THE INITIAL RESOURCES AND MARKET STRATEGY TO CREATE HIGH GROWTH FIRMS

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ABSTRACT

Research-based start-ups (RBSUs) differ in their early growth. Some firms grow very rapidly, while others grow slowly or do not grow at all. In this paper we bring insights in the causes of the diversity in the early growth of RBSUs. The aim is to describe and characterize promising RBSUs based on factors that are observable at founding. To identify some of the key factors that affect growth, we study the initial resource base and the firm's market strategy. We control for age, size and industry differences. Growth is a complex and multidimensional phenomenon and therefore, we study three growth measures, namely employment and revenue growth and growth in total assets. Our multivariate analyses show that raising large amounts of VC is a key driver for early employment and revenue growth. Whilst most RBSUs are founded by pure technical founding teams, we find that R&D experience has no effect on growth. Founding teams with commercial experience, on the other hand, grow significantly more in employees, revenues and total assets. Next, RBSUs, which are internationally oriented from the start, grow significantly faster in terms of revenues and total assets but not in employees. Finally, multivariate analysis indicates that firms that are closer to a market ready product at founding do not grow significantly more in terms of revenues and employees, but firms that are earlier in the product development cycle grow more in total assets during the early growth path. We use in-depth qualitative information to explain and interpret the results and discuss the sustainability of different early growth trajectories. Our findings have important implications for entrepreneurs, investors and policy makers.

Key words: Start-ups; growth; initial conditions

INTRODUCTION

There is a popular and romantic perception that innovative start-ups, often operating in high-technology sectors, develop and commercialize new products and services that will transform their industry's and even their country's prospects. These firms – which we label as 'Research-Based Start-Ups' (RBSUs) - are perceived as the dynamos of technological development, social progress and economic growth (Schumpeter, 1934; Utterback et al., 1988). The supporters of entrepreneurial development argue that the formation of RBSUs can have an appreciable effect on regional job creation and economic renewal (Acs & Audretsch, 1990). This dominant view of rapidly growing RBSUs is also inspired by the highly visible success stories of the early and mid-nineties and the success of 'high tech clusters' such as Silicon Valley and Route 128 (Boston) in the US and Cambridge in the UK (Roberts, 1991; Saxenian, 1994; Segal Quince Wicksteed, 2000). Not surprisingly, policy makers focus upon the promotion of RBSUs as a panacea for economic problems in view of their apparent potential for job and wealth creation (Storey & Tether, 1998).

There is however some concern associated with presuming rapid growth of all RBSUs. Several researchers argue that it is a gross oversimplification to believe that all (or most) RBSUs have high growth potential (Oakey, 1995; Storey & Tether, 1998). Recent studies indeed show that in contrast to the highly visible success stories (the so-called gazelles), the vast majority of RBSUs remain very small (Roberts, 1991; Rickne & Jacobsson, 1999; Autio & Yli-Renko, 1998; Mustar, 1997; Chiesa & Piccaluga, 2000; Segal Quince Wicksteed, 2000). Hence, RBSUs seem to differ enormously in their growth potential but previous research focussed mainly on the high growth firms neglecting the majority of slowly growing firms. As a result, we know very little about which factors distinguish fast growing from slowly or not growing RBSUs. As Autio and Lumme (1998) noted: "many books and studies, while acknowledging that most NTBFs do not grow, still explicitly focus on rapid growth and largely dismiss the study of slowly growing NTBFs."

In this paper, we study the causes of the diversity in growth of RBSUs. More specifically, we study which initial conditions (starting resources), and aspects of the market strategy are related to growth. We study employment and revenue growth and growth in total assets during the first 3 to 13 years after founding. The aim is to describe and characterize promising start-ups based on factors that are observable at founding. As such, this paper builds on previous research, which argues that founding conditions can have a long-lasting effect on firm growth and performance (Boeker, 1989). These insights could be very useful to help policy makers target scarce economic resources to the small proportion of "…high-flying firms which create the jobs" (Gallagher & Miller, 1991, p 100) through a policy of 'picking winners' (Storey et al., 1987; Smallbone et al., 1993). Also entrepreneurs and investors are interested in knowing which factors lead to high growth in order to take the appropriate actions when high growth is their objective.

The paper is organized as follows. We start with a discussion on growth of RBSUs and how to measure it. We concisely review the literature that gives some guidance as to factors, which could contribute to growth and formulate specific hypotheses. Next, we describe our sample, the data, and analytical procedure. In the following section, we discuss the results of our analysis. We end with conclusions, limitations and directions for future research.

LITERATURE REVIEW

The high growth potential has long been the dominant view on RBSUs among researchers and policy makers. Several researchers indicate that RBSUs, once they have reached a certain critical mass, exhibit faster average employment growth rates than non-high tech starters (Mustar, 1995; Licht & Nerlinger, 1998; Storey & Tether, 1998; Delapierre et al., 1998; Autio & Parhankangas, 1998), have a higher probability of survival after start-up (Autio, 1998) and tend to be more internationally oriented than their non-high tech equivalents (Storey & Tether, 1998). However, in recent years several researchers showed that the idea of fast growth does not hold for most RBSUs. Rickne & Jacobsson (1999) found that the vast majority of New Technology Based Firms[1] (NTBF) (80%), established between 1975 – 1993 in Sweden, remained very small. In 1993, the firms had on average about 15 employees. Also Autio and Yli-Renko (1998) reported that most NTBFs in Finland did not grow at all. Similar findings were reported in France (Mustar, 1997), Italy (Chiesa & Piccaluga, 2000) and in Cambridge, UK (Segal Quince Wicksteed, 2000). Several scholars also indicate that the overall impact of RBSUs for employment generation might be lower than the popular perception (Delapierre et al., 1998; Mustar, 1995). Delappiere et al. (1998) further argue that high tech firms that concentrate on R&D and work primarly as research subcontractors for large groups show little employment growth. In contrast, firms that deal with turning technology into new uses tend to grow and create employment as they develop their manufacturing and marketing capabilities. Clearly, there is still much discussion and uncertainty regarding the employment growth potential of RBSUs.

The aim of this paper is to generate insights in the characteristics of RBSUs, which contribute to the venture's growth. The central research question tackled in this paper is 'which factors that are observable at founding of new firms are related to growth?' Our

[1] Research on RBSUs has been conducted under many labels. We refer to the method section for an overview. To overcome confusion we adopt the term 'research-based start-up' in this paper. However, when we cite the work of other scholars we use the labels of the authors.

aim is to contribute to the ongoing debate on the growth (or non-growth) of RBSUs and the potential causes of the observed diversity.

Measuring growth of research-based start-ups: revenues, employment and total assets

Studies on growth and performance of start-ups have come to contrasting conclusions even on the same explanatory variables (Woo et al., 1989). One possible cause might be the use of different growth and success measures such as sales growth (Lee et al., 2001), employment growth (Westhead & Birley, 1994), profitability (Spanos & Lioukas, 2001; Caloghirou et al., 2004), total assets (Achtenhagen et al., 2004), first product shipment (Schoonhoven et al., 1990), self-rated perceptual growth and success measures (Pavia, 1991) or a composite performance indicator (Roberts, 1991). Delmar et al. (2003) argue that there is no "one best way" of measuring growth because firm growth is fundamentally a multidimensional rather than a one-dimensional phenomenon. They showed that high-growth firms do not grow in the same way and that '*what a "high-growth firm" is, conceptually and operationally, is very dependent on the growth measure used*'.

Hence, of critical importance in studying the growth of RBSUs is the clear specification of growth criteria in question. Different measures of growth have been proposed in the entrepreneurship literature. Based on extensive reviews of the literature, Ardishvili et al. (1998) and Delmar (1997) arrive at almost identical lists of possible growth indicators: (return-on) assets, employment, market share, physical output, profits, and sales. There is a lot of discussion going on about which growth measures are most appropriate in the specific context of new ventures. Several scholars argue that traditional accounting-based indicators of profitability are inappropriate for early stage RBSUs (e.g. Hart, 1995; Lee et al. 2001; Shane & Stuart, 2002). Profit margins and net profits are often useless because most start-ups do not make any profit during their first years.

Sales, on the other hand, is an often preferred measure of firm growth and financial performance of new ventures (Ardishvili et al., 1998; Hoy et al., 1992; Brush and

VanderWerf, 1990) because it is relatively accessible, it applies to (almost) all sorts of firms, and it is relatively insensitive to capital intensity and degree of integration (Delmar et al., 2003). Sales growth is often measured as growth in total revenues (Hanks et al., 1993). Several recent studies of performance of new ventures have used revenue growth as a dependent measure (Chesbrough, 2003; Lee et al., 2001; Bruderl and Preisendorfer, 2000).

For RBSUs, it is, however, possible that assets and employment will grow before any sales will occur (Brush et al., 2001; Delmar et al., 2003). Resource-based view scholars value employment- and assets-based measures as a highly suitable indicator of firm growth (Penrose, 1959; Kogut & Zander, 1992). If firms are viewed as bundles of resources, a growth analysis ought to focus on the accumulation of resources, such as employees and other assets. Policy makers are especially interested in identifying firms, which contribute most to job creation (Westhead & Birley, 1994). Finally, growth in terms of total assets and resource bases is increasingly receiving attention (Achtenhagen et al., 2004). In particular for RBSUs, growth in total assets might be a relevant growth measure because these firms often need to invest heavily in product and market development before generating revenues. To conclude, based on these previous studies, we argue that three measures are most appropriate to study the early growth of RBSUs, namely growth in employees, revenues and total assets.

Potential causes of firm growth

'How and why' start-ups grow to become successful firms is one of the least understood aspects in entrepreneurship research (Cooper et al., 1994; Gartner, 1985; Kazanijan & Drazin, 1990). Growth is argued to be a complex and multidimensional phenomenon (Westhead & Birley, 1994). Not surprisingly, there is no single theory, which can adequately explain small business growth, and chances are small that such a theory will be developed in the future (Gibb & Davies, 1990). On the other hand, several researchers argue that firms do not end up with particular growth patterns at random, but that "how firms grow" is systematically related to characteristics of these firms and their environments (Smallbone et al; 1993; Delmar et al., 2003).

While it is unlikely that a comprehensive model with predictive capability for growth will emerge, we think it is possible to identify key success factors that affect growth of RBSUs. To do so, we build on previous research which argues that the circumstances of an organization's founding play an important role in imprinting the initial form of the organization and influence its later growth and performance (Boeker, 1989; Stinchcombe, 1965). Hence, in this study we focus on the 'imprinting' effects of initial conditions to explain heterogeneity in firm growth. More specifically, we use two approaches to identify factors which differ at founding and which may affect growth: (1) the resource-based view (RBV) approach, which emphasizes individual firm resources (Barney, 1991), (2) the broader market-led and international management approach, which emphasizes factors such as breadth and international scope of the market strategy. In the following paragraphs, we use these two theoretical approaches to formulate specific hypotheses regarding the determinants of growth for RBSUs. In agreement with previous empirical studies on firm growth we include differences in industry and competitive environment and the firm's age and size as control variables. Figure 1 gives an overview of our conceptual model.

INSERT FIGURE 1 ABOUT HERE

Initial resources

Researchers in the stream of the Resource-Based View (RBV) of the firm argue that success is dependent on the characteristics of the firm's resource bundle (Barney, 1991; Chandler & Hanks, 1994) and that one of the new venture's challenges is to identify and acquire an initial resource base (Penrose, 1959). RBV-scholars explicitly recognize that a firm's initial resources are an important antecedent to current capabilities and opportunities (e.g. Barney, 1991). 'Firm resources' is a multidimensional construct and entrepreneurship scholars studied different aspects of a firm's resource base such as financial resources (Roberts, 1991; Hellmann & Puri, 2000; Manigart et al., 2002), personal characteristics of the founders or entrepreneurial team (e.g. Utterback et al.,

1988; Roberts, 1991, p. 47 – 99; Shane, 2001; Shane & Stuart, 2002; Burton et al. 2002) and product technology (Utterback et al., 1988; Roberts, 1991). Human capital, financial capital and technology are all instrumental in the development of an initial resource base and are considered as key to the survival and success of RBSUs (Carter et al., 1997; Gartner et al., 1998; Roberts, 1991).

In this study, we complement this literature by studying how different starting resources relate to growth in employment, revenues and total assets. More specifically, we use different measures of the firm's technological base, its financing and its human resources. For the technology we focus on how far the new venture is from product launch at founding. Previous research on high tech start-ups shows that firms that start with products significantly outperform those that begin as consultants or R&D contractors (Roberts, 1991; Delapierre et al., 1998). In line with this, we argue that new ventures that are closer to a market ready product at founding will grow faster during the first years than firms that are at earlier points in the product development cycle.

Hypothesis 1:RBSUs, which are further in the development cycle, will grow more in terms of employees, revenues and total assets compared to RBSUs, which are earlier in the product development cycle at founding.

For financing, we study the effect of the amount of starting capital and the involvement of venture capital (VC) investors. Insufficient financial resources are often cited as a primary reason why new ventures fail. Firms with greater financial resources can invest more in product/service development, production, and marketing, and have a larger financial cushion to provide insulation against slow start-up, market downturns, or managerial mistakes. Previous research suggests that the amount of initial capital invested is positively related to new venture survival and success (Cooper et al., 1994). Next, Davila et al. (2003) give descriptive evidence on how VC is significantly associated with high growth companies. This positive association between VC and high growth might be due to VCs ability to select firms with high growth potential or to postinvestment benefits that accrue to VC-backed firms (Baum & Silverman, 2003). In

this study, we aim to test the hypothesis that more initial financing and VC involvement leads to higher growth.

Hypothesis 2:RBSUs, which have more financial resources and/or raised VC, will grow more in terms of employees, revenues and total assets compared to RBSUs, which start with more modest financial resources.

Firm-specific human capital in new firms is contained within the management know-how and experience of the founder and/or founding team (Welbourne et al., 1996). VCs consistently mention the quality (experience) of the founding team as an important criterion for venture funding (MacMillan et al., 1985), which suggests that human capital is an important predictor for new venture success. In line with this, several researchers report that the entrepreneur's skills and experience are positively related to new firm success (Roberts, 1991; Cooper et al. 1994). We study the effect of the experience of the entrepreneurial team on early growth. More specifically, we study the cumulated experiences of all members of the founding team in different functions such as R&D, business development and sales, financing, production, etc. The hypothesis can be formulated as follows:

Hypothesis 3:RBSUs started by founding teams with more experience in different functional domains (R&D, commercial, other) will grow more in terms of employees, revenues and total assets compared to RBSUs started by less experienced teams.

Breadth and international scope of the market strategy

In addition to the decision of which industry to enter, entrepreneurs must decide upon the scale with which to enter that industry. In particular, entrepreneurship scholars suggest that two important aspects of the market strategy are the breadth of the targeted market and the international orientation of the new venture. We explore whether differences in the breadth of market strategy and international orientation at founding result in different growth rates in terms of revenues, employees and total assets.

Some start-ups focus on a narrow niche market, while others target directly large markets, which are broadly defined in terms of number, size and types of customers (Cooper et al., 1986; Romanelli, 1989). Other RBSUs focus initially on a niche market but have the specific intention of differentiating into larger, broadly defined markets later on (Tiler et al., 1993). Several entrepreneurship and strategy scholars advised new ventures to pursue very narrow niche markets in order to avoid direct competition with large firms. They suggest that new ventures should concentrate on specialized products and market segments where customization and high levels of customer service create unique (to small firms) advantages, or opportunities too small to be of interest to larger, economies-of-scale oriented firms (Porter, 1980; Cooper et al., 1986). Other scholars found that new ventures with a broader more aggressive market strategy outperform start-ups with a focused strategy (Biggadike, 1979; MacMillan & Day, 1987). Noting the mixed results of research about the breadth of the new ventures market approach, McCann (1991, p. 193) suggests that it 'is a variable that should at least be considered in any research'.

The firms in this study develop and introduce really novel products or services in the market place. Such firms may try to compensate for greater technological uncertainty by a greater market focus (Pavitt, 1998). In a similar sample of firms in the Boston area, Roberts (1991, p. 28) found that companies that focus on core technologies and markets do much better than those that diversify into multiple technologies and markets. Moore (1991) argues that focusing on a specific market segment at first is critical to market and sell new 'high tech' products. Once the potential of the product/technology is demonstrated in an early (smaller) market segment, the firm can use these first customers as a reference to go after larger, broader markets. This suggests that RBSUs with a focus or a niche strategy at first will be more successful than firms pursuing broad markets from the start. Therefore, our fourth hypothesis is:

Hypothesis 4: RBSUs targeting narrowly defined niche markets at start-up will show higher growth in terms of employees, revenues and total assets than RBSUs with a broad, less focused market strategy.

Start-ups also differ in their international orientation, ranging from a local market focus, over international new ventures, which are committed from inception to sell their products and services in multiple countries to truly global start-ups, which proactively act on opportunities to acquire resources and sell outputs wherever in the world they have the greatest value (Oviatt & McDougall, 1994). Previous research found that RBSUs tend to be more internationally oriented early on in their lifecycle compared to non-high tech starters (McDougall, 1989; Storey & Tether, 1998). As the new millennium begins, the number of young firms experiencing rapid internationalization appears to be increasing (Shrader et al., 2000). Autio et al. (2000) argue that a key strategic issue for entrepreneurial firms is whether it is better to start the internationalization process soon after founding, or to postpone international entry until the firms has accumulated significant resources. However, our understanding of the consequences of internationalization for young firms is rudimentary. This study, we analyze the impact of an international orientation from the start on the early growth of RBSUs. Previous research argues that internationalization provides firms with growth opportunities (Brush, 1992; Shrader et al., 2000; Autio et al., 2000). Therefore, our fifth hypothesis is:

Hypothesis 5: RBSUs with an international market orientation from the start will show higher growth in terms of employees, revenues and total assets than RBSUs focusing on local markets.

Controlling for industry, competitive forces, size and age

We control for several variables, which fall outside our conceptual model, yet might affect the early growth of RBSUs. These control variables include the firm's industry, competitive forces in the chosen market segment, firm size and age. Below we provide our rationale for including each of these control variables.

Industry

Many researchers study growth and performance of firms in single industry samples with the underlying belief that the growth potential of firms depends on the overall growth of

the industry, which should be controlled for (Clarysse, 1996; Stuart et al., 1999). In a sample of manufacturing SMEs in the UK, Smallbone et al. (1993) found, however, that firms are able to achieve high growth in all eight industries represented in their sample but that growth was indeed harder to achieve in some industries than in others. Delmar et al. (2003) report significant differences in growth patterns, which are related to differences in industries. Thus, assuming industry differences is not straightforward but might not be a bad first approximation. Therefore, we control for industry differences in this study.

Competitive forces

The Industrial Organization (IO) literature argues that a firm's performance is not only dependent on the industry in which the firm is active but also on how the firm positions itself in this industry. The IO-literature views the firm as a bundle of strategic activities aiming at adapting to the industry environment by seeking an attractive position in the market arena (Porter, 1980). Most well known is Porter's framework of competitive strategy, which emphasizes the actions a firm can take to defend their positions against competitive forces such as threat of entry, threat of substitution, bargaining power of buyers, bargaining power of suppliers and competitive rivalry among industry incumbents. Sandberg and Hofer (1987) found that venture strategy as well as competitive forces in the industry have an impact on the success of new ventures. Therefore, we control for three competitive forces, namely threat of new entrants, threat of substitutes and bargaining power of buyers. We don't include bargaining power of suppliers because most RBSUs do not have important dependent relationships with suppliers. Controlling for direct competition is also troublesome in the context of RBSUs because these firms develop and commercialize new products and services. For these firms, the industry boundaries are very vague. Therefore, defining and quantifying direct competitors is very difficult and in our view inappropriate.

Firm size

Previous theoretical work acknowledges that a firm's growth pattern is dependent on its age and size (Penrose, 1959; Stinchcombe, 1965). Population ecologists also study the

relationships between firm size, age, survival and growth in context of analyses of firm size distribution in organizational populations (Carroll & Hannan, 2000). The most well known relationship between an organization's size and its growth rate is Gibrat's (1931) law or the Law of Proportionate Effect. This law holds that (absolute) growth is proportional to size and that the factor of proportionality is random. Put differently, proportional growth rates are independent of size. However, recent empirical research challenges this vision and indicates that (proportional) growth rates diminish with size for firms of the same age (Evans, 1987a,b; Dunne et al., 1989; Barron et al., 1994; Sutton, 1997). Hence, indications exist to reject Gibrat's Law. Therefore, we control for size differences in this study. Following recent work on firm growth, we use the firm's employment size as our control measure (Lee et al., 2001).

Firm age

Empirical studies indicate that firm growth decreases with firm age for firms of the same size and that the variability of firm growth decreases with age (Sutton, 1997). The relationship between firm age and growth stands out independently of whether the sample of firms studied comes from multiple industries or from a single industry (Barron et al., 1994; Sutton, 1997). Evans (1987b) concludes that "this inverse relationship between growth and age is consistent with Jovanovic's (1982) theory of firm growth in which firms uncover their true efficiencies over time with a Bayesian learning process" (pp 657 – 658). Entrepreneurship scholars also find that the growth potential of new firms is most apparent during their initial phase of evolution (Storey & Tether, 1998; Delmar et al., 2003). Reynolds (1987) argues that the age of the small firm may have a profound influence on its ability or inclination to generate new jobs. Hence, previous research suggests that the younger firms in our sample will have a higher annual growth rate than the older firms. However, in considering the effect of age on growth of RBSUs, it must be emphasized that all firms in this study are young and range in age between 3 and 13 years old. Compared to the other studies on the effect of firm age on growth, the variation in age in this study is low. With this young age profile in mind, we expect that age will not explain much of the variety in growth in our sample. Nonetheless, we include firm age at time of survey as a control variable in our analyses.

METHOD

Population of RBSUs

Studies of innovative new ventures have been conducted under many labels such as 'New Technology-Based Firms (NTBFs)' (Little, 1977), 'new high tech firms' (Keeble & Walker, 1994; Roberts, 1991), new innovative companies (Hellman & Puri, 2000), technology-based small and medium sized firms (Harrison & Mason, 1994) and (corporate or academic) spin-offs and university start-ups (Smilor et al., 1990; Chiesa & Piccaluga, 2000; Debackere, 2000; Mustar, 1995, 1997; Zahra, 1996; Nlemvo et al., 2001; Degroof, 2002; Clarysse & Moray, 2004; Shane & Stuart, 2002). In this paper, we prefer to use 'research-based start-up' or RBSUs to overcome the conceptual confusion that exists around 'NTBFs' and related concepts (Storey & Tether, 1998; Rickne & Jacobsson, 1999; Rickne, 2000). We believe that 'research-based start-up' better captures what most researchers actually mean, namely new companies (start-ups) introducing new innovative products and services on the market, which they (partly) develop themselves (research-based).

Sampling

We study RBSUs in a homogeneous region in order to reduce the non-measured variance resulting from environmental conditions. We choose Flanders, which is a small, export-intensive economy, located in the northern part of Belgium. Flanders is considered as an emerging high tech region, experiencing a fast process of convergence between old and new technologies and thereby improving its competitive position (Cantwell & Iammarino, 2001). To construct the sample frame, we first identify the RBSUs among academic spin-outs, venture capital backed firms, and start-ups that received R&D subsidies. Next, we complement our sample with a random selection drawn from the entire population of companies that are active in high-tech and medium high-tech industries. In total, our sample comprises 205 firms founded in Flanders (Belgium) since 1991. For this study, we limit our sample to the 171 firms founded between 1991 and 2000, in order to have at least three-year growth figures.

Data Collection and Descriptive Statistics

The primary data source is a structured questionnaire, which enables the reconstruction of the firm's history and particularly focuses on the firm's resources, products, market characteristics, and employees. For each item, we collect the data on the initial conditions (during their first year of operations) as well as on the current situation (time of interview). The questionnaire is conducted during personal interviews with the founder. The founders or CEO's were targeted because they typically possess the most comprehensive knowledge on the organization's history, the firm's strategy, its processes and performance (Carter et al., 1994).

Measures

Of critical importance in hypothesizing about the growth implications of starting with different resource configurations, with different market approaches and operating under different competitive pressures, is the clear specification of the growth criteria in question. There is very little consensus on how to measure growth and divergent results for the same explanatory variables highlight the importance of including multiple measures of growth in research studies, particularly for those on new ventures (McDougall et al., 1994; Delmar et al., 2003). In this study, we choose employment growth, revenue growth and growth in total assets.

The first criterion, employment growth, is especially relevant for policy makers with a more macro-oriented interest in new ventures as sources for job creation. The second criterion, revenue growth, has been the most popular operationalization of growth and financial performance in studies of small firms and new ventures (Brush & VanderWerf, 1990; McDougall et al., 1994; Delmar et al., 2003). Finally, total assets might be especially relevant in the context of new ventures, which may grow their assets first before any revenues occur (Achtenhagen et al., 2004).

A lot of debate has also been devoted to whether absolute or relative growth measures should be used (Achtenhagen et al., 2004). Absolute measures tend to ascribe higher

growth to larger firms whereas smaller firms more easily reach impressive growth in percentages (i.e. relative) terms (Delmar et al., 2003). We follow the arguments of Westhead and Birley (1994) and use the absolute growth and not the percentage change. "*The obvious concern is that the same change when calibrated from different bases would be represented by different percentages. The effects of employing percentages would be particularly problematic in the sample of small start-ups with three or less employees*" (Woo et al., 1989, p 139). In other words, using relative i.e. percentage, growth measures is especially troublesome if one studies small ventures since the smallest venture naturally ends up with the highest relative growth even if in absolute terms its growth is negligible compared to the absolute growth of its larger counterparts. To assess the potential causes of employment and revenue growth, we use 'Annual Absolute Employment Growth', 'Annual Absolute Revenue Growth', and 'Annual Absolute Total Asset Growth', which are objective measures of the annual absolute employee and revenue change (Hanks et al., 1993; Westhead & Birley, 1994; Delmar et al., 2003).

Annual Absolute Employment Growth (AAEG) = (Present total employment size of surveyed firm – Total employment size of firm in first year) / Age

Annual Absolute Revenue Growth (AARG) = (Present total revenues of surveyed firm – Total revenues in first year) / Age

Annual Absolute Total Asset Growth (AATAG) = (Present amount of total assets of surveyed firm – Amount of total assets in first year) / Age

We already discussed the independent variables in this study in the formulation of the hypotheses. Table I describes how the independent variables are measured. Table II gives an overview of the descriptive statistics.

INSERT TABLE I ABOUT HERE

INSERT TABLE II ABOUT HERE

Sample characteristics

The firms in the sample are between 2 and 14 years old with an average of 5 years. At start-up (during their first year of operation), these firms employed 725 people in total. At the time of survey, these firms employed 4290 people in total, which means they have grown their employment base since start-up by almost 600 percent. The mean total employment size is 21 with the majority of the firms employing less than 7 people. However, the growth is not uniform across the sample. As expected, the 20 fastest growing RBSUs (about 10% of our sample) account for more than 56 percent of net additional jobs. Overall, the RBSUs appear to be a group of firms of particular interest to policy-makers. In a relatively short time, they have created apparently viable growing businesses in a wide range of technologies, including software (42%), micro-electronics (12%), medical-related technologies, including biotech (17%) and others (29%).

RESULTS

Table III presents the Pearson Product-Moment correlations for the three dependent variables, namely Absolute Annual Employment Growth (AAEG), Absolute Annual Revenue Growth (AARG) and Absolute Annual Growth in Total Assets (AATAG). The correlation coefficients range between 0.51 and 0.68. The Cronbach Alpha for these three growth measures is 0.83 when missing data are case wise deleted and 0.71 when missing data are substituted by means. Hence, our data indicate that the three growth measures are strongly correlated. Although employment, revenues and total assets are different aspects of growth, these indicators seem to measure one underlying growth construct.

INSERT TABLE III ABOUT HERE

Uni- and bivariate analysis

We first explore the relationship between the different independent variables in this study and the three growth measures with univariate analysis techniques (t-tests, F-tests, Mann-Whitney U-tests, and Pearson Product-Moment correlations).

Software start-ups grow significantly more in terms of employment compared to RBSUs in other industries (t-value= -2.25; p=0.02). Medical-related start-ups, on the other hand, grow significantly more in total assets during their first years (Z-value (Mann-Whitney U) = -2.05; p=0.04).

Next, venture capital involvement at start-up is strongly associated with growth in employees (t-value= -4.54; p<0.001) and total assets (t-value= -5.15; p<0.001) but does not explain differences in revenue growth (t-value = -1.51; p=0.13). Starting with an almost market-ready product, on the other hand, significantly affects revenue growth (t-value= -2.30; p=0.02), and has a marginally positive effect on employment growth (t-value= -1.69; p=0.09) but does not affect growth in total assets (t-value= -0.48; p=0.63). Finally, regarding the human capital, Pearson product moment correlations show significant (p<0.05) positive associations between the total number of years of experience of the founders and growth in employment (r= 0.18), revenues (r= 0.26) and total assets (r= 0.24). If we look into more detail to the type of experience that has the strongest association with our different growth measures, we find that only commercial experience (i.e. experience in marketing, sales and business development) shows a significant (p<0.05) positive correlation with employment (r=0.21) and revenue (r=0.29) growth. Experience in R&D and other functional domains such as financing, production and legal functions do not show significant correlations with growth.

The market strategy of the firm significantly affects the early growth of RBSUs. It seems that firms, which target broadly defined markets and are international oriented from the start grow faster in employment ($F= 6.99$; $p=0.001$ and $F=8.27$; $p<0.001$, respectively) and revenues ($F= 2.91$; $p=0.058$ and $F=8.66$; $p<0.001$, respectively). International oriented start-ups also grow more in total assets ($F=20.09$; $p<0.001$). RBSUs, which target broader mainstream markets, do not grow significantly more in total assets than firms with a more focused (niche) market approach ($F=1.75$; $p=0.18$).

In summary, these analyses provide support for hypotheses 1, 2, 3, and 5. For the relationship between the breadth of the market strategy and growth (hypothesis 4), the F-tests indicate that start-ups pursuing broadly defined markets grow faster in terms of revenues and employees. These uni- and bivariate results give only a first indication regarding some of the relevant founding characteristics of RBSUs, which are associated with growth. We use multivariate regression analyses to explore further the relative importance of these determinants of new venture growth.

Multivariate regression analysis

In order to assess the combination of factors that best explains growth of RBSUs, we use general least squares (GLS) regression analysis. This statistical technique allows association of each independent variable with the dependent variable while controlling for the effects of other independent variables. The dependent variables, i.e. our growth measures, are not normal distributed. As a result statistical tests on the absolute growth measures might be invalid (Hair et al., 1984). We remedy for the non-normality by taking the logarithms of the growth measures. An undesired consequence of using the logarithms of our growth measures is that the cases in which growth is zero or negative are lost for the GLS analyses. Hence, our sample of observations on the log dependent variables is biased towards firms with positive growth figures. It is possible that the exclusion of observations introduces a sample bias in our estimation. We therefore also conduct a sample selection model, where we estimate the likelihood of positive growth in employment, revenues and total assets in separate Probit equations. We estimate these models using the Heckman two-step estimation procedure. We tried many different

combinations of variables to estimate the probit models in the first step including the same explanatory variables of the main regression as well as others such as size of founding team, age (founding year), sector, etc. None of these combinations resulted in significant lambda's and the results of the sample selection models do not differ from the GLS models. We also conducted the GLS analyses with the absolute growth measures. The interpretation of the results is not substantially different but in these models some of the control variables are also significant while they are not in the log-transformed models. The normality assumption is the most fundamental assumption for GLS. Therefore, we prefer to only report the GLS results of log-transformed data.

Table IV shows the results of three general least-squares (GLS) regression models, one for each dependent variable in this study, i.e. log employment growth, log revenue growth and log growth in total assets. Each GLS model includes all the independent variables for which we formulated specific hypotheses regarding their effect on growth and the control variables. The results from the different estimating methods reveal a reassuring consistency. Independent variables explain 28% of the variance in employment growth, 12% of revenue growth and 32% of growth in total assets.

INSERT TABLE IV ABOUT HERE

The multivariate analyses show that starting resources have an important impact on the early growth of RBSUs but the effects are not always in the direction we supposed. In hypothesis 1, we argued that firms that are closer to a market-ready product at founding would grow faster in terms of employees, revenues and total assets. Our data do, however, not support this hypothesis, on the contrary. Our multivariate analysis indicates that firms, which are earlier in the product development cycle grow significantly more in total assets during the first years than firms that are closer to market launch at founding.

In line with hypothesis 2, we find that higher amounts of starting capital and attracting venture capital during the first year are associated with higher employment and revenue

growth[2]. However, if we include the interaction effect between the amount of start capital and whether or not venture capitalists participated in the initial capitalization, we get a very different picture. The interaction effect has a significant positive effect on employment and revenue growth. In other words, higher amounts of capital provided by venture capitalists lead to higher growth in employment and revenues. In contrast, the venture capital dummy in itself is significantly negatively associated with employment and revenue growth. Hence, raising venture capital at founding has a rather large negative effect on employment and revenue growth unless the invested capital is high.

Next, several researchers already showed that the characteristics of the founder(s) affect venture success. Therefore, we argued for a positive effect of the founder's experience on early growth of RBSUs in hypothesis 3. We tested the effect of the cumulated total experience of the founding team members as well as their experience in different functional domains such as R&D, commercial functions and business development, and other domains such as financing, legal, production, etc. We find that the total number of years of experience of the founding team has a significant positive effect on growth in employees, revenues and total assets. Taking a closer look at the type of experience that best explains growth, we find that only experience in business development and commercial functions (sales/marketing) has a significant positive effect on growth. Experience in R&D and other functional domains (finance, legal, production, etc.) have no significant effect on growth. Therefore, we choose to replace the variable measuring the total experience of the founding team by the variable measuring the commercial experience in the reported model (Table IV). Thus, hypothesis 3 is supported, especially with regard to the commercial experience of the founding team. We also calculated a team heterogeneity measure and found that more heterogeneous teams are associated with higher growth but this effect is not significant.

Regarding hypothesis 4, we find no effect of the breadth of the firm's market strategy on employment and revenue growth states For growth in total assets our results support our

[2] The models in which log capital and the VC dummy are introduced separately are not shown and can be obtained from the others on request. In these models the coefficients of log capital and the VC dummy are significantly positive.

fourth hypothesis. Companies with a niche approach grow more in total assets during the early growth path compared to new ventures targeting broadly defined markets. Next, we find strong support for hypothesis 5. Going after international markets from the start leads to significantly higher growth in revenues and total assets. For employment growth we also find a positive effect of an international orientation from the start but it is not significant.

Regarding the control variables, we find that software start-ups grow significantly more in number of employees during their early growth path than start-ups in other technologies. Medical related firms, on the other hand, grow more in total assets. Firms in medical-related industries mostly need higher investment in laboratories and equipment compared to firms in other industries. Hence, it is not surprising that these firms grow more in total assets during their first years. The significant higher employment growth of software start-ups might be linked to the availability of venture capital for software companies in the late nineties. Next, we find no effect of competitive forces (entry barriers, threat of substitutes and buyer power) on the early growth of RBSUs. We used the same measures as the ones used in previous studies on start-ups and SMEs (Spanos & Lioukas, 2001). Caloghirou et al. (2004) also report that the impact of competitive forces on performance is much weaker than a firm's resources and capabilities. It is, however, also possible that these measures do not adequately capture the competitive forces at founding because these measures are subjective and self-reported by the respondents during the interview. These retrospective measures are, however, the best proxies we have to control for differences in the competitive environment. Finally, we only find a significant positive effect of age and size on growth in total assets, indicating that older and larger firms grow more in total assets.

Robustness checks

We conduct a series of checks to evaluate the robustness of our findings. First of all, growth might not be a linear function of age. We controlled for that by including age as a control variable in our previous models and found no significant effect. However, our dependent annual growth variables are calculated as the difference between the 'size' (in

employees, revenues and total assets) in the first year and the 'size' at time of interview, divided by the age (in years) of the firm. Hence, these growth measures assume a linear growth process. Therefore, we also checked the robustness of our results in sub-samples of firms with different age profiles. More specifically, we estimated similar models for the sample of firms that are between 3 and 7 years old and between 7 and 13 years old. Our results remain qualitatively the same, i.e. the directions and significances of the regression coefficients are the same. Further, we were able to obtain annual data for total assets for most companies in our sample. As an additional check, we calculated the yearly growth in total assets for the first three years (all the companies are at least three years old, hence we could calculate this measure for the full sample). Again our results remain robust.

We find that early growth in employees, revenues and total assets are significantly correlated with each other. Some independent variables such as commercial experience of the founders explain for the three forms of growth while other variables such as amount of capital and VC explain for employment and revenue growth but not for growth in total assets. Across our three growth measures different cases are missing. As a result, these models are not based on completely the same firms. In order to make a more sound judgment on whether different independent variables explain growth in employment, revenues, and total assets, we also conduct the same analysis on a reduced dataset excluding all cases where one or more variables are missing. In other words, we only include those 56 firms in the analysis for which all variables are available. The results are again comparable.

DISCUSSION

In this section, we compare our main findings with other studies. We also carefully examine the qualitative information (interview reports) of the firms in the upper and lower growth quartiles in order to explain our results and to gain deeper insights in the growth path of RBSUs,.

'Investor' and/or 'market' acceptance are the key drivers for early growth.

Several studies show that most RBSUs start with the limited personal savings of the entrepreneurs and that only a small number of RBSUs are able to raise venture capital in their first year (e.g. Roberts, 1991; Manigart & Struyf, 1996; Heirman & Clarysse, 2004). This study clearly indicates that those firms that are able to attract large amounts of VC – and hence get 'investor acceptance' for their business idea early on - grow faster in terms of employees and/or revenues. All of the top 20 highest employment growers were able to raise abundant financial resources. Seventeen firms rose between 1 and 6 Mio Euros in venture capital during their first year of operations. Three firms started without venture capital but had access to other abundant financial resources early on. Two of them started with small investments by the founders and 3F money of about 75 000 Euro. Four years after founding, driven by a beneficial financial climate on the technology stock markets, these firms went public on NASDAQ Europe. The other none-vc-backed high growth company had access to the deep financial pockets of its parent company. The entrepreneur formulates it as follows *'Even though this firm takes care of its own development, marketing, sales and support, we can fall back on the experience of our parent company. Moreover, the almost unlimited access to funds was probably the key to the success of this firm.'*

The importance of sufficient financial resources for growth is also observed in other studies. For example, Roberts (1991, pp. 264 - 269) and Lee et al. (2001) found a positive effect of the initial capitalization of technological start-ups on sales growth. However, Roberts (1991) found that this positive effect of initial financing on growth and success is

especially strong when the companies generate revenues through product sales. In a mixed sample of product-based firms and companies, which begun without product revenues the association of initial financing and firm performance gave mixed results. Nearly all high performing firms received high levels of initial financing, but 10 of the 23 firms, which received high levels of initial capital still belonged to the lower performers. Schoonhoven et al. (1990) found that companies with greater monthly expenditures – hence those that raised large amounts of VC - need more time to ship their first product for revenues. They argue that this might signal that firms raising larger amounts of VC focus on more technical ambitious projects. Alternatively, they argue that "just throwing money at a new venture does not appear to be a viable approach to speeding product to markets" and "may inhibit organizational performance". These firms may show high employment growth figures during their first years because they invest heavily in R&D personnel. However, the sustainability of such a growth path depends on the firms ability to develop products and ship them to customers for revenues before all the cash is burned (Schoonhoven et al., 1990). Baum and Silverman (2003) find that VCs are attracted to firms that have technology that can lead to strong future performance but that are teetering on the edge of short-term failure. The economic function of early stage VC financing is indeed to provide financial resources for risky but promising start-ups.

Our results indicate that getting 'investor acceptance' (i.e. being able to raise large amounts of VC) at start-up leads to high growth in the first years but previous studies indicate that this high growth trajectory can be very risky and might not be sustainable. The number of failures in our sample is too small to do a quantitative analysis but we can get some first insights in the risks associated with fast early growth by studying the top 20 highest growers in more detail. To get more insights in the sustainability of high growth we study to what extend 'investor acceptance' leads to/ or is preceded by 'market acceptance' for the top 20 firm that grow most in employees and/ or in revenues. Revenue growth is an indicator for market acceptance, while growth in employees which is not matched by growth in revenues is possible when the firm obtains investor acceptance first.

We already showed that employment and revenue growth are strongly correlated (Table III). This relationship seems to be even stronger among the high growth firms. In particular, 15 of top 20 high employment growth firms are in the top 20 of high revenue growth firms. This is in line with Smallbone et al. (1993) who found a strong relationship between employment growth and real turnover growth in a sample of high growth SMEs. These 15 firms were able to convince the venture capital community and get market acceptance for their products/ technology. The high employment and revenue growth can therefore be explained by acceptance of these firms' business models by the investors community and by the market they address.

For the five firms that belong to the top 20 of revenue growth, but not to the top 20 of employment growth, the driver for growth is only market acceptance and not acceptance by the venture capital community. These five firms financed their growth out of their sales activities and did not (or were not able to) raise venture capital. These five companies grew less in employment compared to other RBSUs, i.e. they are not in the top 20 of employment growth. Their ratio revenue growth to employment growth is higher than for most other RBSUs. The growth path of these companies can best be described as 'slowly' but steadily. These firms do not need high investments to finish R&D activities and the market rapidly accepts their products and services. As a result, these start-ups are able to grow their revenues under the impulse of strong demand for their products/ services. Moreover, these firms strongly focus on *profitable* growth early on. These firms are on a slower growth trajectory, but their growth seems to be less risky than their counterparts who need large upfront investments before market acceptance is established.

Next, we observe that out of the top 20 employment growth firms, three firms went bankrupt and two firms are currently in trouble, meaning that they are seriously restructuring their business activities and conduct large scale lay-offs. One drug discovery firm was acquired by a large pharmaceutical company and there is some discussion about whether this was a successful exit for the shareholders. Hence, for at least 25% of the high employment growth firms, the early growth seemed to be not

sustainable. This percentage is rather high compared to the failure rate of 7% in our total sample.

If we plot the yearly revenue growth against the yearly growth in employees, we observe that the two firms that are currently restructuring their business grew their employment pool much faster than their revenues. Both restructuring firms were able to raise a lot of money in several VC-rounds and an IPO in the mid nineties. They used these funds to focus on growth without being overly concerned with profitability. As a result, these firms were accumulating the negative cash flows year after year. In line with the low performing firms in the study of Schoonhoven et al. (1990), the high burn rates of these firms did not result in fast product development and strong revenue streams. Of course, the growth-at-any-expense business model has obvious practical limits, as was shown by the late 1990's stock performance of many high-technology firms. Forced by shareholder pressure, both firms are restructuring and started to focus on the 'bottom line' (i.e. their business activities with recurrent revenues) and control the expenses. The large-scale investments in technology development are seriously diminished in order to cut costs and become cash flow positive by the end of the year.

The three firms that failed had no recurrent revenue streams and restructuring was therefore not an option to safe (part of) the business once their investors ran out of patience. These firms used their capital to develop really novel technologies and products. In the late nineties, these so-called platform start-ups with a strong proprietary technology and wide range of applications, attracted a lot of attention from VCs (Baum and Silverman, 2003). One of these firms, active in the development of a telematica platform for the automotive sector, raised about 30 Mio Euro over its 7 years of existence. This money was nearly all spend for technology development and market 'education', i.e. lobbying with all key players to adopt their technological platform and develop applications for it. However, the product development as well as the market acceptance took a lot longer than initially foreseen. Raising more capital in yet another capital round seemed to be impossible and these firms failed. When the company declared bankruptcy, its technological assets were sold for 1.5 Mio Euro.

Other researchers also show the importance of market maturity and the risks associated with creating new markets. In a study of German VC-backed firms, Schefczyk (2001) argues that both high market acceptance of a firm's products and services (resulting in growing revenue streams) as well as market and industry structure affect the performance of companies in the portfolio of venture capitalists. In line with this, Chesbrough (2003) argues that ventures that are able to grow their revenues at a faster rate in their early years are offering goods and services that customers quickly choose to buy. These ventures are more likely to turn profitable sooner, to consume less cash and are more likely to achieve a profitable liquidity event for their investors (Bhide, 1992).

The firms that failed or have the highest risk to fail (high burn rates) in the near future are the ones for who market acceptance of their products/services is very unsure. Reading through the interview reports, it seems that most of these high growth RBSUs show increasingly negative cash flows and spend the largest chunk of their capital for technology development and platform building and not for business development, marketing or sales. In a way, these firms pursue the most technical ambitious projects, which brings considerable risks to the company. Although the technology is young and immature and the market and possible applications are unclear, these firms are also the most ambitious ones with regard to the markets they address. When asked to estimate the market potential, the founders talk about the overall market of the technology, which translates in billion dollar figures globally, spread over many applications and several industries. These companies develop broad platform technologies and have development projects for several applications. Some prior work suggests however that starting on a large scale when technical uncertainty is still very high mostly leads to unsuccessful innovation projects (Branscomb & Auerswald, 2001). Many early stage platform firms are among the highest growers in terms of employees and total assets and some of them are also among the top growers in revenues. These revenues are, however, not coming from product sales but from R&D contracts with milestone payments. The focus on R&D is also visible in their employment pool. Most of their employees are active in R&D and not in commercial functions or product support. For these platform companies, the

growth in total assets is not due to increased sales activities but to increasing investment in R&D. Activations of R&D costs is common practice in Belgium. Therefore, firms that are investing heavily in R&D grow in total assets even if their 'market' activities are not increasing. The accounting practice of activating R&D costs also explains the significant negative coefficient of the NPD-variable on total asset growth. Firms that are earlier in the product development cycle invest more in R&D and since these cost are activated, they grow in total assets.

Really novel products and technologies experience a slow market start-up period prior to take off (Golder & Tellis, 1996; Rogers, 1983; Aggarwal & Bayus; 2002), and managers are typically poor judges of the rates at which markets develop (Twiss, 1984). Also Moore (1991) points to the difficulties associated with the commercialization of breakthrough innovations. In a study of multiple radical innovative projects, Leifer et al. (2002) found that successful projects all pursued market applications that were identified early and had a clear business model appropriate for the chosen application. These were applications that could demonstrate the technology in a smaller market than was ultimately planned for. In line with this, concrete business plans for smaller but focused markets/ applications are found to be more successful than 'large scale/ broad' product introductions (Moore, 1991; Golder and Tellis, 1996). Rothwell (1983 1984, 1988) noted in a series of seminal papers, that although fundamental or radical innovation occurred within large firms or large public laboratories, small firms were disproportionately responsible for near-to-market developments and initial market diffusion. In fulfilling this role, smaller firms enjoyed many unique advantages associated with a lack of bureaucracy, efficient and often informal communications, plus flexibility and adaptability through nearness to markets. It seems that some of these high growth VC-backed platform building RBSUs act as if they are large companies with virtually unlimited resources to develop radically new technologies instead of focusing on the development of first applications that are more easily (earlier) accepted by the market.

For two of the failed firms and for one of the currently restructuring firms, the interview reports point to another difference between these firms and the surviving high growth firms. The failures did not have an asset parsimonious mindset. It seems that management

procedures and techniques for established businesses were inappropriately enforced on the new ventures. These firms often took too much time to make a decision, overplan, and overstaff; rather than make rapid small-chunk, spontaneous commitments. This organizational overkill can be hazardous to fragile new ventures, where timing, action and social interaction are critical (Starr & MacMillan, 1990). Schoonhoven et al. (1990) and Van de Ven et al. (1984) also observe that new ventures with high cash burns during the development period are slower to get products out. For one VC-backed firm the 'big spending attitude' seemed outrageous. In contrast to what one might expect from entrepreneurs of a start-up these founders were paid high salaries, drove expensive company cars, had large offices in an expensive building and always flew business class. The question is whether the investors' money was well spent. Interestingly, the three founders all held senior management positions in a large firm before starting their own firm. Clearly, the mindset of some large company managers is not necessarily appropriate in an entrepreneurial context.

An intriguing finding is also that venture capital has a negative effect on employment and revenue growth if the raised amounts of capital are small. Looking at the lower quartile of RBSUs in terms of revenue and employment growth, we indeed find several RBSU, which started with smaller amounts of venture capital ranging between 100 000 and 1.1 Mio Euro. One explanation for the slow growth of the firms can be that they did underestimate the capital needed to finance their activities and lack the resources to grow. Next, these small amounts of capital are often provided by multiple small VC-funds without a clear lead investor. One of the entrepreneurs complained about how difficult it was to manage the 5 VCs on his board of directors and he actually claimed that the failure of his business was due to the arguing investors who never agreed on important issues. This suggests that if a firms is not able to get investor acceptance from first tier VC-funds it might be better not to raise VC at all and use alternative financing channels. Another possible explanation is that several of these slow growing VC-backed firms are not ready yet to embark on a high growth trajectory because their technology or market or both is immature. Several of the slowly growing VC-backed firms are university spin-offs, which are funded by specialized VC-funds linked to this university. The university

funds in Flanders only invest relatively small amounts in start-ups founded with the mission to develop and commercialize new technologies developed within the university. Most of these firms would not be able to raise venture capital from other private funds because their business idea is too immature. The slow growth of these 'immature' VC-backed firms could therefore be due to the small amounts of venture capital as well as to the early stage of the product technology.

Commercial experience of founders is a main determinant of early growth

Our results consistently show that founding teams with commercial experience grow significantly more in terms of employment, revenues and total assets. This is an important finding because the firms in our sample all have a strong technological (R&D) component in their business plans and the entrepreneurs mostly have pure technical backgrounds. Roberts (1991, pp. 251 – 259) also found that prior managerial work experience and prior sales experiences of the founders correlate with success in a sample of high tech start-ups. He argues that the better performance of commercial experienced entrepreneurial teams can be due to their familiarity with the market as well as to their awareness of VC sources. He argues that entrepreneurs with commercial experience not only have a better understanding of the market but mostly also have a better understanding of the financial community and how to approach investors. Feeser and Willard (1990) found that high growth firms are more often started by entrepreneurs with prior experience with the product, market and/or technology than low growth firms. The importance of founding team experience is also reflected in the venture capital literature which consistently mentions business, sector and management experience of founding teams as one of the key criteria for VCs to make investment decisions (MacMillan et al., 1985; Zacharakis & Meyer, 1998).

However, in our population of RBSUs, the founding teams that show considerable commercial experience are rare. On average the founding teams have only 3.8 years of commercial experience and the median founding team has no commercial experience at all. On the other hand, almost all companies have at least a few years of technical experience among their founders and on average founding teams have 11 years of R&D

experience. It is indeed not surprisingly that the entrepreneurial teams of RBSUs have primarily technical backgrounds and are, presumably, in need of additional members to provide necessary business skills. We observe, however, that technical entrepreneurs seldom seek co-founders with commercial experience because they underestimate the importance of market knowledge or because they believe that they have sufficient market knowledge themselves. Entrepreneurs who have commercial experience but lack technical knowledge, on the other hand, are less likely to overestimate their technical capabilities and are more open to add co-founders with the technical know-how.

The founder of the fastest growing firm in our sample formulates the importance of a partner with complementary experience as follows: "*The first major milestone in setting up this company was the attraction of a co-founder and CEO. I spotted the market opportunity* (software for financial service industry) *while I was working for a major bank but I knew that I was not the right person to lead a company as this one. I needed a partner with knowledge about the technology, experience in the sector and in managing technology-based ventures. After doing some desktop research, I came up with a list of 4 possible men that might be suited to become partner and CEO. Two of them were senior managers at Oracle and Microsoft, the third one was the CEO of a firm in the payment industry and the fourth one was a successful entrepreneur in the online banking industry and at that time chairman of the market leader in the sector. This fourth man was the right match. After talking back and forth for a while about the business idea and how each of us envisioned the company, he got convinced about the potential and became co-founder, CEO and investor."* The important point is that he did not hire a CEO but attracted an equal partner who obtained an important part of the shares. When we asked about how he felt about sharing his invention with somebody else and giving up part of the control, he replied: *"I could never have reached the point where we are today on my own. I rather have a small percentage of something big than 100% of something tiny"*.

These quotes very well illustrate Roure and Keeley's (1999) argument that two of the most important factors affecting growth are the willingness to accept growth and to manage the consequences of growth including the willingness to add new owners.

Aggarwal et al. (2004) also support the notion that direct links to industry knowledge through founders better facilitates the integration of this knowledge than grafting knowledge through hiring employees with industry experience. Despite the importance of complementing technical founding teams with founders with commercial/business experience, our data show that the majority of the RBSUs typically consist of only technical people. Other studies also report that adding people with different complementary experience to technical founding teams is not straightforward. In a case study of one of the RBSUs in our sample, Clarysse & Moray (2004) describe how entrepreneurs with technical backgrounds prefer partners who themselves have technical backgrounds. Similarly, Chandler and Lyon (2001) found that functional diversity was not a major criterion for considering additions to the new venture team in a study of 12 start-up teams in Utah, US. In that study, the most common criteria stated by the founders with respect to team member selection was having a common interest in the technology or service provided by the business. Schefczyk (2001) reports that German entrepreneurs' focus on technology and engineering issues is accompanied by a lack of business skills. Wupperfeld and Kulicke (1993) found that for 80 percent of failing companies sponsored by public pilot programs, characteristics of the founder-manager contributed to the failure. The shortcomings were most frequently identified in business functions or skills, such as marketing and sales and general management know-how.

International orientation is an important driver for growth.

Our data show that targeting international markets from the start leads to higher growth in revenues and total assets but not in employees. Internationalization is costly and thus it is not surprising that firms with an international orientation grow more in total assets than RBSUs focusing on local markets first. The larger international markets are translated in higher revenue growth but not in employment growth. We asked for the total number of employees of the firm and not only for the people employed in Belgium. The reason for not observing an effect of international orientation on employment growth can therefore not be explained by not counting the employees in foreign subsidiaries. A possible explanation is that most start-ups – due to their usual relative poverty of resources – often

use distributors and interorganizational alliances to sell their outputs across national borders (Coviello & Munro, 1997).

During our interviews many entrepreneurs explained that early internationalization was a requirement for their firms to participate in high technology industries because competition itself is international. Other entrepreneurs argued that the small home market for their technology products and services was the main reason to have international ambitions from the start. Shrader et al. (2000) argue that innovative new ventures with high growth ambitions derive more of their revenues from foreign markets and are thus more likely to internationalize early in their existence, prior to thoroughly establishing themselves domestically. Our results are also in line with Autio et al. (2000) who found that the earlier in their development high-tech firms internationalized, the more rapidly they grew internationally. They believe that the survival and prosperity of born-global firms may be explained by their ability to adapt to and innovate more rapidly in new and dynamic environments than would ordinarily be the case for older firms.

CONCLUSIONS AND IMPLICATIONS

RBSUs received a lot of academic and political attention, primarily due to their perceived potential for job creation, economic growth and wealth creation. Empirical evidence has shown, however, that only a small proportion of businesses have the potential for significant wealth and job generation (Storey et al., 1987; Reynolds, 1987; Storey & Johnson, 1986). RBSUs show a highly skewed distribution with respect to growth. In particular, most RBSUs employ only few people and most firms grow slowly or not at all.

A first important finding is that growth in employees, revenues and total assets are highly correlated – at least during the first 3 to 13 years of the firm's existence - and belong to one 'growth' construct. Hence, future research on the early growth of RBSUs could focus on one of these growth measures as a good indicator for early growth. Data on employees and revenues are more readily available of young firms than data on total assets. Total assets are also more difficult to interpret because what is included in this measure depends on the accounting practices of the firm. For example, some firms activate their R&D costs while others don't. Therefore, we suggest to use employment and revenue growth in future studies on growth.

This study brings insights in the characteristics of the high-growth RBSUs by analyzing which starting conditions spur growth in the first years after inception. Studies of initial conditions have had the aim of describing and characterizing promising start-ups by studying traits that are visible at start-up (Gartner et al., 1998). This stream of research is highly motivated by, for example, venture capitalists with an interest in generic selection of investment criteria (Kaulio, 2003) and policy makers favoring a policy of 'picking winners' (Storey et al., 1987). Our results indicate that a bundle of assets, and in particular large amounts of venture capital, a founding team with commercial experience, together with an international market approach lies at the heart of the firm's growth prospects. Starting with an almost market-ready product, on the other hand, does not affect growth in employees and revenues.

Our qualitative data indicate that fast early growth is not equal to sustainable growth. Some high growth firms focus on getting 'investor acceptance' first and raise large amounts of capital without proven 'market acceptance' for their product/technology. Short-term employment creation does not automatically lead to the development of viable competitive businesses (Smallbone et al., 1993). After the crash of technology stock markets in the late nineties, the growth-at-any-expense business model does not seem feasible anymore. Our results indicate that entrepreneurs with the ambition to grow fast and sustainable, should try to balance employment and revenue growth. Our case studies and prior work by other researchers suggest that focussing on concrete market applications for niche markets increases the chances on success to commercialize really new technologies. Early stage technology platform companies that are started on a large scale with a broad and ambitious technology and broad market focus show high growth in employees. This is, however, a high risk growth path, which is only sustainable if the company succeeds to generate a strong revenue stream before all the cash is burned. Of course, these companies mostly have a clear exit intention and aim for an IPO or an acquisition. However, at exit the value of the company will still be determined by the market acceptance of its products/ technology and 'proven' demand.

We also find that some high growth RBSUs pursue market acceptance first without raising external capital. These firms follow a slow, less risky growth path and grow more in revenues during the first years than in employees. In some cases these firms raise large amounts of capital (VC or IPO) to accelerate their growth once the market potential is proven.

Finally, the firms that got 'partial' investor acceptance at founding, i.e. they raised VC but only small amounts (mostly from small VC funds) grow less than firms starting without VC. Entrepreneurs should be aware that VC is not the only way to finance RBSUs and it might not be the best option for any business. Alternative financing methods are bootstrapping or launching ventures with modest personal funds, government grants to finance R&D, loans, fuel early growth with revenues from sales

and/or services, or upfront- and milestone- payments from strategic partners, or any combination of those. Our results indicate that when it is not possible to get sufficiently large VC-backing, it might be better to use alternative financing channels instead of raising small amounts of VC. The true entrepreneurial challenge often is not to raise VC but to start the business without it. Once the market potential is clear, the entrepreneurs can try to raise later stage VC to accelerate the growth.

In short, during its early growth path a company can focus on getting investor acceptance, market acceptance or both. We find that you need both to create a sustainable high growth company. Entrepreneurs may try to get either investor or market acceptance first but they should not forget the other. To create a sustainable business, it will ultimately be the market for their product/ technology that determines the value of the firm and its chances on survival in the long-term.

We find that especially commercial experience has a strong impact on the early growth of RBSUs while the majority of RBSUs is started by purely technical founding teams. The importance of commercial/business development experience is still often undervalued by technical entrepreneurs, technology transfer offices and policy makers. Technical entrepreneurs often think that the ‘technology’ is the most important aspect of their company and lack a clear market orientation. This study clearly shows that also for RBSUs commercial experience is more important for growth than R&D experience. Prospective entrepreneurs should assess their own readiness for starting a new business. If they have the ambition to grow the company they should be willing to search for business partners to complement their own experience or alternatively acquire the necessary skills themselves and postpone starting their own venture.

Also the government can play an important role in this respect. Several government initiatives exist to support firms in their ‘technical’ activities (R&D subsidies) but business support programs on the other hand are scarce. Sponsoring training programs, organizing networking events and subsidies for market research are some initiative that could really make a difference. Finally, technology transfer offices and university start

capital funds also seem to emphasize the ‘quality’ of the technology more than the quality of the entrepreneurial team when selecting and investing opportunities to commercialize public research results. Technology transfer offices and university start capital funds can also play an important role in bringing business people and experienced entrepreneurs in contact with inventors and people with deep technical expertise.

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

Our study only contains data on Flemish RBSUs. A positive consequence of this small geographic coverage is that it reduces the influence of non-measured variance. The trade-off, however, is that one might question the external validity of this region and our findings. High tech clusters such as Silicon Valley and Boston in the US and Cambridge in the UK indeed have unique characteristics, which differ considerably from Flanders. For example, Saxenian (1994), Roberts (1991) and Schoonhoven et al. (1990) mention that the availability of venture capital, a strong entrepreneurial community, a rich industry infrastructure and a massive influx of government funding facilitate the firms' access to resources in these regions. As a result firms in such high tech environments may grow faster in comparison to firms in less developed environments such as Flanders. We argue that the Flemish region is comparable to most emerging and developing high tech regions. Nonetheless, we hope our findings will be tested in other regions in the future. Secondly, we focus on the impact of starting conditions on the early growth path of RBSUs. Of course, starting resources as well as a firm's strategy are not static. This calls for more dynamic designs, following up not only the growth variables but also the development of explanatory variables (Davidson & Wiklund, 2001). Next, future research should dig a little bit deeper with respect to what distinguishes early growth from *sustainable* early growth. This implies linking the growth literature to the literature on survival, failure and sustainable competitive advantage. Our research indicates that a promising path to follow is to study the business models of RBSUs in more detail. Do the firms have recurrent revenue streams or large one-time contracts? Is the growth in employees disconnected from their revenue growth? Does every new employee make the cash flow more negative or positive? Do they grow more in R&D employees or in sales people? Finally, we think a very interesting area for future research concerns entrepreneurial team formation. Our data clearly show that adding experienced business people to technical entrepreneurial teams facilitates early growth of RBSUs. However, functional heterogeneity brings with it various challenges, increasing both cognitive conflict and affective conflict within the decision-making team (Forbes et al., 2004).

Until today, we lack insights in how technical entrepreneurs can deal with these cognitive challenges and what can be done to connect entrepreneurs with business people.

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Figure 1: A Multi-level Model of Early growth of Research-Based Start-Ups

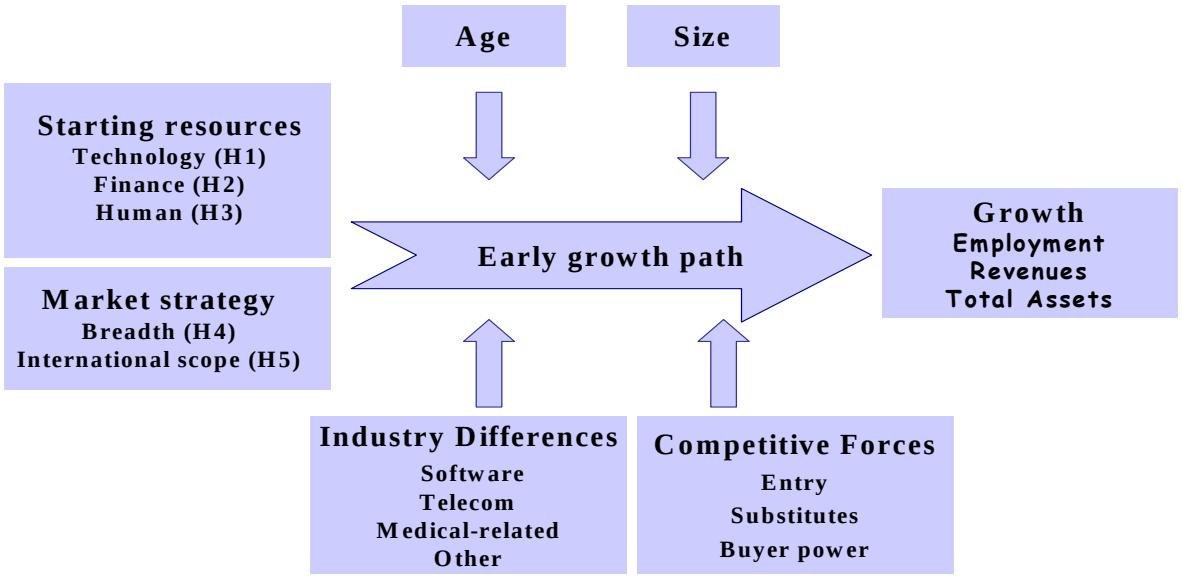

Table I: Description of explanatory variables

Variable Name	Description
Starting Resources	
Start Capital	Amount of capital raised in the first year (Euro)
VC	Dummy indication whether capital was raised from venture capital investors during the first year (1 = yes; 0 = no)
Experience of Founders	Cumulated numbers of years of experience of all members of the founding team in R&D, a commercial function (business development), and other functional domain such as finance, production, etc. (N)
Stage NPD	Stage of development of core product : Ranging from (0) no α-prototype, (1) over α-prototype, (2) β-prototype, to (3) a market-ready product at founding
Market Strategy	
Market breadth	Breadth of the targeted market at founding ranging from (1) niche or focus strategy, over (2) temporary niche with specific intention to penetrate larger market later on, (3) large and broadly defined market
International orientation	Geographic coverage of market ranging from (1) local focus, over (2) European to (3) global orientation
Control variables	
Industry	4 dummy variables indicating whether the firm is active in (1) medical-related, micro-electronics, software or other sector; (0) otherwise
Entry	Barriers to entry the industry ranging from (1) very low (very easy to enter) to (5) very high (very difficult to enter)
Substitutes	Threat of substitutes ranging from (1) not at all to (5) very high
Buyer power	Power of the customers of the firm ranging from (1) very weak to (5) very strong
Age	Number of years since founding (N)
Initial size	Number of fulltime employees during first year of operation (N)

Table II: Descriptive Statistics for Metric Variables

Variables	N	Mean	Median	Minimum	Maximum	SD
Dependent variable						
Annual Absolute Employee Growth (AAEG)	170	2.44	0.80	-5.00	21.00	4.40
Log AAEG	136	0.17	0.14	-0.99	1.33	0.55
Annual Absolute Revenue Growth (AARG)	140	333208	81054	-400000	6336142	761744
Log AARG	115	5.12	5.20	3.70	6.80	0.68
Annual Absolute Total Assets Growth (AATAG)	155	214070	45860	-3397500	6472250	812277
Log AATAG	116	1.94	1.89	-0.20	3.81	0.74
Independent variables						
Start Capital	169	477009	62000	6200	6000000	1081703
Total Experience of Founders (years)	170	19.29	15	0	102	17.83
Total R&D Experience of Founders	170	11.52	8	0	61	13.16
Total Commercial Experience of Founders (years)	170	3.80	0	0	47	7.71
Total Other Experience of Founders	170	3.95	0	0	83	9.15
Stage NPD	170	0.93	0	0	3	1.14
International orientation	169	2.14	2	1	3	0.83
Market breadth	169	1.46	1	1	3	0.69
Entry barriers	158	3.82	4	1	5	1.23
Substitutes	149	2.80	3	1	5	1.00
Supplier power	79	3.09	3	1	5	1.04
Buyer power	145	3.70	4	1	5	1.06
Control variables						
Employees in first year	168	3.78	2.00	0	30	4.78
Age (years)	171	6.15	5	2	14	2.63

Table III: Correlation Table between dependent variables: Absolute Annual Employment Growth, Absolute Annual Revenue Growth, Absolute Annual Total Assets Growth

		DV1	DV2	DV3
DV1	Log AAEG	1		
DV2	Log AARG	0.51	1	
DV3	Log AATAG	0.53	0.68	1

All correlations are significant at $p<0.05$

Table IV: Multiple Regression Models[3]

Variable	Log Employment Growth	Log Revenue Growth	Log Total Asset Growth
Intercept	-0.559	4.169****	1.088
	(0.470)	(0.710)	(0.730)
Age	0.002	0.030	0.0468*
	(0.019)	(0.029)	(0.274)
Initial Size (FTE)	-0.014	0.008	0.042**
	(0.013)	(0.019)	(0.027)
Medical	0.234	-0.099	0.513**
	(0.153)	(0.232)	(0.246)
Micro electronics	0.199	-0.058	0.106
	(0.165)	(0.248)	(0.265)
Software	0.386****	0.081	0.079
	(0.110)	(0.171)	(0.157)
Log Start Capital	0.011	0.091	-0.053
	(0.084)	(0.121)	(0.134)
VC	-2.816**	-3.583*	-0.352
	(1.517)	(2.190)	(2.178)
VC * Log Start Capital	0.546**	0.608*	0.159
	(0.258)	(0.372)	(0.366)
Total Commercial Exp	0.013**	0.022***	0.014*
	(0.005)	(0.009)	(0.008)
Stage NPD	0.027	-0.004	-0.116**
	(0.043)	(0.062)	(0.058)
Market breadth	0.116	0.013	-0.242**
	(0.080)	(0.124)	(0.124)
International orientation	0.104	0.208**	0.377****
	(0.066)	(0.099)	(0.092)
Entry barriers	-0.006	-0.001	0.021
	(0.042)	(0.062)	(0.054)
Substitutes	-0.024	-0.014	0.009
	(0.040)	(0.062)	(0.056)
Buyer power	-0.009	-0.065	-0.016
	(0.047)	(0.074)	(0.069)
R2 adjusted	0.28	0.12	0.32

[3] Reported Models are GLS models. The results remain robust when the same models are estimated with sample selection models (following Heckman's two-step estimation procedure).

N	113	92	98
'F'	3.84	1.83	3.71
Prob. Model	<0.0001	0.04	<0.0001

*p < .10; ** p < .05; *** p < .01; **** p < .001; Coefficients are reported; standard errors are in parentheses