

New Firm Growth: Exploring Processes and Paths

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Abstract

This paper provides a new methodology for the diachronic study of new firm growth, theoretically grounded in the work of Penrose (1995). We show that a model of firm growth as an unfolding process makes possible draw simple, measurable inferences from firm level to aggregate evidence on growth paths of new firms, expressed as propositions. Metrics on growth paths of new firms in three longitudinal samples of new firms are examined for evidence at the aggregate level consistent with the dynamic model. Dynamic processes in the early development of young firms result in variations in the timing, magnitude, duration and rate of change of growth as between firms and in the same firm over time. The conceptual and methodological framework in this paper provides a basis for future research aimed at explaining the development of new firms.

Key words

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Introduction

The study of new firm growth suffers from an absence of conceptual models that can link research at different levels of analysis and make possible consistent inferences from one level to another. Case studies are commonly used to provide firm level evidence of entrepreneurial and management behaviour, while the analysis of aggregate rates and trends in growth in populations of new firms dominates in economic studies of new firm growth. To provide a basis for inferences from one level to another, a conceptual approach that views firm growth as a developmental process is needed. In this paper we provide the outline of a Penrosean analysis of the development of new firms. According to Kor and Mahoney (2000, p. 128): “in order to find comprehensive and rigorous answers to the questions Penrose (1959) posed concerning firm growth processes, more conceptual and especially empirical research needs to be done on the dynamics of growth, that is analysing the paths and the effects on the outcome of different sequences in the growth process”. The developmental model we propose can explain why growth in the new firm is non-linear, prone to interruptions, amplifying forces and setbacks. Management scholars seldom come to grips with non-linear phenomena. Instead, phenomena like firm growth are modelled as if they were linear in order to make them tractable. Aggregate behaviour tends to be modelled as if it is produced by individual entities which all exhibit average behaviour (cf. Anderson et al., 1999). A methodological implication of our model is that standard cross sectional measures and average growth rates fail to capture important features of the course of growth in firms.¹ To illustrate the extent to which a developmental approach of this kind can inform empirical work - not only at the case study but also at the aggregate level - we offer examples of methods that can be used to compare the growth paths of new firms. We draw simple propositions from the Penrosean conceptual framework and examine these propositions in the light of empirical data on the growth paths of innovative new firms in three countries. The aim of this paper is to show that studies of new firm growth require a sound conceptual base and call for new methodological perspectives that reveal the unfolding nature of new firm development.

New firm growth studies

Aggregate studies of firm growth have been dominated by the analysis of variance using cross sectional measures to compare the attributes or conditions of new firms in samples and populations. Attributes of firms with a successful growth record have been found in a number of studies to include factors such as: ambitious founders, a founding team, education and relevant experience among founders, willingness to share equity, a multi-skilled management team, marketing expertise (Almus and Nerlinger, 1999; Barkham et al., 1996; Cosh and Hughes, 2000; Storey, 1997a; Utterback et al., 1988; Wiklund, 1998). Indicators of this kind provide a guide to desirable attributes of new firms. However, inferences from the attributes of successful firms have been questioned. Critics point out that as much as 80% of sample variance is left unexplained in some of these studies (Curran and Blackburn, 2001, p. 44; Woo et al., 1994, p. 507). Adherents have granted that prediction of performance based on start up attributes is weak, but hope that “once the business is in operation, forecasting improves somewhat” (Storey, 1997a, p. 159).

Integrating findings from attribute studies has proved a challenge. Different samples and time frames have come up with contradictory or inconclusive results. For example, Storey found in his useful review that: “Five studies do not identify an impact, three indicate that prior sectoral experience is associated with slower-growing firms, and one suggests that prior sector experience is associated with faster-growing firms” (Storey 1997a, p. 135). Some research suggests that long experience of the industry by founders may inhibit innovative performance (Storey, 1997a) while other findings indicate that prior knowledge of an industry enhances firm performance (Oakey, 1995; Shane, 2000). Storey reported that growth firms tend to have older than average founders (1997a, p. 158) while Barkham et al. (1996, p. 62) found younger owner-managers had faster growing firms. Some studies find merit in a deliberate niche market strategy, exploiting a quality or technological advantage (Storey, 1997a, p. 142-3). Others find that niche strategies may trap the firm (Aldrich, 1999). Since

many of the sample survey studies have low response rates and compare firms that differ in their age, business cycle timing and sector experience, these inconsistencies are not surprising.

Greater consistency could be provided in attribute studies by studying cohorts of comparable new firms over the same time period. This would address the charge that attribute studies have drawn inappropriate inferences from survivors in samples by excluding less successful firms. The problem of survivor bias has long been recognized but is often disregarded (Keasey and Watson, 1993; Penrose, 1995, p. 7). Moreover, unless factors and attributes held to cause success are clearly differentiated from the effects of success, studies of this kind are open to the charge of circular reasoning (Porter, 1991, p. 108-9).²

No less criticism has been directed at generalizations about growth based on studies at the firm level. Case study evidence is not acceptable to many journals and has been dismissed as unscientific (Kerlinger, 1986). Stage theories of growth based on case evidence have been held to be unproven and non-predictive (Storey, 1997a, p. 122). Excessive claims for invariance in stage of growth theories have led scholars to reject the idea of any 'recurring temporal sequence' in the development of the new firm (Bhide, 2000, p. 247). The merit in such studies stems from the benefits of observation at the firm level and of identifying dynamic connections between stages (e.g. Greiner, 1972).³ But stages of growth studies have lacked the intellectual base needed for reliable analytical generalization. Unrelated concepts and over-specified phase timings are found in models of growth stages that reflect observations from a particular context, with no basis for empirical or conceptual alignment among themselves (Churchill, 1997; Churchill and Lewis, 1983; Greiner, 1972; Kazanjian, 1988; Kazanjian and Drazin, 1989).

Without observations of firm's internal dynamics, the mechanisms and processes of growth remain obscure, however sophisticated the regressions and cross sectional analysis of variance used (Mohr, 1982). Measures of attributes drawn even from comparable firms cannot reveal the underlying mechanisms and processes that give rise to new firm growth. Argenti articulated the problem in connection with firm failure: "...a mere list of causes and symptoms, no matter how coherent and comprehensive it may be, is not enough. What is missing from such an inventory – and indeed from all previous work in this field – is the dynamics ... the sequencing of events..." (Argenti 1976, p. 121). Moreover it is essential to have related explanatory concepts to guide inquiry and make sense of evidence. A mass of undigested empirical findings can be misleading. For example evidence that outstanding growth occurs among only a few firms has been used as a rationale for investing in fast growth firms. Databases are created to identify such firms, but by excluding firms from fast track databases as soon as their performance falters, the very evidence required to understand the experience of fast growth in a firm's development is eliminated.

In brief, the study of new firm growth suffers from an absence of conceptual models that can filter and assimilate diachronic evidence (i.e. on change over time) at the firm level and interpret this in terms of a shared discourse. Conceptual models are needed to build on prior work and make connections between related fields of study, e.g. management, strategy, entrepreneurship, innovation and network studies.

A Dynamic Process Approach

A variety of methodologies can be adopted to achieve better understanding of the interacting conditions and mechanisms of new firm growth. Attribute and stage growth studies of new firms using rigorous methodologies have an important contribution to make. This paper does not attempt to remedy existing approaches, but illustrates an alternative approach to exploring growth in new firms, theoretically grounded in the work of Penrose.

Penrose found a middle way between description and unsubstantiated generalization in her book on the growth of the firm (1995; cf. Best and Garnsey, 1999; Kor and Mahoney, 2000; Pitelis, 2002;

Rugman and Verbeke, 2002). She identified dynamic processes by inference from detailed observation, drawing together these inferences to build an account of the interconnected causes of growth in established manufacturing firms. It is argued in this paper that dynamic processes operate in new firms, as in established firms, shaping early growth experience, but with distinctive effects that reflect the liabilities of newness.

Penrose (1995) saw growth as a cumulative process in which the members of a firm build knowledge and competence. Firm growth is “(...) a result of a *process* of development (...) in which an interacting series of internal changes leads to increases in size accompanied by changes in the characteristics of the growing object” (Penrose, 1995, p. 1). Penrose derived her evidence from detailed study of the history of particular firms, but was able to provide an analysis going beyond the firm specific context. She retained her focus on internal processes of change while emphasizing the importance of the firm’s positioning in its industrial environment. Entrepreneurship is a key ingredient of her theory as this comprises the entrepreneurial judgement necessary for recognizing market opportunities. Firm growth is driven by a ‘productive opportunity’ (Penrose, 1995) in a cumulative, endogenous process of interaction between the firm’s productive base and market opportunities, which are reflected respectively in the firm’s ‘organizational capabilities’ and its ‘entrepreneurial judgement’ (cf. Best, 2001; Ghoshal et al., 2001)

Despite Penrose’s own concern with entrepreneurial management, the resource-based theory of the firm - an approach inspired by her work - has had little to say about entrepreneurial behaviour⁴ and the development of (new) firms (Montgomery, 1995, p. 262). Recent versions of the resource-based theory of the firm have been largely concerned with issues prominent in organizational economics: the existence, boundaries, organization, resources and capabilities of firms and how these provide competitive advantages (Foss and Foss, 2000). The literature on the resource-based theory of the firm, unlike Penrose’s work, has not been primarily process-based but has been concerned with the association of resource attributes with performance (Foss and Foss, 2000). In contrast with empirically based studies listing firm attributes, resource-based theory uses an axiomatically derived theoretical framework to establish when a resource will procure superior rents (Barney, 1991; Peteraf, 1993). This framework can be expressed qualitatively or quantitatively; conceptually both are forms of variance analysis. The resource-based perspective has effectively identified the effects of resources on outcomes (i.e. variance analysis), but has not yet been able to explain how resources and firms (as resource-bundles) develop (Barney et al., 2001, p. 635; Foss, 1997). Variance and process studies adopt contrasting approaches.

Process based analysis of the kind we have in mind engages in reasoning about interconnected causes of change and growth and attempts to identify mechanisms and drivers of change in relation to timing and sequence.⁵ This usage is close to Van de Ven and Poole’s (1995) use of process theories as theories that explain how and why change unfolds in organizations. Mohr (1982) argued that process theories embody a flow of action in which the time ordering of events is of critical importance. In contrast “...in a variance theory the ordering of two direct causes, X_1 and X_2 , is immaterial in the sense that each has an independent effect on Y with the other held constant” (Mohr, 1982, p. 60). Many studies that attempt to account for variance do not inquire into the influence of timing and sequencing on causal processes.

The importance of timing is conveyed in Penrose’s dictum that ‘history matters’ in the growth of the firm. Useful attempts have recently been made to apply resource based theory to new firms (Brush et al., 2001; Lichtenstein and Brush, 2001). However the potential of Penrose’s original dynamic process approach remains to be explored. In the next section we will draw inferences from Penrose’s work (1995) pointing to non-linearities in new firms’ growth paths.

Dynamic Processes affecting New Firms' Growth Paths

We view the entrepreneurial process as comprising the pursuit of opportunity and the mobilisation of resources to deliver value and capture returns through business activity. When this process is embodied in new firm creation, the entrepreneur has to develop a business idea of the means to create value and capture returns and, through the entrepreneurial process, translate this into a business model that can be implemented. For Penrose, entrepreneurs seek to realise a 'productive opportunity' which comprises "all of the productive possibilities that its 'entrepreneurs' see and can take advantage of" (Penrose 1995, p. 31). The concept emphasises the cognitive and cultural dimensions of enterprise. Opportunities are objectively identifiable but their recognition is subjective and requires exploratory activity either before or after the formal foundation of the new firm. To realise the opportunity it is necessary to organise business activity, which calls for some kind of resource base.⁶ The new firm may aim at a productive base that is very simple, as in the case of a research services company, or very complex, as in the case of a plant or other installation. Penrose (1995) was dealing with mature firms that already had a base of this kind. The new firm, in contrast, rarely starts out with a productive base, except in special cases such as de-merger or well-endowed spin-out, but has to build one from the resources the entrepreneurs mobilise. In *The Theory of the Growth of the Firm* Penrose was concerned with the production base of 'industrial firms'. The term 'productive base' is used here because Penrose's concept can also be applied to service activities. As it grows, the firm's resources may come to support a variety of productive bases, but Penrose pointed out that: "(...) movement into a new base requires a firm to achieve competence in some significantly different area of technology" (1995, p. 110).

Empirical data on firm growth, whether at the case study or aggregate level, will reveal diversity in the speed with which opportunity recognition can be translated into a functioning resource base. We can expect diversity in the onset of growth in terms of both inputs and outputs.

Liabilities of Newness⁷

Penrose explored the dynamic processes taking place in established firms that achieved sustained growth. She identified the key to sustained growth as ability to build a resource base and adapt this base to respond to new opportunities as these arose. Because markets and opportunities undergo change, she argued that there could be no state of rest in the firm. Penrose recognized the significance of entrepreneurial alertness to opportunity (cf. Kirzner, 1997). New firms must mobilize resources for and generate returns from the "particular productive activities (...) chosen from among the alternatives suitable to the abilities, finance and preferences of the entrepreneur" (Penrose, 1995, p. 82). But in practice, abilities and preferences may not include responsiveness to new opportunities. Indeed most small firms are run by people with modest expectations and limited access to resources who fail to recognize or pursue new opportunities.

It follows that if the new firm is started by entrepreneurs who settle for low or no growth, its sales and inputs are threatened as soon as the conditions in which it operates change. Cash constraints are a likely outcome of low or no growth in revenues. New firms are at risk before they have been able to build the resource base.⁸ In contrast, more established firms have 'organizational slack' (cf. Cyert and March, 1963) that acts as a buffer for growth interruptions and for the exploitation of new opportunities. Unless they can finance the building of a resource base themselves, new firms that run out of cash have to turn to the financial system, which imposes criteria they may be unable to meet. New firms often close before they have built a sustainable resource base.

Dynamic Instability

If failure to grow makes firms vulnerable, those that do grow are continually challenged by the demands of coordinating growth. Both growth inducing and growth limiting factors create

coordination problems. Penrose explicitly rejected equilibrium theories of the firm (Foss, 1997, p. 363). She pointed out that:

The attainment of such a 'state of rest' is precluded by three significant obstacles: those arising from the familiar difficulties posed by the indivisibility of resources; those arising from the fact that the same resources can be used differently under different circumstances, and in particular, in a 'specialized' manner; and those arising because in the ordinary processes of operation and expansion new productive services are continuously being created. (Penrose, 1995, p. 68)

In some cases, asynchronies of this kind can actually stimulate growth by spurring action to remedy deficits or surpluses - either by building new resources internally or by obtaining complementary resources externally. Obtaining or creating complementary resources are solutions that enlarge the firm's knowledge base, from which new opportunities can be pursued (Penrose, 1995, p. 54). The learning process that new firms go through may result in non-linear and discontinuous growth paths in which sudden spurts of growth are followed by periods of stagnation. Dynamic processes continually alter the resource mix. Underutilized resources are an unacceptable opportunity cost for entrepreneurial managers intent on the pursuit of growth. Those who find ways to exploit under-used resources to realize new opportunities are more likely to sustain growth. But, once growth prospects are actively pursued, asynchronies arise again, possibly giving rise to the perverse effects of growth discussed below.

Perverse Effects of Growth

According to Penrose, growing firms tend to experience a critical resource deficit in the capacity of decision makers to deal with the demands of growth. Managers with inside knowledge, experience and authority cannot be recruited in the market (Penrose, 1995, p. 45). Other kinds of resource deficit are common and have to be dealt with by acquiring external or building internal resources.⁹ This occurs sequentially as growth exerts uneven pressures on resources and hence on requirements for matching resources to remedy deficits or complement surpluses. If firms do not create or acquire complementary resources required, their growth will be inhibited and a period of 'stagnation' may follow (Penrose, 1995, p. 47). This applies not only to those faced with capacity shortages, but also to those who allow some of the resources they have to remain unused. They are failing to exploit a key growth mechanism, the building of complementary resources.

The mismatch between available resources and required resources "limits the amount of expansion that can be undertaken at any given time..." (Penrose, 1960, p. 31). If we apply these insights to the case of the rapidly growing new firm, we can foresee perverse effects of rapid growth. The growing firm must draw in new resources to support growth, but it faces planning delays and coordination problems because it is impossible to synchronize resources precisely in a dynamic system. The need for internal coordination sets a brake on the rate at which market opportunities can be pursued (Penrose, 1995, p. 44-54).

Rapid growth may have dangerous consequences in new firms still lacking reserves. The rate at which new resources are effectively mobilized may be insufficient to keep up with the pressures of growth. Growth may consequently stall and bottlenecks can move growth into reverse. Penrose was concerned with firms of the kind that had built up sufficient reserves to carry them through short term crises, and did not examine situations of this kind. But if we apply her analysis to the new firm that has achieved early growth but still has an immature resource base, we see that crises are a likely outcome of uncontrolled early growth (Hugo and Garnsey, 2002a; Garnsey and Heffernan, 2003). This effect will tip previously growing firms out of the growth league and into the faltering or declining categories.¹⁰

Growth Reinforcement

The relatively few firms that overcome the difficulties inhibiting early growth are those that experience growth-reinforcing processes. The ability to generate resources attracts further resources. The most successful of these firms can embark on an accumulation process that further enhances their

market position: “past success is a powerful aid to future progress” (Penrose, 1995, p.205). Expanding firms of this kind – that are able to take over competitors and complementary firms – are likely to become major employers. A firm’s expanding resource base allows it to respond to changes in opportunity structure without succumbing to resource shortages, but as Penrose emphasized, it is necessary to perceive and act on the need for such reorientation. Penrose was interested primarily in endogenous growth.¹¹ But she also emphasised the need for the firm to be continually adjusting its activities to the shift in opportunities consequent on changes in technology and markets. This ability to respond to a new market is also key in current debates on dynamic capabilities (Teece et al., 1997; Eisenhardt and Martin, 2000). She identified prospects for new firms to grow in interstices, with expanding opportunities in new growth industries (cf. Hugo and Garnsey, 2002b). There is great interest at the present time in fast growth firms that become major employers. These are often contemporary versions of Penrose’s successful entrepreneurial firm.

Growth Patterns in Established and New Firms

Penrose (1995) examined certain kinds of dynamic processes in established manufacturing firms. We have been identifying how dynamics of this kind can also be identified in new firms, where coordination problems create particular instability. New firms lack the management procedures required to anticipate shortages, which often catch them unprepared (Garnsey, 1998). In these firms, interruptions cause large fluctuations in revenues. Because they lack an established productive resource base or financial reserves to fall back on when their performance falters, new firms face stark alternatives. If they do not grow they are particularly vulnerable to changes in their environment. But for new firms that do grow, serious setbacks may result from external change and internal asynchronies.

Cases, Stages and Development Processes

Our argument is that a theory of new firm growth does not require a stage approach (the form in which most developmental approaches are presented) but can be based on the operation of growth processes. Developmental processes may sometimes be manifest in stages – as where the process of initial resource mobilization involves an early inflow of funds and recruitment. Stage are more likely when dynamic processes occur sequentially, as in firms that need to build an extensive productive base before they can generate revenues. But stages are by no means universal, nor even identifiable in some cases. Stages of growth approaches are marred by a proliferation of conceptual approaches and definitions of stages with no common conceptual basis. The absence of a common conceptual framework also makes it difficult to compare individual case studies and explaining the underlying development processes from case study evidence (Eisenhardt, 1995; Yin, 2003). We have shown that many of the dynamic processes that Penrose identified can be seen to occur in new firms and shape their development experience. Detailed case studies of new firms can be carried out to investigate the application of key Penrosean concepts such as the productive opportunity and the productive base and to explore the operation of dynamic processes of the kind set out above. Here our aim is to use the Penrosean model outlined above to connect mechanisms of growth at the level of the individual firm to evidence on growth among populations of firms.

Dynamic Processes and Growth Indicators

The dynamic processes Penrose analysed are not directly measurable by growth indicators. Rich case data is required to identify and explore the way they operate. However growth metrics could be used to challenge or support our inferences from Penrose on the development of new firms. For example if there are few signs of unsteady growth, interrupted growth, or growth surges and reversals, our argument that asynchronies are endemic in new firms and result in performance fluctuations would be in question. We present evidence in support of these non-linearities in new firm growth.

The following section explores new ways of identifying and comparing diachronic features of new firms’ growth that are obscured by the standard synchronic measures. Cross sectional attributes cannot capture the growth paths of new firms or represent the surges, interruptions and reversals which are to be expected from the operation of dynamic processes. This paper is an exercise in theory building, not theory testing. We are not carrying out variance analysis to compare the growth rates

and performance of new firms, nor formally testing associations among episodes of experience. The study was carried out to draw quantifiable propositions from the Penrosean explanatory model and to see if these are consistent with aggregate data on new firm growth. This required efforts at data collection and new methodologies to represent evidence on the growth paths of new firms.

Developing a Methodology to Explore New Firm Growth Paths

Recent reflections on the fields of new firms and entrepreneurship research have concluded that there is an explicit need for longitudinal research on new firm growth (Davidsson and Wiklund, 2000; Chandler and Lyon, 2001). Little evidence is available on the growth paths of firms over time. Standard cross sectional attribute measures and average growth rates are unable to convey the cumulative process of new firm growth. It was therefore necessary to collect and analyse new data for this purpose and to devise methods for representing this evidence.¹² Since no established statistical methods were available for our purpose we used a form of exploratory data analysis (EDA, see Tukey, 1977; Marsh, 1988) which seeks to find patterns in data that are of empirical and conceptual interest. In the empirical part of this paper we explore these issues by investigating the growth paths of several longitudinal samples of new firms. The Penrosean model provided guidance on causal factors and pointed to the kinds of patterns in growth paths to look for.¹³ Here we draw from the explanatory model of firm growth outlined above measurable inferences about the extent, direction, and discontinuities in firms' growth over time. We express these inferences as propositions. Our data analysis was exploratory in that we had no prior conceptions as to how to recognise or represent relevant evidence in studies of new firm growth. We had to find new graphical methods to represent sequences of growth behaviour.

We applied sequence analysis¹⁴ in a novel way to uncover growth episodes and turning points during the early life course of new firms. For this purpose, the data points making up the growth paths are compressed: 'B' is the coding for a reduction in a growth indicator, 'G' for an increase, and 'P' for no (or negligible) change. The resulting measures, examined below, were thus coded to represent key turning points in the firms' growth paths. Sequences such as G-P (plateau following growth), P-G (growth following plateau), and G-B (growth reversal) can be identified in the samples. The interval between turning points (inflections) is measured over time; the period between inflections is a *growth episode*. Growth inflections are not unique but recurrent, i.e. a firm may face some turning points more than once in the course of its existence.

Measuring New Firm Growth

To represent and compare new firms' growth experience, it is necessary to conceptualize the growth of a new firm in ways that can be measured. According to Penrose (1995, p. 25): "Ideally, the size of firm for our purposes should be measured with respect to the present value of the total of its resources (including its personnel) used for its own productive purposes. This is almost impossible to discover in practice, and in the absence of any really satisfactory measure of size we have a wide choice depending on our purpose." Penrose was sceptical of measuring firm attributes that are unique to individual firms; these may not be "reducible to any common denominator and are therefore incapable of quantitative treatment" (Penrose, 1995, p. 199). But she recognized the need to measure growth performance on some basis, for example in terms of the growth of fixed assets (Penrose, 1995, p. 25). Some such measures are needed for the purpose of comparing the growth experience of firms.

To examine growth paths we need metrics. Each of the following measures illustrates some feature of growth and each is subject to limitations as a growth indicator. A firm's growth can be measured in terms of *inputs* (investment funds, employees), in terms of the *value* of the firm (assets, market capitalization, economic value added) or *outputs* (sales revenues, profits).

- Many studies of new venture growth cite *funds invested* at various stages, but these track the 'burn rate' of investment funds rather than the growth of productive resources.
- *Employment figures* are the most commonly used measure because they offer standardized, comparable data on the rate and direction in which a firm has been expanding.

- *Sales figures* (turnover) have to be adjusted for inflation, and are affected by vertical integration (how much of final sales is produced internally or bought in).
- *Profits* are in various ways to avoid tax liability or to raise the valuation of the firm, creating comparison problems.
- *Valuation* of the firm's assets is a composite indicator of growth. This includes tangible assets, for example productive equipment and buildings, and a valuation of intangible assets, the firm's expertise and reputation. The valuation of the firm varies with investor sentiment over the business cycle. A battery of financial ratios is supplied for investors once firms become public.
- Composite indicators of growth can be devised, and measures may be weighted. Some indicators like Birch's take into account initial firm size when representing relative growth rates. The Birch Employment Growth Index (Birch, 1987) corrects for firm size by using the product of absolute growth and percentage growth.

Tracking growth measures over time (instead of taking average measures of growth rates and cross sectional indicators of attributes) is a way of approaching growth in a diachronic way. It is clear that growth indicators reflect the outcomes of many different interacting causes that influence new firm growth paths. Before the relationships between cause and effect can be meaningfully explored, there is groundwork to be done on ways of representing firm growth without losing diachronic information that conveys the path of growth over time. This is the objective of the rest of the paper.

A firm's growth can be thought of as following one among multiple possible paths (Garnsey, 1998). This could be traced out by various growth measures at varying intervals. We started from the axiom that at any point in time metrics of firm size change will show the firm undergoing growth, stability or decline. Slope and change in slope are the elemental components of a firm's growth path. Fluctuations may occur at any time and on any scale. As in other fractal phenomena, fluctuations give the appearance of being smoothed out when measures are taken at wider intervals. The series of intervals at which measures are taken along the x-axis determines how many such fluctuations are captured in the data. The representation of growth paths also depends on measures used. We have chosen the standard indicator, namely employment, which is most readily available and comparable.¹⁵ In our analysis, employment growth has been used for the construction of *growth episodes* and the operational definition of *turning points*. We converted firms' growth over time from interval to nominal scales. These represented types of growth episode experienced, according to rate of growth over that episode. A sequence of summarised growth episodes was used to depict turning points in growth paths.

Research Samples

Longitudinal samples of new firms which were diverse in some respects but shared enough common features to allow meaningful comparison was needed as a research base for the empirical investigation of early paths of growth over at least five years. We aimed to examine firms founded in the same place and year so that the firms examined would experience similar macro economic effects as they aged. We wanted to investigate the growth of a cohort of new firms drawn from a coherent population of firms. The group of firms investigated should not be in zero-sum competition for customers. High tech firms founded in the Cambridge area met these criteria. Data on growth performance over a ten year period were compiled for 237 firms founded in 1990 (Garnsey and Heffernan, 2003). The inquiry was replicated and refined using a quota sample of 136 German high tech firms surviving over seven years from 1991/92 (Hugo and Garnsey, 2002a) and a sample of 25 young fast-growing Netherlands firms surviving over at least 5 years from 1990-1995 (Stam, 2003). The characteristics of the three research samples are summarized in table I.

Table I. Characteristics of the research samples

	Sampling	Data
Cambridgeshire (UK)	Population of 237 high tech firms founded in 1990 (93 survived over ten years)	Biennial data on employment
Germany	Sample of 136 technology based firms founded in 1991/92 and surviving over 8 years	Annual employment and sales data (& 15 qualitative case studies)
Netherlands	Sample of 25 young fast-growing firms founded in 1990/95 and surviving at least 5 years	Annual employment data (& all 25 qualitative case studies)

The data were compressed in two ways. First, interval scale data were reduced to nominal scale by converting employment level to direction of change from previous period. Data-points in the Cambridgeshire and German sample were coded for growth reduction greater than 5%, for increase greater than 5%, and for change in either direction of less than 5%.¹⁶ In a subsequent compression, the resulting measures were coded according to key turning points in evidence. Growth paths are categorised by dominant turning point(s), presented as archetypes in figure 2.

In what follows propositions from the model of dynamic processes are examined in the light of evidence on growth paths.

New Firm Development Explored: Growth Paths

The propositions that follow are drawn from the Penrosean model and are applied to the three research samples outlined above.

Proposition 1: New firm growth is uneven

Delay, interruptions and surges of growth are likely in new firms as resource problems arise, are resolved and opportunities shift for resource constrained new firms. Dynamic processes of this kind are likely to result in variations in the timing, magnitude, duration and rate of change of growth as between firms and in the same firm over time. For example, difficulties regarding the recognition of the ‘productive opportunity’ and of building a productive base will result in differences in the onset of growth, with some new firms showing a slow start and growth picking up as the productive base becomes operational.¹⁷

The growth paths of the firms demonstrated an uneven record. In figure 1, rate of growth is shown by slope, extent of growth by the scale used. Figure 1 illustrates growth discontinuities for several of the firms that survived over a ten-year period. They include variations in the timing of the onset of growth, interruptions in the form of growth plateaux and growth reversal. Sustained growth (like firms A and B in figure 1) among the firms studied was rare.

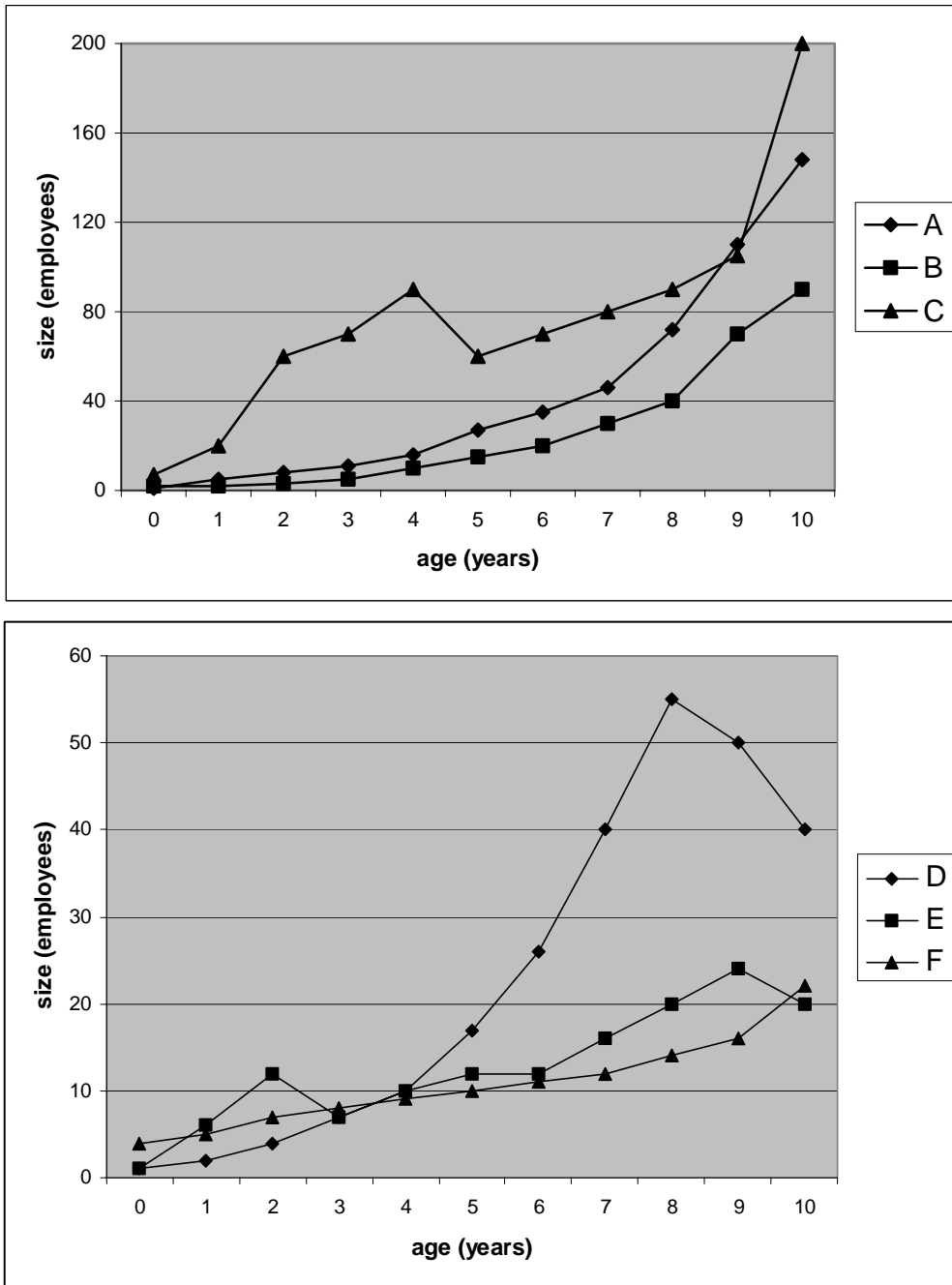


Figure 1. Growth paths of new firms, Netherlands sample

Proposition 2: There are turning points in new firms' growth paths

This is a corollary of proposition 1. Dynamic processes provoke interruptions and setbacks. These discontinuities imply turning points marking changes in growth trajectories in terms of rate and duration. Summary measures, graphics and equations did not readily capture relevant information from growth path data of the kind illustrated in figure 1. Standard measures of growth rates lost the information we sought.

These data provide further evidence for Proposition 1; growth of new firms is uneven. In the Cambridge data set, only 6% of the surviving firms grew continuously over the ten years, with another 14% growing continuously after a delay or preparatory period. Another 24% stagnated after an initial growth period, while 37% faced growth setbacks during their early life course.

Figure 2 summarises turning points for the 93 firms founded in 1990, which survived ten years and remained in Cambridge. These firms are those with the best survival record in a cohort of high tech firms.

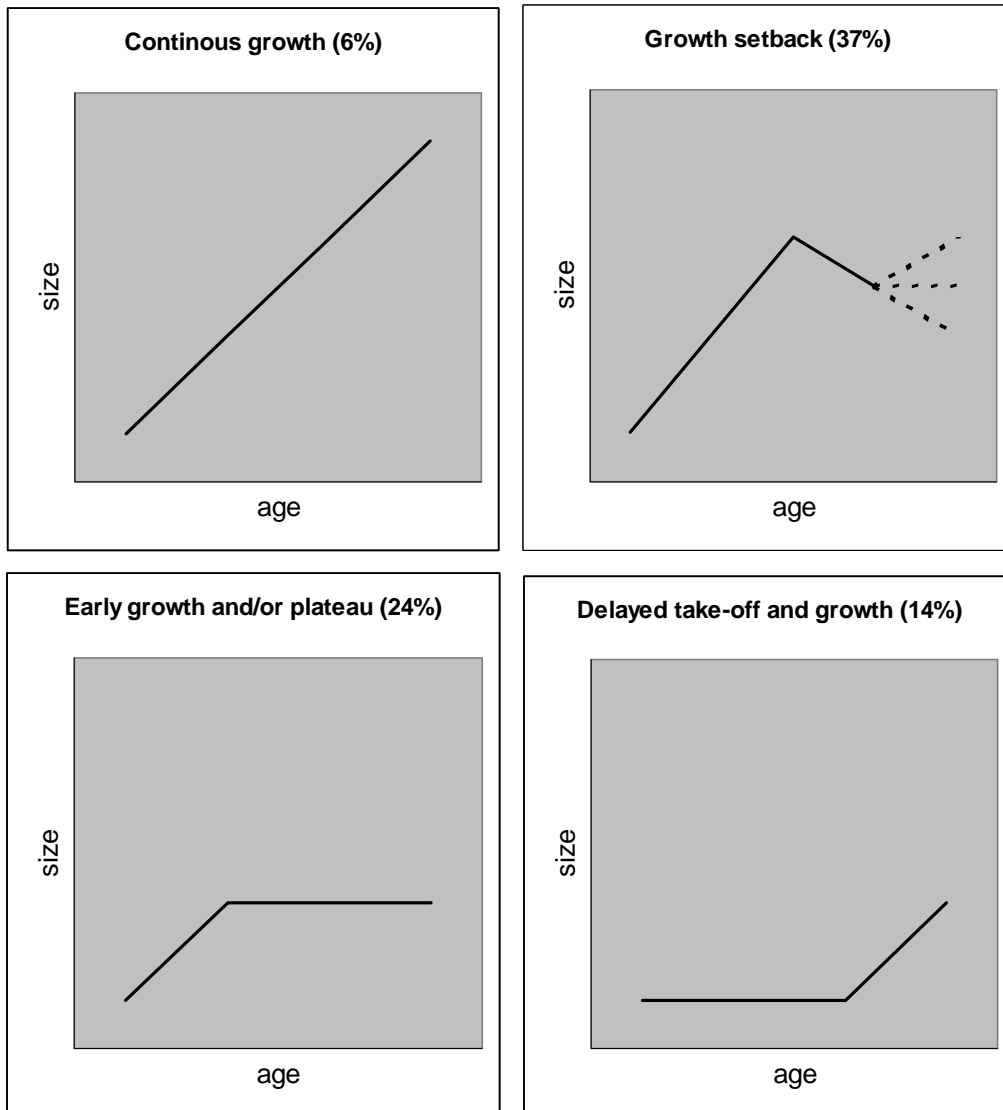


Figure 2. Turning points among 93 high tech firms in Cambridgeshire founded in 1990 surviving ten years¹⁸

A parallel study was carried out of a survivor cohort of 136 technology-based firms founded in Germany in 1991/92. The revenue growth record of a cohort of survivors in the German study shows that only 4% of the firms experienced continuous growth while 59% experienced at least one episode of decline and 88% experienced at least one episode of stagnation. Employment growth data produces a similar picture, with only 1% of all firms having grown continuously, while 49% experienced at least one period of decline.

The Netherlands study, which consisted of young fast-growing ('successful') firms, revealed a higher proportion of continuous growth paths (32% of the firms). Only 16% of the firms in the sample faced a setback during their early life course. These paths are those of an elite set of new firms, since the sample included only those that had reached a size of at least 20 employees within the first ten years. Even in this sample, 28% of the firms experienced delayed growth and 24% had an initial growth period followed by a plateau period.

Proposition 3: Firms that do not grow are more likely to close

New firms that experience little growth are less likely to build up reserves to tide them over the resource asynchronies experienced by most new firms. Because firms need a continuous inflow of resources in order to trade and survive, those without growing revenues are particularly vulnerable to change. If their environment shifts, the revenues on which they depend for inputs are threatened. Figure 3 shows that as the cohort of firms aged, the survivors included fewer firms that had not grown (40% after 2 years to 20% after ten years).¹⁹ This is consistent with Kirchhoff's findings for high tech firms, that firms with a better growth record were more likely to survive (Kirchhoff, 1994, p. 184; see also Phillips and Kirchhoff, 1989; Cosh and Hughes, 2000).

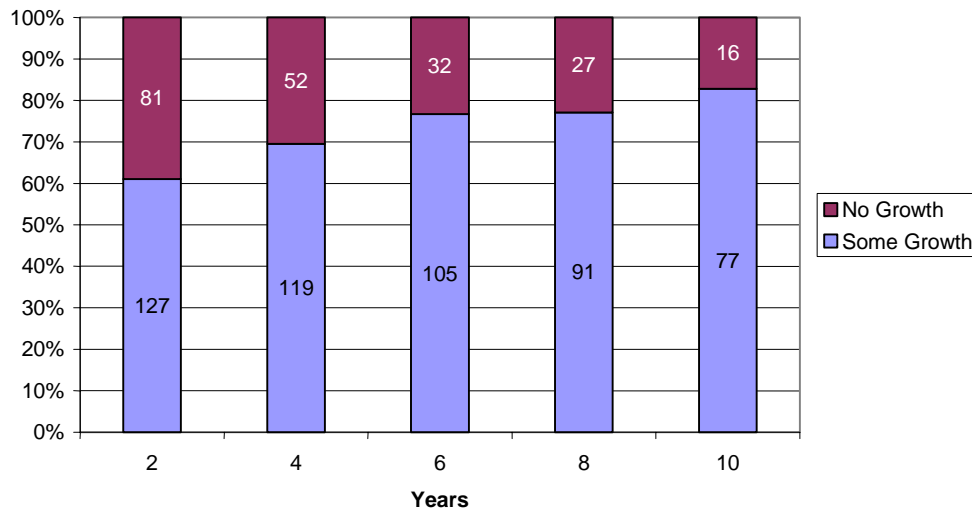


Figure 3. Growth and no-growth by age of firm, Cambridgeshire cohort

Growth creates problems: Reynolds and White (1997, p. 122 and 215) found that in their large US new firm samples, “firms with more (growth) potential reported more problems of every kind”. But the problems accompanying growth are less dangerous to a firm’s survival than the absence of growth.²⁰

Proposition 4: Growth can stimulate further growth

This follows from the tendency for growth to reinforce growth within the constraints of capacity. The advantages of early growth are internal (learning effects) as well as external (market position). The data from all three samples showed growth more likely to follow growth than to follow an episode of plateau or decline. This is consistent with other work showing that growth is more likely among growth firms (e.g. Stanley et al., 1996; Cosh and Hughes, 2000). The dynamic process approach explains why conditions for growth reinforcement are not created during stasis or decline phases; growth is more propitious for further growth unless resource constraints set in.

In the German sample the ‘growth-growth’ formation, i.e. a year of growth followed by another year of growth, was the most common sequence, representing 30% of all two-period sequences in the sample of 136 firms. Expressed differently, 58% of sequences beginning with an incidence of growth were followed by a second period of growth, whereas only 36% of sequences beginning with a plateau were followed by growth. In the Netherlands sample of successful firms the ‘growth-growth’ formation was even more pronounced: 69% of all two-period sequences. Even more of the sequences beginning with an incidence of growth were followed by a second period of growth (91%), while only 41% of sequences beginning with a plateau were followed by growth.

Proposition 5: Rapid growth is liable to reversal

The tendency for rapid growth that is interrupted to spiral into decline or reversal is a dynamic process explained in the explanatory model. Figure 2 showed that at least a third of the surviving firms in the Cambridgeshire cohort experienced growth reversal. Many other firms did not recover from this experience and so are not included among survivors. In the German sample 30% of the firms experienced at least one “Growth-Decline” sequence for revenue growth, but only 18% did so for employment growth, suggesting that lay-offs were slow to take effect in the German firms. The ‘successful’ firms making up the Netherlands sample revealed, as could be expected, a much lower incidence of setbacks.

There is evidence from other sources that rapid growth is hard to sustain. In one study of fast growth firms, among the fastest 10% of growth companies, one fifth show a decline in performance within four years (Storey, 1997b, p. 6). Had the fast track database extended beyond the top ten percent and over a longer period, the proportion of firms failing to sustain growth might have been higher. An earlier study cited “empirical evidence which suggests that the financial structures and performances of high performers and failing firms are very similar” (Keasey and Watson, 1993, p. 112). The pressures of growth take a toll even of the most promising new ventures.²¹

Concluding remarks

This paper proposes a multi-level and diachronic approach to new firm growth which can reveal dynamic processes at work as new firms develop. Firm development processes at the individual level can be seen to be associated with growth patterns in populations of new firms. The conceptual scheme proposed makes sense of non-linearities in growth paths of new firms. The exploratory analysis of three longitudinal samples of new firms has shown that development processes generate recurring patterns in the growth of new firms. The methodology proposed provides a way of examining and comparing the growth paths of new firms in a population or sample. Interesting cases can thereby be identified for detailed study, while case studies can be compared and contrasted in terms of their growth paths and turning points.

As research advances, it should be possible to code or quantify clusters of causal variables to operationalize a model of growth that would make it possible to test hypotheses regarding relationships between independent and dependent variables. How far the minutia in growth patterns can be explained depends on the detail of the evidence available. It should be possible to move from exploratory summary data to soundings taken at closer intervals. For example quarterly time series data on firms’ growth and performance is collected and could be compared for cohorts of firms in the same sectors. Further investigation can examine shifts in growth paths that reflect substantive changes in the activity or conditions of the firm in its early development.

A dynamic developmental approach can complement the case study, stage model and cross sectional attribute approaches that dominate the literature and throw further light on the patterns we have found to be endemic among new firms. Further work developing empirically grounded dynamic models is needed to explore the various causes of growth, stability and decline over the life course of a firm.

NOTES

¹ In their exhaustive overview of organizational growth studies, Weinzimmer et al. (1998) show that these studies are dominated by formulae using manipulations of first-year (t_0) and last-year (t_1) size to measure growth, either as absolute growth or as growth rate. They acknowledge that these studies “ignore valuable information concerning the middle years of a study, and thus fail to capture the dynamic properties of growth. This may result in either weak models and/or misspecified results and interpretations.” (Weinzimmer et al., 1998, p. 238). However, they leave the issue of growth processes aside in the rest of their article.

² Penrose was well aware of the 'tautological problem' inherent in a theory of the growth of firms concerned only with firms that can successfully grow (1995, p. 7). She was not concerned with predicting the growth of a particular firm in advance, but in understanding the mechanisms which bring about growth in more generic terms.

³ The problems of setting up a firm often require sequential solutions, but growth processes do not result in universal stages (Garnsey, 1998; 2002).

⁴ Alvarez and Busenitz (2001) have recently argued that the resource-based view of the firm can theoretically inform and extend research on entrepreneurship. Entrepreneurial alertness, entrepreneurial knowledge, and ability to coordinate resources are viewed as scarce resources in their own right that may lead to sustainable competitive advantage.

⁵ The idea of a process has been used in at least two other ways in the social science literature according to Van de Ven (1992). In the first usage, accounts are proposed as to how and why a change in one variable (e.g. founder experience) might lead to a subsequent change in another (e.g. growth rate). Causation between independent and dependent variables (or input and output) is assumed to account for differences in outcome. The process of growth taking place *within* the units of analysis is not examined. In the second usage identified by Van de Ven, 'process' refers to activity that has sequential dimensions, for instance work flows or decision-making and may include 'cognitive transitions' (Van de Ven, 1992, p. 170). Analysis reveals whether – but not necessarily how – change in these activity flows occurred over time. In addition to the senses of process identified by Van de Ven, formal models and simulations provide abstract analyses of processes of change.

⁶ Building on Penrose, we also find it useful to distinguish between the productive and commercial dimensions of the resource base of a company. The productive base encompasses all the physical facilities and production know-how of a company whereas the commercial base provides legal and marketing competence.

⁷ This argument is partly different from the 'liability of newness' that new firms face as identified by Stinchcombe (1965; cf. Penrose, 1995, p. 205) who described the different risks of dying of an organization during its life course. First, new firms lack the social ties to key stakeholders that give them access to resources. Second, entrepreneurs also have to convince external stakeholders to invest in a venture with uncertain future prospects. Third, the processes of mobilizing resources and learning of the new roles are resource- and time-intensive, which leads to economic inefficiencies.

⁸ Initial resource endowments – the stocks of resources that entrepreneurs contribute to their new firms at the time of founding – may explain the different life chances of new enterprises during start (cf. Shane and Stuart, 2002; Bhide, 2000); in that way certain enterprises (e.g. spin-offs or firms of serial entrepreneurs) already control a relative large productive base and some financial reserves at start.

⁹ Penrose (1960) examined this in the case study of Hercules Powder, the Dupont de-merger whose unused resources opened new opportunities, which however required further complementary resources to overcome resource deficits.

¹⁰ Putting them at risk of being taken over on unfavorable terms (as a solution to their 'growth-problems').

¹¹ She recognised the importance of merger as a source of growth, though she was more interested in the internal creation of knowledge and resources enabling growth (1995, p. 167).

¹² The tracking of growth paths is proposed not as an alternative but as a supplement to approaches which measure variance. This exploratory inquiry could be a starting point for more analytic quantitative work, drawing for example on methodologies of demographers (cf. Van Wissen and Dykstra, 1999), sociologists (cf. Abbott, 1995b) in studies of career paths.

¹³ In contrast to the traditional research design, EDA does not start with a fully specified research problem but involves an open-minded inductive approach, exploring what is to be found in the data, whether or not anticipated. This exploratory research generates questions that can be answered by analysing contrasting cases with regard to interesting features of the data, for example why a certain enterprises initially follow the same growth path but bifurcate after a certain moment in time. Unlike some EDA studies we were not without interpretive guidance.

¹⁴ Sequence analysis involves the temporal ordering of events, which mark the transitions of one phase state into another. The roots of sequence analysis can be traced back to the study of gene sequencing in biology, and has been applied to the study of the careers of persons (Abbott, 1995b). Three kinds of questions are central to sequence analysis (Abbott, 1995a): (1) questions about the pattern of sequences, (2) questions about independent variables (causes) that affect those patterns, and (3) questions about the dependent variables affected by the patterns (consequences).

¹⁵ The German sample has parallel data for sales and employment, enabling us to identify discrepancies between the two sets of measures.

¹⁶ In the Netherlands sample this change had to be at least 10% instead of 5%.

¹⁷ In simple terms to map dynamic processes from growth measures, input growth is some measure of resource mobilization, output growth of revenue generation. The official incorporation of the firm however is often not a very accurate indicator of early entrepreneurial activity (Reynolds and White, 1997).

¹⁸ 18% of the firms revealed other growth paths.

¹⁹ It is possible that in some firms the decision to lay off employees would have been planned and desired, e.g. through the sale of a division. But firms would not have intended cutbacks that increased their vulnerability to closure.

²⁰ Across all sectors, the well endowed start up and initial large team is less likely to lose impetus (Reynolds and White, 1997). In technology based ventures, large team startups are often the result of demergers or groups of people leaving earlier employment together in spinouts. Where they have experience and access to a resource base this enables the 'new' firm to achieve revenues early on.

²¹ An analysis based on a large US data set indicates that the chances of achieving high growth are greater among highly innovative (mainly high tech) firms. But among these highly innovative firms, those that fail to grow sufficiently are more likely to close than those that achieve growth (Kirchhoff, 1994). This implies that an innovative firm is more likely to find a promising resource base and market position, but that those firms in this group that fail to sustain growth are likely to run into difficulties leading to closure. We suggest that failure to sustain growth may not simply be the result of resource

constraints (Kirchhoff, 1994), but of growth at a rate too rapid to be sustained in relation to the resources available to the firm. Confirmation requires more detailed data like case study evidence that shows how this can occur.

References

- Abbott, A. (1995a). 'A Primer on Sequence Methods'. In Huber, G. P. and Van de Ven, A. H. (Eds), *Longitudinal Field Research Methods*, Thousand Oaks: Sage, 204-227.
- Abbott, A. (1995b). 'Sequence Analysis: New methods for old ideas'. *Annual Review of Sociology*, **21**, 93-113.
- Aldrich, H. E. (1999). *Organizations Evolving*. London: Sage.
- Almus, M. and Nerlinger, E. A. (1999). 'Growth of New Technology-Based Firms: Which Factors Matter?'. *Small Business Economics*, **13**, 141-154.
- Alvarez, S. A. and Busenitz, L. W. (2001). 'The entrepreneurship of resource-based theory'. *Journal of Management*, **27**, 755-775.
- Anderson, P. (1999). 'Complexity Theory and Organization Science'. *Organization Science*, **10**, 216-232.
- Argenti, J. (1976). *Corporate Collapse – the causes and symptoms*. London: McGraw-Hill.
- Barber, J., Metcalfe, J. S. and Porteus, M. (1989). *Barriers to Growth in Small Firms*. London: Routledge.
- Barkham, R., Gudgin, G., Hart, M., and Hanvey, E. (1996). *The Determinants of Small Firm Growth: An Inter-Regional Study in the UK 1986-1990*. London: Jessica Kingsley Publishers.
- Barney, J. (1991). 'Firm resources and sustained competitive advantage'. *Journal of Management*, **17**, 99-120.
- Barney, J., Wright, M., and Ketchen, D. (2001). 'The Resource-Based View of the Firm: Ten Years After 1991'. *Journal of Management*, **27**, 6, 625-642.
- Best, M. (2001). *The New Competitive Advantage - The Renewal of American Industry*. Oxford: Oxford University Press.
- Best, M. H. and Garnsey, E. (1999). 'Edith Penrose, 1914-1996'. *Economic Journal*, **109**, 453, 187-201.
- Bhide, A. (2000). *The origin and evolution of new businesses*. Oxford: Oxford University Press.
- Birch, D. (1987). *Job Creation in America*. New York: The Free Press.
- Brush, C. G., Greene, P. G. and Hart, M. M. (2001). 'From initial idea to unique advantage: the entrepreneurial challenge of constructing a resource base'. *Academy of Management Executive*, **15**, 1, 64-78.
- Chandler, G.N. and Lyon, D.W. (2001). 'Methodological issues in entrepreneurship research: the past decade'. *Entrepreneurship Theory and Practice*, **25**, 4, 101-113.
- Churchill, N. and Lewis, V. (1983). 'The five stages of small business growth'. *Harvard Business Review*, May-June, 30-50.
- Churchill N., (1997), 'The Six Key Phases of Company Growth'. In Birley, S. and Muzyka, D. (Eds), *Mastering Enterprise*, London: Financial Times, Pitman, 213- 219.
- Cosh A., and Hughes, A. (2000). *British Enterprise in Transition*. Cambridge: ESRC Centre for Business Research.
- Curran, J. and Blackburn, R. (2000). *Researching the Small Enterprise*. London: Sage.
- Cyert, R.M. and March, J.G. (1963). *A behavioral theory of the firm*. Englewood Cliffs, NJ: Prentice-Hall.
- Davidsson, P. and Wiklund, J. (2000). 'Conceptual and empirical challenges in the study of firm growth'. In Sexton, D.L. and Landström, H. (Eds). *The Blackwell Handbook of Entrepreneurship*. Oxford: Blackwell, 26-44.
- Eisenhardt, K. M. (1989). 'Building Theories from Case Study Research'. *Academy of Management Review*, **14**, 532-550.
- Eisenhardt, K. M. and Martin J. A. (2000). 'Dynamic capabilities: What are they?'. *Strategic Management Journal*, **21**, 10-11, 1105-1121.
- Foss, N.J. (1997). 'Resources and Strategy: Problems, Open Issues, and Ways Ahead'. In Foss, N.J. (Ed). *Resources, Firms, and Strategies. A Reader in the Resource-Based Perspective*. Oxford: Oxford University Press, 345-365.

- Foss, K. and Foss, N. (2000). 'The Knowledge-Based Approach and Organizational Economics: How much do they really Differ? And how does it Matter?'. In Foss, N. and Mahnke, V. (Eds). *Competence, Governance and Entrepreneurship, Advances in Economic Strategy Research*, Oxford: Oxford University Press.
- Garnsey, E. (1998). 'A Theory of the Early Growth of the Firm', *Industrial and Corporate Change*, **3**, 523-556.
- Garnsey, E. (2002). 'The Growth of New Ventures; Analysis After Penrose'. In Pitelis C. (Ed). *The Growth of the Firm; the legacy of Edith Penrose*. Oxford: Oxford University Press, 101-126.
- Garnsey, E. and Heffernan, P. (2003). *Growth Setbacks in New Firms*. Discussion Paper. Cambridge: Centre for Technology Management, University of Cambridge.
- Ghoshal, S., Hahn, M. and Moran, P. (2001). 'Management Competence, Firm Growth, and Economic Progress'. In Pitelis C. (Ed). *The Growth of the Firm; the legacy of Edith Penrose*. Oxford: Oxford University Press, 279-308.
- Greiner, L.E. (1972). 'Evolution and Revolution as Organizations Grow', *Harvard Business Review*, July-August, 37-46.
- Hugo, O. (2002). *Understanding New Venture Growth as a Development Process*. PhD thesis University of Cambridge.
- Hugo, O. and Garnsey, E. (2002a). 'Investigating the growth paths of young technology firms: A process approach'. Report to the Anglo-German Foundation. Cambridge: Centre for Technology Management, University of Cambridge.
- Hugo, O. and Garnsey, E. (2002b). 'Hotmail & Co.: The Emergence of Electronic Messaging and the Growth of Four Entrepreneurial Entrants'. In Oakey, R. (Ed). *New Technology-Based Firms in the New Millennium*. Amsterdam: Pergamon Press.
- Kazanjian, R. K. (1988). 'Relation of dominant problems to stages of growth in technology-based new ventures'. *Academy of Management Journal*, **31**, 257-279.
- Kazanjian, R. K. and Drazin, R. (1989). 'An empirical test of a stage of growth progression model'. *Management Science*, **35**, 12, 1489-1503.
- Keasey, K. and Watson, R. (1993). *Small Firm Management: Ownership, Finance and Performance*. Oxford: Blackwell.
- Kerlinger, F. N. (1986). *Foundations of Behavioral Research*, 3rd edition. New York: Holt, Rinehart & Winston.
- Kirchhoff, B. (1994). *Entrepreneurship and Dynamic Capitalism: the economics of business firm formation and growth*. Westport, CT: Praeger Publishers.
- Kirzner, I. M. (1997). 'Entrepreneurial Discovery and the Competitive Market Process. An Austrian Approach'. *Journal of Economic Literature*, **35**, 60-85.
- Kor, Y. Y. and Mahoney, J. T. (2000). 'Penrose's resource-based approach: The process and product of research activity'. *Journal of Management Studies*, **37**, 1, 109-139.
- Lichtenstein, B. M. B., and Brush, C. G. (2001). 'How do "resource bundles" develop and change in new ventures? A dynamic model and longitudinal exploration'. *Entrepreneurship Theory and Practice*, **25**, 1, 37-58.
- Marsh, C. (1988). *Exploring Data*. Cambridge: Polity Press.
- Mohr, L. B. (1982). *Explaining Organizational Behavior*. London: Jossey-Bass.
- Montgomery, C. A. (1995). *Resource-based and evolutionary theories of the firm: towards a synthesis*. Boston: Kluwer.
- Oakey, R. (1995). *High technology new firms: variable barriers to growth*. London: Paul Chapman.
- Penrose, E. (1960). 'The Growth of the Firm - a Case Study: The Hercules Powder Company'. *Business History Review*, **34**, 1, 1-23.
- Penrose, E. (1995). *The Theory of the Growth of the Firm*. 3rd edition. Oxford: Oxford University Press
- Peteraf, M. A. (1993). 'The cornerstones of competitive advantage: a resource-based view'. *Strategic Management Journal*, **14**, 179-191.
- Phillips, B. D. and Kirchhoff, B. A. (1989). 'Formation, growth, and survival: Small firm dynamics in the US economy'. *Small Business Economics*, **1**, 1, 65-74.

- Pitelis C. (2002). *The Growth of the Firm; the legacy of Edith Penrose*. Oxford: Oxford University Press.
- Porter, M. (1991). 'Towards a Dynamic Theory of Strategy'. *Strategic Management Journal*, **12**, 95-117.
- Reynolds, P. and White, S. (1997). *The Entrepreneurial Process*. Westport, CT: Quorum Books.
- Rugman A. M. and Verbeke, A. (2002). 'Edith Penrose's contribution to the resource-based view of strategic management'. *Strategic Management Journal*, **23**, 8, 769-780.
- Shane, S. (2000). 'Prior knowledge and the Discovery of Entrepreneurial Opportunities'. *Organization Science*, **11**, 448-469.
- Shane, S. and Stuart., T. (2002). 'Organizational endowments and the performance of university start-ups'. *Management Science*. **48**, 1, 154-170.
- Stam, E. (2003). *Why Butterflies Don't Leave. Locational Evolution of Evolving Enterprises*. PhD thesis Utrecht University.
- Stanley, M. H. R., Amaral, L. A. N., Buldyrev, S. V., Havlin, S., Leschhorn, H., Maass, P., Salinger, M. A. and Stanley, H. E. (1996). 'Scaling Behaviour In The Growth Of Companies', *Nature*, **379**, 6568, 804-806.
- Stinchcombe, A. L. (1965). 'Social structure and organizations'. In March, J. G. (Ed) *Handbook of organizations*. Chicago: Rand McNally. 142-193.
- Storey, D. (1997a). *Understanding the Small Firm Sector*. London: Thomson.
- Storey, D. (1997b). *The Ten Percenters, Fast Growing SMES in Great Britain*, Second Report. London: Deloitte Touche Tohmatsu International.
- Teece, D. J., Pisano, G., and Shuen, A. (1997). 'Dynamic capabilities and strategic management'. *Strategic Management Journal*. **18**, 509-533.
- Tukey, J. W. (1977). *Exploratory Data Analysis*. Reading, Mass.: Addison-Wesley.
- Utterback, J. M., Meyer, M., Roberts, E. and Reitberger, G. (1988). 'Technology and industrial innovation in Sweden: A study of technology-based firms formed between 1965 and 1980'. *Research Policy*, **17**, 15-26.
- Van de Ven, A. H. (1992). 'Suggestions for Studying Strategy Process: A Research Note'. *Strategic Management Journal*, **13**, 169-188.
- Van de Ven, A. H. and Poole, M. S. (1995). 'Explaining Development and Change in Organizations'. *Academy of Management Review*, **20**, 510-540.
- Van Wissen, L. J. G. and Dykstra, P. A. (1999). *Population Issues. An Interdisciplinary Focus*. New York: Kluwer Academic/Plenum Publishers.
- Weinzimmer, L. G., Nystrom, P. C. and Freeman, S. J. (1998). 'Measuring Organizational Growth: Issues, Consequences and Guidelines'. *Journal of Management*, **24**, 2, 235-262.
- Wiklund, J. (1998). *Small firm growth and performance: entrepreneurship and beyond*. PhD thesis Jönköping International Business School.
- Woo, C. Y., Daellenbach, U. and Nicholls-Nixon. C. (1994). 'Theory Building in the Presence of 'Randomness': The Case of Venture Creation and Performance'. *Journal of Management Studies*, **31**, 4, 507-524.
- Yin, R. K. (2003). *Case study research: Design and methods*. 3rd edition. Thousand Oaks: Sage.

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