dominant tool in the evolutionary literature (see, among others, Chiaromonte and Dosi (1993), Dosi et al. (1995), Marsili (2001) and Dosi et al. (2006); see also Kwasnicki (2003) and Dawid (2006) for surveys). In addition to computer simulation models, the principle of 'growth of the fitter' has also formed the foundations of analytical evolutionary models (see, for example, Winter (1964, 1971), Metcalfe (1993, 1994, 1998)).

The evolution of industries in this family of models is generally guided by the mechanism of 'replicator dynamics', by which growth is imputed according to profitability. This mechanism can be presented formally by Fisher's 'fundamental equation', which states that:

$$\delta M_i = \rho M_i (F_i - \bar{F}) \tag{6}$$

where δ stands for the variation in the infinitesimal interval $(t, t+\delta t)$, M_i represents the market share of firm i in a population of competing firms, F_i is the level of 'fitness' of the considered firm, ρ is a parameter and $\bar{F}$ is the average fitness in the population, i.e. $\bar{F} = \Sigma M_i F_i$. It is straightforward to see that this equation favours the 'fitter' firms with increasing market share, whilst reducing that of 'weaker' firms.

This 'replicator dynamics' does sound intuitively appealing, because implicit in it is the idea that selective pressures act with accuracy, that financial constraints prevent inefficient firms from growing, and that the economic system adapts so as to efficiently allocate resources amongst firms, such that firms 'get what they deserve'. However, these assumptions may not find empirical validation for a number of reasons. First of all, it cannot be assumed that all firms have the same propensity to grow. Some high-profit firms may not be interested in business opportunities that are instead taken up by less demanding firms. Freeland (2001), for example, documents how GM's shareholders resisted investing in additional business opportunities and sought to restrict growth expenditure even when GM was a highly profitable

[19] Somewhat more far-fetched is Milton Friedman's (1953) reiteration of Alchian's (1950) original idea, which supposes that the mechanisms of growth of the fitter and exit of the weaker will lead the economy to the neoclassical 'optimum', thereby vindicating the predictions of neoclassical theory.

company. If this is the case, then stricter internal selection will cause high-profit firms to overlook opportunities that are instead taken up by less profitable competitors. In this way, growth may be negatively related to profitability. An extension of this idea is presented by the managerial literature (see Section 3.3), which identifies a tension between profits and growth – this arises when managers seek to grow at a rate higher than that which would be 'optimal' for the firm as a whole, with the resulting growth rate being limited by shareholder supervision. If shareholders monitor management closely, growth rates are predicted to be low and profit rates high. If shareholders are ineffective at monitoring and discipline, however, the growth rate may be high and profit rates low. Second, high profits may be made by firms that can exercise market power by restricting their production to obtain a higher price per unit sold. In this case, a firm which has sufficiently inelastic demand for its goods would have a higher profit rate if it reduces its capacity. In this case too, increases in profits would be associated with negative growth. Third, if a firm occupies a highly profitable niche market, it may not have opportunities to expand despite its high profits. Fourth, a firm may experience a higher profit rate due to efficiency gains by downsizing and concentrating on its core competence. Here again, we have no reason to suppose a positive association between profits and firm growth. (Further reasons why firms may not all want to grow are discussed in Section 4.1 on 'Growth strategies'.) As a result, the existence of a relationship between profitability and growth is an empirical question.

The principle of 'growth of the fitter', despite its eloquence, does not appear to receive much support from empirical analyses. Let us consider the two usual candidates for 'fitness', namely profitability and productivity, in the light of the survey of empirical work in Section 2.3.3. To begin with, we observed that profitability and sales growth appear to be largely independent from each other, when we consider the available evidence from studies of French and Italian manufacturing industries. Similarly, research based on data for US, UK and Italian manufacturing firms fails to find that the more productive firms grow faster than the others. Although profitability and productivity are perhaps the most obvious indicators of 'fitness', others such as product quality or cost levels have also been suggested. These latter variables are usually more difficult to observe, and so they are not often used in empirical work (although it can be anticipated that they should be positively correlated with both profitability and productivity). However, we can mention here the work by Hardwick and Adams (2002). Whilst these authors fail to find any effect of profitability on firm growth, they do observe a negative influence of the input cost ratio on growth, for UK life insurance companies (i.e. that high-cost firms have lower growth rates). Weighing up the available evidence, though, we must acknowledge that empirical work on the principle of 'growth of the fitter' does not provide encouraging results. It may be better to suppose that selection works only by elimination of the weaker, with growth not being related to any notion of 'viability' but instead being at the discretion of managers. In this view, we have 'survival of the fitter' without 'growth of the fitter' (as in the simulation model of van Dijk and Nomaler (2000)).

There are also welfare implications attached to the failure of the principle of 'growth of the fitter' (Baily and Farrell, 2006). If high performance firms were observed to have the fastest growth rates, then selective processes would bring about some sort of efficient dynamic allocation of the economy's resources between firms. Scarce productive resources would be attributed to those firms who can best exploit them. However, since 'growth of the fitter' is generally not observed, economies may be far from achieving their full productive potential. This may be an opportunity for policy intervention.

3.5 Population ecology

The 'population ecology' or 'organizational ecology' perspective hails from sociology and follows on from the seminal contribution of Hannan and Freeman (1977). (More on population ecology approach can be seen in the surveys by Geroski (2001) and Hannan (2005), and some recent developments can be found in the special issue of *Industrial and Corporate Change* (Vol. 13, No. 1, 2004).) The basic theoretical prediction pertaining to the growth of organizations is that these latter require resources which are specific to niches, and these niches have a particular 'carrying capacity'. If a firm has discovered a new niche with a rich resource pool, then this firm will be able to grow without hindrance. The number of firms in the niche will also grow, due to entry of new organizations. If the population grows to a level where the niche's resource pool is saturated, however, then competition between firms will limit the growth rates of firms. This relationship between the growth of organizations and the competition for resources in a particular niche is known as 'density dependence'.

The population ecology perspective thus places the growth of organizations in the context of niche-specific growth patterns without focusing as much on heterogeneity between organizations occupying the same niche. This should not be taken to mean that the scholars deny the existence of differences between organizations.[20] Instead, this is due to the fact that the fundamental unit of analysis here is the population of organizations within a niche, rather than the individual organizations that make up the population. As a consequence, population ecologists tend to explain the performance of organizations by referring to features common to all organizations within the same niche, rather than firm-specific factors.[21] Of course, there are clear limits to a theory of firm growth rates based solely on industry-wide characteristics, because large differences in growth rates can be observed between firms in the same industries.

[20]There is ample evidence that the population ecology perspective explicitly acknowledges interorganizational heterogeneity. For example, in the seminal article by Hannan and Freeman (1977: 956), they write "[f]or us, the central question is, why are there so many kinds of organizations?" Furthermore, Hannan (2005) opens his literature review with this very same question.

[21]As Geroski (2001: 535) notes, there is a "heavy reliance on density dependence to drive dynamics."

Notwithstanding the analytical starting point, however, some efforts have been made to relate the performance of organizations to idiosyncratic rather than environmental factors.

Broadly speaking, the empirical strategy in the 'population ecology' literature takes place by gathering life-history data on populations of organizations that are arguably in the same 'niche'. This niche may refer to specific industries (e.g. automobile producers (Hannan et al., 1995)), niches within industries (such as biotechnology drug discovery companies (Sørenson and Stuart, 2000)), or even non-commercial ideological organizations (Minkoff, 1999). Most studies focus on the effects of characteristics of organizations[22], populations, and the environment on organizational performance by examining birth and death rates of organizations. However, efforts have been made to explain differences in growth rates between firms in the same industry. Baron et al. (1994) analyse data on New York Credit Unions over the period 1914-1990 and observe that larger firms have lower expected growth rates than their smaller counterparts. The interpretation they offer is that larger organizations have become less efficient and less well adapted to the current business environment, thus being more vulnerable to young competitors. This builds upon a key population ecology tenet that firms are fundamentally inert (Hannan and Freeman, 1984), being both averse to and relatively incapable of strategic or organizational change.

4 Growth strategies

In the following we will first discuss the attitudes of firms towards growth, and then the available means of achieving growth (such as diversification and acquisition). It appears useful to relate these two topics to the distinction between 'demand' for growth and 'supply' of growth opportunities, respectively. Firm growth requires both a willing attitude to take up growth opportunities, and also the availability of suitable opportunities. However, in the long-run, the distinction between supply and demand determinants of growth may become blurred (Penrose, 1960). Managers with a strong desire to grow will surely find suitable growth opportunities if they search for them. Correspondingly, even firms with a marked aversion to growth will eventually take up additional growth opportunities if these are attractive enough.

4.1 Attitudes to growth

As firms get older, they generally increase in size. However, growth is neither irresistible nor inevitable. Indeed, some firms may not wish to pursue growth even if the opportunity presents itself. We observed in Section 2.3.3 that a firm's growth rate is largely independent of its financial performance. This is consistent with suspicions of a disconnect between a firm's

[22] Organizational heterogeneity is usually modelled using variables such as age, size, and organizational form.

ability to grow and its desire to grow. In this section we attempt to expound why firms may or may not want to grow, as well as discussing the intentionality of growth.

4.1.1 The desirability of growth

Advantages of growth Growth of an organization can be seen as a means of alleviating tensions in its internal management. Employees appreciate the opportunities for promotion as well as the higher salaries and prestige that accompany growth. Aoki (1990) writes that employees may even be willing to forego current earnings in exchange for future benefits made possible by promotion in an expanding hierarchy. In addition, work is likely to become more challenging as the firm 'breaks from its routines' and expands into new business areas. "Work is more fun in a growing company" as Roberts (2004: 243) bluntly puts it. Conversely, a lack of growth can create an uninspiring and stultifying business environment which depresses managerial efficiency (Hay and Morris, 1979). As a result, in growing firms it is "easier to obtain commitment to organizational goals and priorities from various factions and to resolve conflicts between those factions" (Whetten, 1987: 340). An organization may thus seek a positive growth rate in order to keep its members satisfied. Indeed, it has been conjectured that firms that take their employees interests seriously are likely to have higher growth rates (Aoki, 1990).

The managerial vision of the firm can be considered as an extension of this line of reasoning. Managers attach positive utility to the growth rate of the firm, because an increase in firm size is associated with increases in compensation, power, prestige, bonuses and perquisites. One difference is, however, that managers have the power to determine a firm's growth strategy themselves, and so they can pursue a growth rate above that which would be optimal for the shareholders. For more on the managerialist theory of the firm, see Section 3.3.

Firms may also seek growth as a means of attaining other objectives related to its production of goods and services. Lower production costs may be achieved if expansion leads to economies of scale (due to a larger scale of production), or economies of scope (because of a wider range of products or services). Growth may also take place if firms wish to expand their productive capacity or boost their output so as to deter entry from potential competitors (Dixit, 1980).[23] Furthermore, a larger, more diversified firm is better able to spread its risk among its various activities. (This will be an advantage for managers whose fortunes are tied to those of the firm (Amihud and Lev, 1981), although it is not necessarily an advantage for shareholders because they can reduce their risk by investing in a diversified portfolio including other firms.) In this way, growth can be considered to be a basis for security (Whetten, 1987).

[23] The 'entry deterrence' argument is of limited relevance, because entrants are usually too small to pose a serious threat. However, the argument may hold as long as large firms in other industries are deterred from diversifying into the sector under consideration.

Other reasons have also been advanced to suggest why firms might want to grow. One reason might be because growth is sometimes a more suitable metric of performance than profits – this is particularly true for high-volatility markets. A firm's management may thus set its performance goals in terms of percentage increases in sales rather than profit margins or share prices. Other firms may grow for want of a better alternative. This might be the case for firms who grow by reinvesting profits in the company, as a means of avoiding heavy taxes (on dividends, for example).

There is some empirical evidence that demonstrates the positive effect of growth on firm performance. Coad (2005) analyzes a large sample of French manufacturing firms and observes that growth is associated with short-lived increases in profit rates, whether growth is measured in terms of employment, sales, or value added. Perhaps surprisingly, there seems to be a larger effect of growth on profits than that of profits on growth. This finding of a beneficial and temporary influence of firm growth on profit rates is consistent with the Kaldor-Verdoorn 'dynamic increasing returns', Penrose's (1959) theory of 'economies of growth', and Starbuck's (1971) 'Will o' the Wisp' models of firm growth.

Disadvantages of growth Despite the aforementioned advantages linked to growth, some managers or owner-managers may be wary of increasing the size of their firm. One major reason for this is what we could call the 'control-loss' argument. Loss of control may originate from the increased size or the rate of growth. As a firm increases in size, as employees are added and the number of hierarchical levels increases, the manager has less control of the firm and is less well informed of its current state (Williamson, 1967). Problems of control and coordination are also increasing functions of the growth rate. Whilst it has been advanced that problems of coordination vanish under truly static conditions (Kaldor, 1934), fast-growth firms may experience difficulties in coordinating operations in a complex and changing environment.[24]

Family-owned and traditional firms may have an especially cautious approach to growth if they are keen to keep the firm under tight control or if they are reluctant to integrate a large number of employees and managers from outside the family. Furthermore, they may be particularly risk-averse because failure of the enterprise may take on connotations of ruining the family tradition. Managers whose training and experience have been confined to a single industry are also characteristically timid when it comes to growth, especially growth by diversification (Ansoff, 1987). This is also true for managers approaching retirement. In these cases, firms may prefer not to expand, and instead remain in a 'comfort zone'.

Larger firms are less attractive environments than smaller firms for a number of reasons. Large firms are less adaptable and less responsive than their smaller counterparts. Routiniza-

[24]Using survey evidence for Dutch SMEs, Lensink et al. (2005) observe that higher growth firms perceive that they have more idiosyncratic uncertainty than other firms.

tion replaces initiative, and bureaucratic ossification replaces the dynamism associated with small firms. Large organizations tend to become less motivating environments for employees. Furthermore, the initial energy and motivating enthusiasm of the founding entrepreneur is replaced by a manager whose role is to monitor and coordinate a more routinised method of production (Witt, 2000). A common ideology and a cooperative working environment is substituted by an organizational culture in which employees are more concerned with personal and self-centered goals. However, it should be emphasized that a distaste for organizations of large size does not necessarily preclude a firm's growth. Because of 'economies of growth', firms may still benefit from taking up marginal growth opportunities even if there are diseconomies of large size (Penrose, 1959). Indeed, growth should not be seen as merely a means of attaining a larger size.

A firm's attitude to growth may also be influenced by the existence of a certain size threshold. Schivardi and Torrini (2004) demonstrate that Italian firms close to the threshold of 16 employees are reluctant to expand because this would be associated with an increase in their employment protection responsibilities. Although statistically significant, this effect can only be detected using large databases, however, and so its economic importance should not be exaggerated. Tybout's (2000) survey of manufacturing firms in developing countries describes how small firms have incentives to stay small and informal to avoid taxes. In contrast, medium-sized firms have incentives to grow in order to become large enough to be able to lobby the government. It has also been suggested that large firms whose sales account for a significant fraction of the market may also restrain their own growth in order to keep prices high and avoid 'spoiling the market' (see e.g. Nelson (1987)).

Some empirically-minded papers have found negative attitudes to growth in a range of situations. A lack of desire for growth has been found by Tether (1997) in the case of UK high-tech firms as well as by Audretsch et al. (2004) for family-owned hospitality industries in the Netherlands. Hay and Kamshad (1994) present evidence from a survey of UK SMEs. They find that many software firms encounter limits to growth imposed by the scarcity of first-class programmers. In the instruments industry, the scientists that founded the firms are often not well prepared for the management roles that larger firms require. In the printing sector, many firms choose not to grow simply because the owners use their business as a means to support a relaxed and independent lifestyle. More generally, Greiner (1998) provides the following description of the 'lifestyler' manager's attitude to growth: "Top management that is aware of the problems ahead [linked to organizations of a large size] could well decide not to expand the organization. Managers may, for instance, prefer to retain the informal practices of a small company, knowing that this way of life is inherent in the organization's limited size, not in their congenial personalities. If they choose to grow, they may actually grow themselves out of a job and a way of life they enjoy" (Greiner, 1998: 67).

4.1.2 Is growth intentional or does it 'just happen'?

Are growth opportunities to be passively seized or are they to be built? Is firm growth intentional and proactive, or does it 'just happen'? Some perspectives on firm growth, such as Gibrat's law, view it as a passive absorption and accumulation of growth opportunities. Other authors, however, talk of 'growth strategies', and sometimes firms include growth rate targets among their explicit performance objectives. In this section, we discuss different perspectives on the intentionality of firm growth.

Gibrat's (1931) 'law of proportionate effect', in its simplest form, considers that the growth of firms is best modelled as a stochastic process in which the magnitude of a random 'growth shock' over a specific period is independent of a firm's size. Relatedly, the 'island models' developed by Ijiri and Simon (1977), Sutton (1998) and Bottazzi and Secchi (2006b) present statistical processes in which firms are seen as 'islands', or independent entities, whose resultant growth is simply a cumulation of the stochastic opportunities they receive in any period. These growth opportunities are supposed to be exogenously created and upon arrival they are randomly allocated across firms. Firms are required to have minimal rationality, and, more generally, these statistical models can be said to have a minimal recourse to any economic theory because growth is entirely explained by random factors. One advantage of this class of models, however, is that they can explain the observed size distribution whilst demonstrating both simplicity and generality. Whilst Gibrat's law appears to be one of the more useful approaches to modelling firm growth and the evolution of industries, it should nonetheless be remembered that there is a certain rationality and intentionality in the process of firm growth.

Another early model considered that the size of an organization has an inherent and quasi-automatic tendency to drift upwards (Parkinson, 1957; see also Starbuck, 1971: 16-17). The rationale of this model is that members of an organization, at all hierarchical levels, are guided by motives of prestige, power, and security. Consider the case of an employee, A, who considers herself overworked. She has three options – she may resign, she may ask to halve her work with a colleague called B, or she may ask the assistance of two subordinates, C and D. In fact, the third option is the only serious one. If she were to resign, she would lose her job and all associated privileges. Were she to ask for B to be appointed, she would merely introduce a rival into her level of the hierarchy (which would also reduce her chances of promotion). As a result, she asks for two assistants. These assistants improve her status in the organization, and furthermore, by dividing her work into two categories (for C and D) she will become entrenched in a position of power because she is the only person who understands the work of both of the assistants. In turn, when C and D consider themselves to be overworked, A will be more than happy to introduce further insubordinated employees. These later additions will improve her standing in the hierarchy, and make her more eligible for promotion and salary increases. As we have seen, in this particular model, the growth of the organization has little to do with 'decisions taken at the top' but instead it is due to the behavior of people throughout the hierarchy.

Some authors, mainly from Penrose's camp, explain growth as being due to the build-up of internal pressure. As time goes by, managerial resources are continually being released as managers become more accustomed to their work and become more productive. (More on Penrose's 'Theory of the Growth of the Firm' can be found in Section 3.2.) As a result, managers can divert their attention from routine operations to planning and carrying out growth projects. Unused managerial services are a key determinant in a firm's capacity to expand. Firms must then decide upon the direction for growth. Managers must search for potential growth opportunities and draw up growth plans. As a result, growth is an informed and intentional process (Penrose, 1955).[25] Growth is seen primarily as a result of managerial decision and 'human will' rather than being a response to technological factors.[26] If, on the other hand, these unused managerial services are involved in growth projects that are unstructured or ill-prepared, then they are unlikely to succeed (Penrose, 1955; Dixon, 1953).

In neoclassical work, even stronger rationality is attributed to firms that grow. In this perspective, growth is the result of a forward-looking process in which firms adjust their current scale of production to anticipate future market trends. According to neoclassical q-theory, firms are assumed to have rational anticipations, and their size is determined as the solution to an intertemporal profit-maximization problem on an infinite time horizon (see Section 2.3.3).

By way of conclusion, then, we consider that firms do have some rationality in their growth, although assuming perfect rationality is certainly taking things too far. For some firms, such as small firms struggling to reach the MES (minimum efficient scale of production), growth is very much an intended outcome. This is in spite of what a simplistic and literal interpretation of Gibrat's law might suggest – firm growth is not just an 'organizational drift', but instead there is some rationality and planning involved.

4.2 Growth strategies – replication or diversification

"[G]rowth is not for long, if ever, simply a question of producing more of the same product on a larger scale; it involves innovation, changing techniques of distribution, and changing organization of production and management" (Penrose 1959: 161). Although in some cases

[25]In fact, it is precisely because of the intentionality attributed to the growth of firms that Penrose (1955) rejects biological analogies as valid descriptions of firm growth.

[26]An unpublished comparison of sectoral growth rate distribution parameters (at the 3-digit level) for Italy and France reveals that there is very little in common in the growth rate distributions for same sectors across countries. This hints that the underlying sector-specific production technology does not go far in explaining growth rates – instead it may well be that human factors play a major role.

firms may be able to expand by producing 'more of the same' using the same resources, the time will come when further expansion will require them to take on new employees, build new production plants, or even diversify into new markets. There are thus a number of issues and complications that accompany a firm's decision to grow. These issues are discussed in the following sections.

4.2.1 Growth by replication

In traditional economic theory, firms decide how much to produce by selecting a profit-maximizing output level determined by the demand curve. It is supposed that the firm operates in a homogenous product market and can easily expand or contract to arrive at the optimal output level. While this may be an acceptable description of the output of one particular factory floor, it is unhelpful in describing more significant growth events such as the hiring of new employees or the setting up of new production plants.

One caveat of this primitive vision of firm growth is that the production of goods and services requires the application of a certain amount of tacit knowledge. This tacit knowledge is difficult to transfer from one individual to another, or from one locus of production to another. As a firm grows, problems may arise because of the difficulty in transferring this tacit knowledge. Although the firm may have enjoyed successful production in the past, is may be non-trivial to replicate this past success with newly-introduced additional productive capacity, especially where production processes are characterized by a high degree of complexity (Rivkin, 2001). In other words, businesses may fail when they try to reproduce a best practice because the in-house 'experts' don't truly know why it worked in the first place (Szulanski and Winter, 2002).

Indeed, the extensiveness of tacit knowledge and the difficulty of replication may go some way in explaining the persistent heterogeneity in profitability and also productivity levels that are visible even between firms in the same narrowly-defined industrial sectors.[27]

How then can a firm replicate its superior performance? A firm's replication strategy is more likely to be successful if a few guidelines are followed (Winter and Szulanski, 2001; Szulanski and Winter, 2002). First, the template should be kept in mind throughout the replication process, and even after acceptable results have been obtained by the new unit. This template should be copied as closely as possible. Changes can be introduced only after decent results have been obtained. Managers should focus on the activity they are trying to replicate, rather than on what the documentation or the experts say. Finally, it is important that managers have a meek attitude and a keenness to copy the template faithfully rather

[27]For empirical evidence on the heterogeneity of firm productivity levels, even within narrowly-defined industrial sectors, see Dosi and Grazzi (2006). See also Dosi (2007) for evidence on the dispersion of profit margins within industries.

than to attempt to improve upon it.

A more extreme approach to technology transfer, applied by Intel, is known as the 'copy **EXACTLY!**' policy (MacDonald, 1998). Semiconductor manufacturing is characterized by very complex production processes in which the process steps have low tolerances and have complex interactions. In addition, this complexity has increased with successive generations of semiconductors. Precision in replication is thus of paramount importance. If variables such as barometric pressure, ultra pure rinse water temperature and the length of the electrode cooling hose are not copied with utmost accuracy, the results can be catastrophic. After a period in which new plants exhibited a dismal performance, Intel developed the 'Copy **EXACTLY!**' philosophy according to which "'everything which might affect the process, or how it is run' is to be copied down to the finest detail, unless it is either *physically impossible* to do so, or there is an *overwhelming competitive benefit* to introducing a change" (MacDonald, 1998: 2 (emphasis in the original)). Furthermore, if a modification has been suggested and is applied, this idea is simultaneously implemented at all other sites as well. As a result of this replication strategy, it is now common for Intel's new production plants to meet best-practice performance standards from the very first day of production.

4.2.2 Growth by diversification

Theoretical perspectives An early view of diversification considered that managerial competences were the key to superior firm performance, irrespective of the sector of activity. In other words, this perspective holds that "management is an amorphous substance which can be applied with equal success to totally unrelated lines of business" (Mueller 1969: 651). In order to take full advantage of these scarce assets, successful firms sought to spread their superior management capabilities across several different industries. In this way, diversification was guided by a logic of synergies of managerial competence as opposed to synergies of a technological nature. As a result, the large diversified conglomerate became a popular organizational form, especially in the 1950s and 1960s.

Penrose's (1959) vision of firm growth by diversification can be placed within this context. Managerial attention is seen to be the main factor limiting firm growth. As a firm continues its operations, incumbent managers gradually gain experience, and new managers can be trained and integrated into the firm, thus expanding the firm's resource base. In this way, managerial resources are continually being freed up over time. Growth thus constitutes a responsible use for excess managerial attention – it challenges managers to focus their attention on generating profits in new activities. However, Penrose also gives clear recommendations as to the direction of diversification. A key element of Penrose's theory of firm growth is that firms are composed of indivisible resources, which are specialized and specific to the firm. A firm's diversification strategy should therefore focus on how to best exploit the idiosyncracies of the firm's current resource base. In other words, growth by diversification is most effective when the new activities are related to the existing resource base.

The notion of related or 'synergistic' diversification is central to Igor Ansoff's [1965] (1987) celebrated book. Ansoff advocated a prudent approach for diversification at a time when, in retrospect, it appears that general management synergies were overestimated. According to him, firms should only consider diversification when there is no other option for a firm of realizing its growth objectives – "if a firm can meet all of its objectives by measures short of diversification or internationalization, it should do so" (Ansoff 1987: 131). Indeed, in many cases a firm can discover growth opportunities by re-evaluating and re-formulating its strategies within its present portfolio of activities, instead of expanding the portfolio by commencing new activities. Firms that choose to diversify, however, can do this in one of three ways: by exporting the firm's traditional products or services into new markets (which constitues the "highest synergy move" (Ansoff 1987: 125)), or by diversifying according to synergies of demand or synergies of technology. In each case, attention must be paid to the coherence of the diversified firm's portfolio of activities. Candidate new businesses must display synergies with the existing portfolio of activities along dimensions such as operations, R&D, or marketing and distribution. These synergies may be due to lower expected fixed costs of starting-up, or alternatively due to anticipated operating economies. Furthermore, efforts should be made to convert the *ex ante* 'potential synergy' into 'realized synergy', by actively seeking to integrate the new activity alongside the firm's existing activities. If these guidelines are successfully applied, synergistic diversification allows firms to earn superior profits by leveraging their capabilities, know-how and general experience in new markets. It should be pointed out that synergistic diversification is not incompatible with corporate refocusing, but is instead closely related (Batsch, 2003). Both of these view the firm as a coherent portfolio of related activities based on a small number of core competences. Refocusing can be seen as a corrective strategic measure undertaken after excessive unrelated diversification – it is a modification (but not necessarily a reduction) in a firm's activities as the firm seeks to focus on exploiting certain specific capabilities. Refocusing should not be seen as a 'return' to the firm's previous condition, however, but as a strategic reevaluation of a firms core competences in an ever-changing business environment (Paulré, 2000).

'Managerial' or 'agency' theories of firm growth, as presented above in Section 3.3, have also made a considerable impact on research into diversification. (In fact, empirical work on diversification has mainly focused on testing the hypothesis that diversification is detrimental to firm performance.) The decision to diversify is usually taken at the initiative and the discretion of managers, and managers have strong incentives to diversify even when this is not in the best interests of shareholders. On the one hand, standard economic theory predicts that diversification will be in the best interests of the firm as a whole when expansion into new activities promises relatively high profit levels. Diversification was also historically encouraged for other reasons pertaining to the business environment around the time of the 1960s – the multidivisional firm (i.e. the 'M-form') was lauded as an effective organizational innovation, underdeveloped financial markets meant that there were advantages of having an internal capital market (i.e. the 'deep pockets' argument), and the prevailing anti-trust legislation limited growth prospects in any one industry. On the other hand, however, diversification also offers at least four other advantages that are more specific to managers. First, managers of large and growing firms receive higher pay (as well as increases in bonuses, 'perks', prestige, and "the pure pleasures of empire-building" (Montgomery, 1994: 166)). This point is clearly illustrated by Hyland and Diltz (2002), who compare managerial compensation for a group of diversifying firms with a similar matched sample of undiversifying firms – "the mean compensation increase over the time interval between proxy statements for diversifying firms is $84,397 and the median is $57,133. . . . For matched-sample firms, the mean compensation increase is $22,642 and the median is $18,128" (Hyland and Diltz 2002: 64). Second, managers who have vested interests in the performance of their firm (or who are merely concerned about their reputations) may attempt to lower the firm's volatility by spreading the risk and diversifying into new activities, even if this does not improve the firm's average rate of return (Amihud and Lev, 1981). This is against the interests of shareholders, because these latter usually prefer to reduce risk by including diverse specialized firms in their investment portfolio, rather than by investing in one diversified firm. Third, managers may diversify in order to ensure that the firm will require their personal skills and services in the future – this is known as the 'managerial entrenchment' argument (Shleifer and Vishny, 1989). Fourth, managers may be reluctant to distribute any spare cash-flow back to shareholders in the form of dividends, and instead they may prefer to spend it on pet projects even if these have a low expected return (Jensen, 1986).

Empirical evidence A large body of research in the financial economics literature has focused on the relative performance of diversified firms vis-à-vis stand-alone firms or less-diversified firms, generally using data on large US firms. The general message that emerges is that diversification is associated with inferior performance (although some more recent evidence has brought this into question – see the survey in Martin and Sayrak (2003)). In some cases, diversification behavior is examined via 'event studies' of stock market reactions to diversification or refocusing. It appears that the stock prices respond negatively to diversification announcements (see e.g. Hyland and Diltz, 2002) but positively to refocusing announcements (Berger and Ofek, 1999; Markides, 1992). Others have analyzed the effects of diversification on *ex post* realized profits, again finding that diversification exerts a negative pressure on profits (Doukas and Kan, 2004). Conversely, there is evidence that corporate refocusing is associated with increases in *ex post* profits (Markides, 1995). The distinction between related and unrelated diversification has also received attention from empirical work. Whilst unrelated diversification is often detrimental to firm performance, related diversification is more successful. As a result, despite the negative tone of research into the performance of diversified companies, it is likely that the 'optimal level of diversification' for large firms is above the minimum of one industry (Montgomery, 1994).

A historical perspective on diversification is also of interest. In the 1950s and 1960s, diversification was actually a popular strategy, for several reasons. First, capital markets were relatively undeveloped and firms had incentives to organize several businesses around an 'internal capital market'. (This is also known as 'deep pockets' argument.) Second, antitrust law imposed limits on the market shares of firms in specific industries, which meant that firms who were willing to grow had to do so in new industries. Third, the multidivisional or 'M-form' organization was growing in popularity. Fourth, there is evidence that early diversification announcements actually received a positive stock market reaction. As a result, the 1960s have been described as a 'wave of unrelated acquisitions' (Montgomery 1994: 170). The 1970s were also characterised by unrelated acquisitions and overdiversification. The 1980s, however, correspond to a 'return to corporate specialization' (Bhagat et al., 1990). During this time, changes in the business environment made diversification less appealing (in particular, financial markets became more developed, and antitrust law changed its stance on measures of absolute market share). Furthermore, the poor financial performance of large diversified conglomerates had become widely recognized.

4.3 Internal growth vs growth by acquisition

Internal growth, also known as 'organic growth', is usually associated with non-diversifying firms, while growth by acquisition is usually associated with diversifying firms. However, both internal growth and acquisition can be used as means of either expanding market share in a particular industry or of diversifying into new industries.

Internal growth is a preferable means of diversifying when there are strong synergies between the firm's existing activities and the target industry. These synergies may take the form of reduced entry costs or reduced operating costs, or both. Furthermore, internal growth is particularly attractive if firms can develop and integrate their new capabilities in an environment where time pressures are not too great. In this way they can steadily cultivate a sound base of in-house competences that will be a source of enduring competitive advantage. Internal growth is also a relevant option when there are no suitable target firms available for acquisition at a reasonable price.

Growth by acquisition of other businesses, on the other hand, is most effective when a firm must rapidly acquire new capabilities, production capacity or good managerial resources. Similarly, acquisition is a preferred means of entry into industries in which market shares are already stable and there is little space for a new entrant. Furthermore, acquisition is more appropriate if synergies with the new activity are not expected to be significant.

Nevertheless, a strategy of growth by diversification is particularly difficult to make good. "There are more unsuccessful acquisitions than there are successful ones" according to John Harvey-Jones, former Chairman of ICI (cited in Ansoff 1987: 10). In reality, acquisitions are rather expensive growth strategies. According to one (admittedly dated) estimate, the typical premium paid by an acquiring firm is 10-30% above the market price of the acquired firm's stock before the merger (Mueller 1969:652). To this must be added the costs of assimilating the target firm, in order to convert the 'potential synergy' into 'realized synergy'.

Acquisitions have been attributed a noble character by some economists because, in effect, they introduce an element of competition into the 'market for corporate control'. The possibility of takeover can act as a disciplining device that gives incentives for management to run a company with efficiency and due responsibility (see e.g. Marris (1964)). In reality, however, the 'market for corporate control' is very imperfect, takeovers are very rare, and inefficient management can continue for long periods. The disciplining device of takeovers is rather weak. In contrast, it seems that acquisitions are often a source of inefficiency in the economic system – indeed, "quite a bit of evidence points to the dominance of managerial rather than shareholder motives in firms' acquisition decisions" (Shleifer and Vishny, 1997: 747). For example, acquisitions may take place because managers act in their own interests rather than those of the firm as a whole (Mueller 1969). This conflict of interests may arise if pay increases, bonuses, perquisites, or prestige are associated with the size of the firm. In addition, managers of mature firms (often having high cash flow but few growth prospects) may choose to acquire businesses because they are reluctant to distribute the earnings to shareholders (Jensen, 1986). Furthermore, managers may undertake acquisitions because they are overconfident of their managerial abilities – this is the essence of Roll's (1986) 'hubris hypothesis'. As a result, empirical evidence suggests that "acquisitions, in general, have a deleterious effect on company performance as measured by profitability" (Dickerson et al., 2000: 424). Acquisitions may also be socially harmful if a firm acquires a competitor as a way of obtaining market power in a particular industry. For all of these reasons then, and perhaps more, acquisitions are often associated with decreases rather than increases in social welfare.

5 Growth of small and large firms

There are fundamental differences between small and large firms that it would not be appropriate to neglect. Indeed, in Section 2 we observed that small firms do have different growth patterns from larger firms. The aim of this section is to elaborate upon these differences. We begin by focusing on the dichotomous distinction between small and large firms, before taking a more detailed look at organizational stresses that accompany the growth process in our discussion of the 'stages of growth' models.

Firms that are small (large) very often correspond to firms that are young (old). Although this is not always the case,[28] in the following small (large) and young (old) can be taken as more or less synonymous adjectives of firms.

5.1 Differences in growth patterns for small and large firms

The growth of small firms is a particularly erratic phenomenon. Entry rates of new firms are high, regardless of the industry, and a large number of these entrants can be expected to fail within a few years. For example, Bartelsman et al. (2005) examine the post-entry performance of new firms in 7 OECD countries and observe that about 20-40% of entering firms fail within the first two years, while only about 40-50% survive beyond the 7th year. A small proportion of these entrants are actually innovators, as highlighted by Santarelli and Vivarelli (2006: 5) – "one has to recognize that when dealing with gross entry across all economic sectors we encounter a huge multitude of 'followers' and very few 'real' entrepreneurs." Instead, overconfidence and the escape from unemployment are often key characteristics of new firms.

These firms enter on a small scale relative to incumbents – around 40-60% of the average size of incumbents (Bartelsman et al., 2005). Their small size puts them at a disadvantage vis-à-vis their larger counterparts, and so they must expand rapidly, as if their life depended on it. The larger they grow, the smaller their cost disadvantage relative to firms above the MES, and thus the higher their chances of survival. For such firms, the growth objective coincides with survival and the pursuit of profits. These firms tend to have a higher average growth rate than larger firms, despite the difficulties they may face in financing their expansion.

According to Penrose (1959), small firms can thrive in the 'interstices' of major markets, in submarkets that are not large enough to support large firms. As a result, they are often sheltered from direct competition with large firms. This is not to say that they are entirely protected from the competition however. In fact, survey evidence for small businesses indicates that competitive pressures are a major factor inhibiting their growth (Hay and Kamshad, 1994; Robson and Bennett, 2000).

[28] It may be that small firms are nonetheless relatively old, if they have a history of aversion to growth.

The growth of large firms is different in several respects. While small firms' survival depends to some extent on their growth, for large firms above the MES the objectives of survival, growth and profits become separated and may even conflict. Growth of large firms takes on a new meaning as 'economies of growth' become more relevant than 'economies of scale'. If these firms grow to become very large, they begin to resemble financial investment trusts composed of relatively autonomous divisions (Penrose, 1959). These firms have a decentralized structure because the firm is too large for the top management to play an active role in the activities of each division. This decentralized structure has been observed to facilitate spinoffs of the weakest divisions (Penrose, 1959).

Empirical evidence presented in Coad (2006b) provides unique insights into differences in the growth of small and large firms. The growth of small firms appears to be marked by a negative autocorrelation which becomes very strong for the fastest-growing small firms. This is consistent with observations on the erratic nature of growth for small firms. Larger firms, on the other hand, have a much smoother growth pattern, with a small positive autocorrelation of one year's growth onto the next. It appears that larger firms enjoy greater stability and are able to plan their growth over a longer time horizon.

Some influential theoretical models have attempted to describe the chaotic process of small firms growing larger. Jovanovic (1982) presents what is known as the 'passive learning' model, in which small firms have a fixed firm-specific productivity level. Their growth and survival prospects are bound to this productivity variable. Although firms do not know how productive they are upon entry, they learn about their relative productivities once they have entered. It is shown that this model is able to account for the faster growth and also the higher exit hazards associated with small firms. Hopenhayn (1992) presents a similar model in which a firm's productivity level evolves according to a Markov process. Finally, the 'active learning' model (Ericson and Pakes, 1995; see also Pakes and Ericson, 1998) investigates the evolution of a competitive industry when firms can influence their specific productivity levels by investing in R&D.

The growth of small firms is often seen as a having a beneficent character, often being taken as a goal for policy intervention. Small firms are often portrayed as being dynamic and innovative, playing a key role in generating new employment opportunities. In contrast, it appears that the growth of large firms is often implicitly put in a bad light – questions of market power, unfair competition, or managerialist 'empire-building' are frequently raised. In our view, this conception of the growth of firms is not very helpful. In reality, only a fraction of small firms are truly innovative, their ability to generate jobs is limited, and the jobs they create often disappear shortly afterwards (see Santarelli and Vivarelli, 2006). It might be better to characterize the entry of small firms by phenomena of excessive entry, high exit rates, and a large amount of waste of economic resources. Larger firms, on the other hand, have the ability to generate jobs in large absolute numbers, and these jobs appear to correspond to relatively stable positions. Furthermore, it has been argued that the ability of large firms to diversify into new markets helps to ensure that markets are reasonably contestable.[29]

5.2 Modelling the 'stages of growth'

As we have seen from the previous section, small and large firms grow for different reasons and in different ways. Indeed, it has been observed that the firm undergoes a radical metamorphosis as it grows, with the entrepreneur's vision and dynamism gradually being replaced by a more bureaucratic structure (see e.g. Witt 2000). A body of research along these lines, guided by "common sense views of youth, adolescence, maturity, and old age" (Whetten 1987: 337), has culminated in theoretical models of regularities in the stages of firm growth. The main thrust of these models is the goals, priorities and issues faced by firms change considerably along their respective trajectories of development.

The 'stages of growth' models view firms as growing through successive stages of roughly sequential ordering as they evolve from birth to maturity. These stages correspond to configurations of problems, strategies, and priorities that firms are likely to face as they grow, as well as describing the level of owner involvement and the organizational structure. The resolution of one set of problems allows a firm to enjoy a period of steady growth and prosperity, but as the firm continues to grow it encounters new difficulties. Typically, these models contain 3-6 stages of firm development, with some models focusing in particular on the early stages of firm growth. Although the unit of analysis is usually the firm, it could also plausibly be taken to be a subsystem of a firm in the case of a mature organization with loosely-coupled divisions.

A prominent and early contribution to this literature was made by Greiner [1972] (1998). In Greiner's model, presented in Figure 6, firms progress through episodes of evolution and revolution, with growth stages corresponding to a series of internal crises related to leadership, control, and organizational coordination. The resolution of one crisis is seen to sow the seeds for the next crisis. Thus, a small young firm, characterized as a creative enterprise, will have to deal with a crisis of leadership as it grows too big to be managed single-handedly by the founding entrepreneur (see Figure 6). If the firm succeeds in introducing a capable business manager, it will typically enjoy a period of growth characterized as the 'direction' stage. However, a crisis of autonomy looms as employees are torn between following procedures and taking their own initiative – this crisis is resolved by promoting delegation in the context of a decentralized organizational structure. As the firm puts delegation into practice, however, top management may feel as though it is losing control. To deal with this control crisis, the firm

[29] Bain, quoted in Penrose (1959: 256).

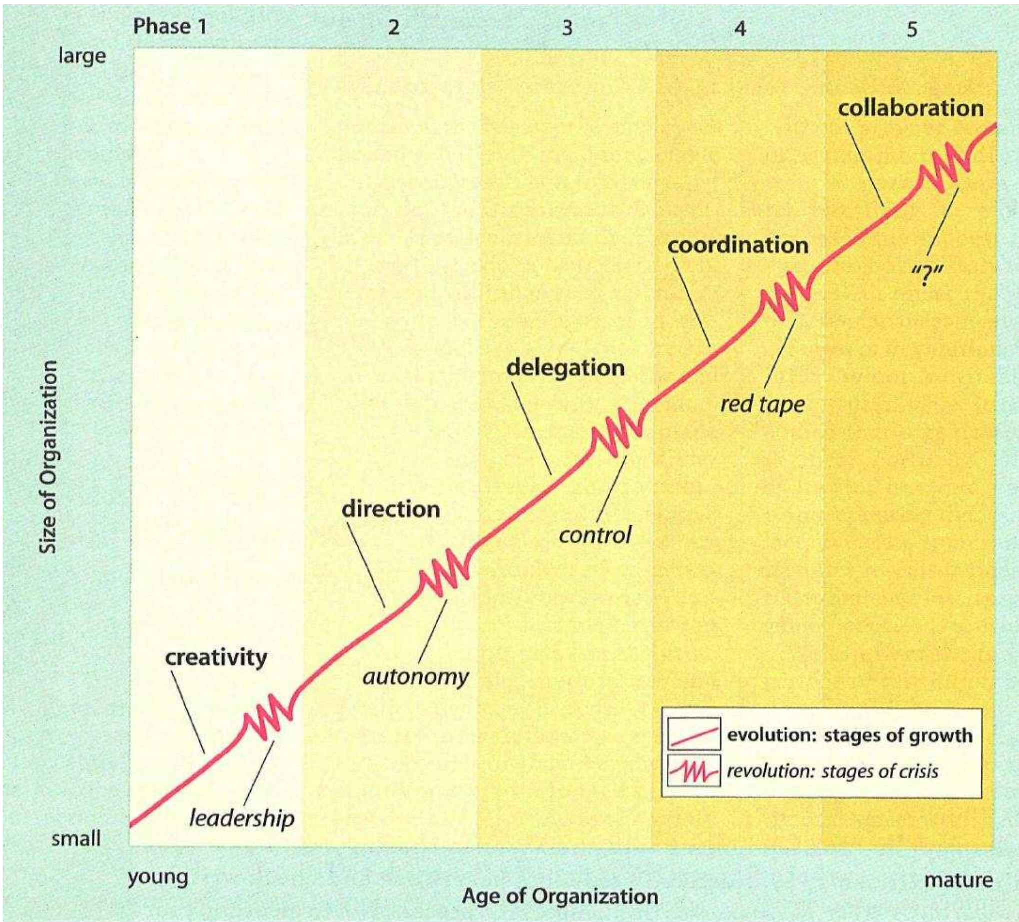

Figure 6: Evolution and revolution in a model of growth stages (Source: Greiner (1998:58))

enters the 'coordination' phase as formal coordination systems are introduced. These latter help to alleviate control problems but they create a gap between headquarters and operating workers. This is the bureaucratic 'red tape' crisis, which occurs when the organization becomes too large to be managed using rigid, formal techniques. Spontaneous managers capable of creating teams and encouraging teamwork help the firm move into the final stage, the stage of 'collaboration'.

Churchill and Lewis (1983) also present a five-stage 'stages of growth' model, although their perspective is quite different. The five stages are those of existence, survival, success, take-off, and resource maturity. At the existence stage, the young firm faces problems of obtaining customers and delivering the product. The firm requires financial resources to take it to the 'survival' stage, at which the firm must demonstrate the quality of its personnel and operating efficiency. The following stage is the 'success' stage, at which the firm must decide whether it wants to expand or just maintain the status quo. At this stage, the owner still has a considerable degree of control over the business, but will forfeit this control if the firm expands further. If the firm does not grow, it remains at what they call the 'successdisengagement' stage. If the firm decides to grow, however, it experiences a 'take-off' and must deal with issues of decentralization and delegation before reaching the ultimate stage, 'resource maturity'. Churchill and Lewis (1983) also emphasize a fundamental transformation that takes place in growing firms – the fact that although the owner's abilities are important at the start of the enterprise, they become less so as the firm becomes mature. Conversely, delegation is not important in small firms but it becomes increasingly important as the firm grows. It follows that the "inability of many founders to let go of doing and begin managing and delegating" (1983: 42) is a major obstacle to the development and growth of small firms.

The model developed by Garnsey (1998) is similar to that of Churchill and Lewis (1983) although it focuses more on the early stages of growth in new firms. She places emphasis on the high hazard rates that confront new firms, and their effort and struggle to quickly access, mobilize and deploy resources before they can generate resources for growth. Once a firm's operations are set up, however, the initial burst of energy required to get things going is no longer required, and resources are released for growth. Garnsey (1998) also discusses the phenomenon of routinization of operations in small growing firms. To begin with, "[n]ew firms are hampered by their need to make search processes a prelude to every new problem they encounter" (1998: 541). As time goes by, however, firms learn about their business and develop problem-solving repertoires that make demanding situations appear more routine. Problems can be identified as recurrent and require less time and energy, and "early challenges are replaced by repetitive grind" (1998: 542). As a consequence, this routinization found in growing small firms can engender disillusionment, and growth can be hindered by morale problems (which may even lead to spin-outs of new ventures).

Although the 'stages of growth' models have largely escaped empirical attention, it is worthwhile to mention here the work by Kazanjian and Drazin (1989).[30] The essence of their test is to observe how small new firms evolve through four discrete growth stages – Conception & Development, Commercialization, Growth, and Stability. Firms are sorted into growth stages by a self-categorization exercise in which CEOs were requested to select from among four alternative, unlabeled organizational descriptions that best described their firm's current situation. Using a longitudinal sample of 71 technology-based new ventures, they present evidence in support of the sequential 'stages of growth' model, although the statistical evidence is rather weak.[31] Their results therefore suggest that, although the evolution of firms along a 'stages of growth' schema is often observed, this schema does not have strict

[30] For another (perhaps less convincing) example of empirical research into 'stages of growth' models, see Mitra and Pingali (1999). These authors apply Churchill and Lewis' (1983) model to an analysis of 40 automobile ancillaries in India.

[31] The authors use the 'del' statistic, which is preferable to the χ^2 statistic because it tests for directionality. They obtain a del statistic (analogous to the R^2 coefficient) of 0.65 (with $p < 0.001$). In other words, knowing the 'stages of growth' rule (whereby firms advance 0 or 1 stages over an 18 month period) leads to a 15% proportionate reduction in error over not knowing the rule in predicting stage transitions.

deterministic or uni-directional properties because, in some cases, organizations may revert to an 'earlier' set of problems.

There are, however, many skeptics of 'stages of growth' models. For example, these models have often been criticised because they are too deterministic, too simple, and because they have little predictive power (Whetten, 1987). One particular group of discontents includes those who affirm that organizational change is a pervasive and continuous rather than discrete and episodic. Tsoukas and Chia (2002), for example, dismiss the notion of episodic change and argue that "[w]e should rather start from the premise that change is pervasive and indivisible" (2002: 569). In this view, change is viewed as a permanent feature of organizations, without beginning or end, emerging from the complex interaction of individuals within an organization and the evolving environment. Even organizational routines can be said to contain the seeds of change, because they are performed by individuals who experiment and improvise as they apply routines to novel situations (Feldman and Pentland, 2003). How then can these two different views of organizational change be reconciled? Is organizational change continuous or episodic? How can some sociologists (e.g. Tsoukas and Chia, 2002) view change as a pervasive feature of organizations whilst others (e.g. Hannan and Freeman, 1984) view organizations as being fundamentally inert? (To complicate matters further, other authors take an intermediate position and view organizational dynamics as occuring in a context of punctuated change – see for example Sastry (1997).) The survey by Weick and Quinn (1999) focuses on precisely this question. For them, organizational change can be either episodic or continuous depending on the vantage-point of the social scientist. If we consider the entire life span of organizations, it is possible to pick out certain points, describe the characteristics of these points and compare them. On the other hand, a more detailed look reveals "all the subterranean, microscopic changes that always go on in the bowels of organizations" (Tsoukas and Chia, 2002: 580). 'Stages of growth' models, therefore, characterize organizational growth and change as episodic because they take a distant perspective of organizations and focus on general trends in their long-term development over their life span.

6 Conclusion

Empirical research Without doubt, the main result that emerges from our survey of empirical work into firm growth is that it is the stochastic element is predominant. "In short, the empirical evidence suggests that although there are systematic factors at the firm and industry levels that affect the process of firm growth, growth is mainly affected by purely stochastic shocks," according to Marsili (2001: 18). Geroski (2000: 169) makes an even bolder statement: "The most elementary 'fact' about corporate growth thrown up by econometric work on both large and small firms is that firm size follows a random walk." The R^2 statistic

Table 2: A survey of R^2 values obtained from regressions where the dependent variable is the growth rate of a firm or plant

Study	Data	Control variables	R^2
Kumar (1985)	Around 700-800 quoted UK companies	Size, lagged growth	**1-4%**
Variyam & Kraybill (1992)	422 small businesses in Georgia, USA	Size, age, multiplant firms, industry	**11-17%**
Geroski & Toker (1996)	209 leading UK firms	Size, innovation, advertising, industry growth, industry concentration	**32%**
MacPherson (1996)	1671 small firms in 5 Southern African countries	Firm age and size, dummies for sector and location, human capital and socio-economic variables	**13-20%**
Harhoff et al. (1998)	About 10'000 West German firms	Size, age, subsidiary, diversification, legal status, industry	**8%**
Liu et al. (1999)	Over 900 Taiwanese manufacturing plants	Age, size, industry dummies, capital-labour ratio, sales per worker, dummies for R&D and exporting activity	**19-22%**
Robson & Bennett (2000)	Over 1000 SMEs in Britain in 1997	Size, age, exports, profits, industry, innovation and technology, use of external advice, strategy variables	**4-8%**
Geroski & Gugler (2004)	Large firms in 14 European countries, over 100'000 obs. 1994-98	Size, age, subsidiaries, diversification, growth of rivals	**5-6%**
Beck et al. (2005)	Survey data covering over 4000 firms of all sizes, in 54 countries	Dummies for government/foreign ownership, export status, subsidies, sector of activity; controls for number of competitors, GDP, GDP per capita, GDP growth, financial/legal/corruption obstacles	**2-3%**
Coad (2005)	8405 French manufacturing firms, 1996-2004	Gross operating margin, lagged growth, lagged size, industry and year dummies	**4-8%**
Calvo (2006)	About 1000 Spanish firms	Size, age, legal liability, product/process innovation, technology, sample selection	**9%**
Fagiolo & Luzzi (2006)	14'277 Italian firms 1995-2000	Size, age, cash flow, dummies for multiplant firms, year and industry dummies	**2-3%**

Notes: Control variables include the constant term (though this is not mentioned above). Where fixed-effect regressions have been employed, we refer to the overall R^2 and not the within R^2 or between R^2. Where we have the choice, we prefer the adjusted R^2 to the basic R^2. Although growth rates are mostly obtained by measuring size at annual intervals, this is not always the case. For example, McPherson (1996) takes the average annual growth rate for the whole of the period since start-up, whereas Liu et al. (1999) take a yearly average of the growth rate over 4 years.

in growth rate regressions is characteristically low, especially for databases containing many small firms whose growth is particularly erratic. Including a long list of explanatory variables and lags does little to help raise the R^2 value, as is evident from the survey provided in Table 2. Firm growth thus appears to be remarkably idiosyncratic, even if the assumption of a purely stochastic process of firm growth is often rejected on purely statistical grounds.

It is also fitting for us to make a statement with regard to validity of Gibrat's law. The question of whether or not we should reject Gibrat's law has indeed been hotly debated. Whilst Mansfield (1962), for example, voiced strong opposition to Gibrat's law, Ijiri and Simon (1964) take a much more favourable approach. These latter consider that although Gibrat's law does not hold with perfect accuracy, it is a useful first approximation, just as Galileo's law is approximately correct in describing the motion of balls rolling down inclined planes (albeit without taking into account such factors as friction, air resistance and magnetic fields). This seems to us to be a sensible position to take.

Our survey has also emphasized two other surprising and perhaps counterintuitive findings. First, an examination of the evidence reveals that financial performance and productivity do not predict growth. Selection by differential growth does not seem to work very effectively at all. Instead, selection appears to operate via exit of the weaker only – this considerably reduces the power of selective forces. Although there are strong implications hinging on the relationship between 'fitness' (usually profits or productivity) and growth, there is nonetheless a remarkable lack of empirical research that has been done in this domain. As a result, I feel obliged to reiterate Caves' (1998: 1977) recommendation: "Because reallocations of activity from the less efficient to the more efficient are so important for the optimal use of resources, more evidence is needed on how competitive conditions within an industry affect the speed with which the more efficient displace the less efficient."

Second, another large gap in the literature concerns the link between innovation and firm growth. While much theoretical work, as well as questionnaire evidence from managers, stresses the crucial role of innovation in explaining growth, empirical studies have not really picked up on this in a satisfactory manner. This may well be because the standard regression approach, which focuses on 'the average effect for the average firm', is ill-appropriate for analyzing a phenomenon by which a minority of firms will grow very fast while the average firm will barely grow at all. The semi-parametric quantile regression approach employed by Coad and Rao (2006b) is much more suitable in circumstances where firms are *a priori* heterogeneous.

By and large, therefore, we put forward that empirical work seeking the determinants of firm growth has made limited progress. Instead, firm growth appears to be a idiosyncratic and fundamentally random process. It may be that the majority of the total variation in firm growth rates is within firms over time (Geroski and Gugler, 2004; see however Davis et al. (2006) who observe that the between-firm variation in annual growth rates exceeds the average within-firm variation). As a result, it makes sense for future empirical work to attempt to explain growth by referring to variables that vary more over time within particular firms than they vary between firms (in the cross-section) at any given time. Unfortunately, however, firm-specific variables that display such properties are not easy to find.

Theoretical work The theories we have surveyed above are certainly diverse and sometimes they are contradictory. For example, while neoclassical theory considers that growth is only a means to an end, Penrose considers that growth is an end in itself, and that it may occur even if the firm is beyond an 'optimal size' threshold, in the case where 'economies of growth' of exploiting a marginal growth opportunity offset the diseconomies of the resultant size.

It is also striking that the theories, though intuitively appealing, do sometimes yield predictions that are quite false. The neoclassical proposition that firms grow in an attempt to reach an 'optimal size' is unhelpful at best. The evolutionary principle of 'growth of the fitter' consistently fails to receive empirical support. Furthermore, the main prediction from the population ecology perspective (i.e. that firm growth should be modelled by considering industry-specific components) seems rather weak when it is confronted to the empirical test.

In our view, it is meaningful to follow Penrose and suppose that growth is not just a means to obtain a certain size, but rather it is an end in itself, a constructive application of spare resources. Indeed, in the presence of learning-by-doing and dynamic increasing returns, a lack of growth would be akin to stagnation.

Concluding discussion We have observed that theoretical predictions have been of limited use in understanding the growth of firms, if not downright misleading. It appears to us that the way forward is through empirical analysis. We recommend a Simonian methodology (Simon, 1968) whereby facts are first pursued through empirical investigations, and in a second stage theories are formulated as attempts to explain the 'stylised facts' that emerge.

Empirical research into firm growth has nonetheless come up against some major obstacles. The main message that seems to emerge is that growth is largely a random process. There seems to be little value added by the multiplication of investigations into Gibrat's law. Furthermore, there seems to be limited use in trying to find the determinants of growth rates using aggregated data in a standard regression framework, because the combined explanatory power of the independent variables is remarkably low – the R^2 coefficients are usually around 4-10%, although in rare cases rising to about 30%. In order to make progress in this field, we feel obliged to reiterate an exhortation that is dated but nonetheless still very relevant: "The subject of organizational growth has progressed beyond abysmal darkness. It is ready for – and badly needs – solid, systematic empirical research directed toward explicit hypotheses and utilizing sophisticated statistical methods" (Starbuck, 1971: 126).

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