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Advances in the research on young business growth: persistence, impact on profits and the moderating role of firm age

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Advances in the research on young business growth: persistence, impact on profits and the moderating role of firm age

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ABSTRACT

This dissertation contributes to the research on young firms' growth by analyzing two major issues, namely growth persistence and its impact on profits, where further theoretical development is needed and the empirical evidence is scarce and inconclusive. Based on Penrose's approach, the resource-based view and evolutionary economics, this doctoral thesis examines (i) the relationship between firm growth and profits, (ii) the autocorrelation among young firms' growth, and particularly, (iii) the growth persistence and the impact of growth on profits in the case of high-growth firms.

Employing longitudinal panel data extracted from SABI©, this dissertation analyzes different cohorts of Spanish young firms from manufacturing and services sectors, during their earlier years of life. This thesis is organized upon three different papers, each one corresponding to one of the aforementioned objectives. The results of the first paper show that unlike some theories suggest, profits do not affect young firm growth whereas firm growth indeed enhances firm profits. Interestingly, these relationships are highly affected by intra- and inter-industry heterogeneity. The second paper indicates that young firm growth rates tend to exhibit a positive autocorrelation, that is, growth rates are persistent over time, which contrasts several previous studies. Nevertheless, as long as firm matures this positive correlation becomes more erratic, being the fifth year a turning point in a young firm growth path. The last paper, in turn, demonstrates that high growth firms are unlikely to sustain their high growth episode for more than one period and that these episodes show a slightly positive impact on subsequent profits. Additionally, this impact is higher if the high growth episode takes place once the firm surpasses its first few years.

All these findings have important implications for theory development and future research on young firm growth, discussing previous theories in the light of the new empirical evidence.

RESUMEN

Esta tesis contribuye a la literatura sobre crecimiento en empresas jóvenes al focalizarse sobre su persistencia y su impacto sobre la rentabilidad, dos aspectos donde es necesario un mayor desarrollo teórico y donde la evidencia empírica no sólo es escasa sino también ambigua. A partir de los aportes de E. Penrose, el enfoque de la empresa basado en los recursos y la teoría evolucionista, esta tesis de doctorado examina (i) la relación entre el crecimiento y la rentabilidad, (ii) el nivel de autocorrelación entre las tasas de crecimiento, y particularmente, (iii) el grado de persistencia de los períodos de alto crecimiento y su impacto sobre la rentabilidad empresarial.

A partir de bases longitudinales de datos de panel, extraídos del SABI©, esta tesis analiza diferentes cohortes de empresas españolas, tanto manufactureras como de servicios, durante sus primeros años de vida. Esta tesis está estructurada sobre la base de tres artículos, cada uno correspondiente a uno de los tres objetivos mencionados precedentemente. Los resultados del primer artículo muestran que, a diferencia de lo que varias teorías sugieren, los beneficios no afectarían el crecimiento en las empresas jóvenes al tiempo que la relación inversa sí se verifica, desde el crecimiento hacia los beneficios. Un dato interesante es que ambas relaciones se encuentran afectadas por altos niveles de heterogeneidad, tanto entre sectores como dentro de un mismo sector, a nivel de las empresas.

El segundo artículo muestra que en general las tasas de crecimiento entre las empresas jóvenes, tienden a mostrar una correlación positiva. Esto es, las tasas tienden a ser persistentes en el tiempo, hecho que contradice varios estudios previos que incluso planteaban que las tasas de crecimiento eran aleatorias. Sin embargo, esta relación positiva está afectada por la edad de la empresa. En efecto, este artículo muestra que a medida que la empres va madurando, su crecimiento se va haciendo más errático y por ende, menos persistente. Específicamente, los resultados muestran que el quinto año de vida representa un punto de quiebre en la trayectoria de crecimiento de las empresas. El tercer y último artículo, demuestra en primer lugar que las empresas de alto crecimiento difícilmente pueden sostener períodos de alto crecimiento sucesivos y que los mismos tienen un leve impacto positivo sobre la rentabilidad.

Todos estos resultados tienen importantes implicancias tanto para el desarrollo teórico como para futuras investigaciones sobre el crecimiento de empresas jóvenes, discutiendo teorías previas a la luz de nuevas evidencias empíricas.

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Finally, I finished it! I said to my supervisor. Underlying this expression lays a mixture of relief and satisfaction. It has been a long way since I left Barcelona and came back home to finish this dissertation. In the middle, a number of difficulties and hard times seriously jeopardized the possibility to complete it.

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1. GENERAL OVERVIEW OF THE DISSERTATION

1.1 Problem statement and motivation

After more than fifty years of academic research, firm growth theory is now at a crossroad. Despite the advances achieved during this period, some authors suggest that academics still have not reach a clear understanding of this phenomenon (Davidsson, Achtenhagen, & Naldi, 2006; McKelvie & Wiklund, 2010; Shepherd & Wiklund, 2009). Even more, some recent reviews argue that theory development, in particular, has been limited (Leitch, Hill, & Neergaard, 2010; McKelvie & Wiklund, 2010; Wiklund, Patzelt, & Shepherd, 2007). Overall, quoting Anyadike-Danes & Hart (2014) *"…the theory of firm growth is in a rather unsatisfactory state…"*.

From a theoretical point of view no relevant advances have been made since the appearance of E. Penrose´s *Theory of the Growth of the Firm* (Penrose, 1959). On the contrary, it could be the case that scholars have gave up in their search for an integrative model of firm growth by recognizing the complex and multi-dimensional nature of this phenomenon (Leitch et al., 2010). As Coad (2007b, p. 59) affirm *"…theoretical predictions have been of limited use in understanding the growth of firms, if not downright misleading. It appears to us that the way forward is through empirical analysis*".

However, empirical studies on firm growth are characterized by a huge degree of fragmentation, making difficult (not to say impossible) to extract some ´stylized facts´ or summarize results (McKelvie & Wiklund, 2010). To a great extent, this situation reflects the fact that business growth research has been mainly phenomenon-oriented rather than theory-driven (Davidsson, Delmar, & Wiklund, 2006). Consequently, a wider number of known factors affecting firm growth have been indicated by the empirical literature, namely entrepreneurs' willingness to growth, human capital endowments, firm specific resources, firm location, industry context, organizational structures and systems and business strategy, among others. This proliferation of internal and external growth determinants leads researchers to build integrated or holistic models that combine different theoretical perspectives in a single model (e.g. Capelleras & Rabetino, 2008; Capelleras, Greene, Kantis & Rabetino, 2010; Roper, 1999; Wiklund et al., 2007). However, even these approaches that integrate multiple perspectives and levels are only able to explain just a limited proportion of firm growth at the firm level (Coad, 2007b; McKelvie & Wiklund, 2010).

This kind of models, grouped by McKelvie & Wiklund (2010) as the *Growth as an Outcome* stream usually take the form of regression analyses where growth – regardless how it is measured – is the dependent variable and a number of variables are the regressors. However, as Coad & Hölzl (2010) and Storey (2011) show even when some of these relationships are statistically significant, the combined explanatory power of these models – measured by their R^2 – is rather low. As a corollary, some authors started to raise their voices arguing that growth rates are predominantly random (Coad, Frankish, Roberts, & Storey, 2013a; Geroski, 2005; Storey, 2011). Hence, they propose a novel theoretical approach to deal with this dominant feature of growth, i.e. the Gambler´s Ruin approach, which assimilates firm growth with a game of chance (Coad, Frankish, et al., 2013a).

Thus, the present moment is a quite interesting one for those who are interested in firm growth. The most established wisdom about growth determinants and the very notion of growth paths have been challenged by a number of recent empirical studies based on large longitudinal datasets and employing advanced econometric techniques to account for heterogeneity and endogeneity. As Coad & Hölzl (2010, p. 8) affirm, *"more work would be welcome in making the empirical results match the theory, and also of course in making the theory match the data".*

As it was mentioned before, too much has been written about growth determinants. However, only limited attention has been devoted to the study of the effects of such growth (Davidsson, Achtenhagen, et al., 2006; Gilbert, McDougall, & Audretsch, 2006). Underlying this imbalance between determinants and effects may be an uncritical 'ideology of growth' supporting that firm growth is always good and beneficial. In Davidsson, Steffens, & Fitzsimmons (2008, p. 4) own words *"the possibility that growth under some circumstances could be negatively related to a more 'final' outcome criterion is typically not considered or investigated."*. This, in turn, has also created a bias toward studying only successful growth-oriented firms, the so called high growth firms - hereafter HGFs (e.g. Almus, 2002; Barringer, Jones, & Neubaum, 2005; Daunfeldt & Halvarsson, 2015; Hoxha & Capelleras, 2010; Lopez-Garcia & Puente, 2012; Parker, Storey, & van Witteloostuijn, 2010).

This dissertation contributes to fill this gap by studying two noteworthy outcomes of growth, namely its impact on firm profitability and its effect on successive growth (i.e. the degree of autocorrelation or persistence).

In the first place, the focus of this dissertation is on the relationship between firm growth and profits. From a theoretical point of view, most theories emerging especially from industrial economics and strategic management tend to favor a positive relationship between firm profits and growth. Scale economies, cost advantages, (market) selection, and resource-based advantages are the main arguments that have been suggested to explain the positive association between firm growth and profits. However, these approaches implicitly sustain that the causality goes from profits to growth. However... does growth imply profits or because firms are profitable, they are able to growth? Or it could be the case of a 'cumulative causality' between both variables, where growth drives profits and profits facilitates further growth, and so on (Cowling, 2004). In fact, there are also sound theoretical approaches that may indicate that it is growth what drives profits. From a Penrosean approach as long as firms grow, managers become more aware of the resources they control and the outcomes that could be obtained from them. As well, dynamic increasing returns may also imply a positive effect of growth on profits since growing firms may invest in their own capabilities, which will lead to an increase in firm productivity and profits (Coad, 2007c). Hence, in spite of the generally accepted positive relationship between profits and growth, the underlying direction and the potential endogenous nature of this relationship remains unclear.

In addition, given the amount of supportive theoretical perspectives on a positive relationship between business growth and profits, one would expect that empirical research clearly demonstrate this kind of association, regardless the direction of the causality. However, the empirical research on this relationship is rather limited and inconclusive (Coad, 2007c; Cowling, 2004; Davidsson, Steffens, & Fitzsimmons, 2009; Delmar, McKelvie, & Wennberg, 2013). Therefore, a need to better understand the nature and characteristics of this relationship arises, particularly, by fully addressing its complexity and dynamism. Specifically, two major features of such relationship should be properly taken into account, namely endogeneity and heterogeneity.

Another focus of interest of this dissertation refers to the new emerging debate about the randomness of firm growth (Coad, Frankish, et al., 2013a; Coad & Hölzl, 2009; Derbyshire & Garnsey, 2014; Storey, 2011; Westhead & Wright, 2011). This debate resembles earlier discussions from industrial economics based on Gibrat's Law of proportionate effects but in the context of the low explanatory power of most growth studies. Again, there are sound theoretical reasons to expect a positive autocorrelation in growth rates. Traditional microeconomic theory affirms that growth would be followed by subsequently growth as firms move towards the minimum efficient scale. Evolutionary economists propose that growth could be considered as a self-reinforced process because of the presence of economies of scale, network externalities and knowledge accumulation (Bottazzi & Secchi, 2003). As well, Penrose's (1959) notion of ‘economies of growth’ provides further background to the idea of growth as a self-reinforcing process.

However, empirical evidence does not support such relationship as strong as it might be expected. Therefore, proponents of the random view highlight the importance to discuss the accumulated literature in the light of the more recent results showing a lack of persistence in growth rates (Coad, Frankish, et al., 2013a; Coad & Hölzl, 2009; Coad, 2007a). In contrast, other authors critic the random view, arguing that the single fact that future growth rates are difficult to predict does not directly imply that they are random (Derbyshire & Garnsey, 2014). Hence, these authors consider that firm growth is better described as erratic, where growth phases could be followed by reversals or alternatively, stagnation periods (Garnsey & Heffernan, 2005; Garnsey, Stam, & Heffernan, 2006). Consequently, a negative autocorrelation should be expected. Interestingly, new empirical evidence based on large panels and new econometric methods show that the sign of the correlation would depended on several contingent factors such as firm size, age, industry sector and also the rate of growth (Capasso, Cefis, & Frenken, 2014; Coad, Daunfeldt, & Halvarsson, 2015; Coad & Hölzl, 2009; Coad, Segarra, & Teruel, 2013; Coad, 2007a; Fotopoulos & Giotopoulos, 2010). Overall, this debate continues to be open and vibrant.

The last topic covered by this dissertation refers to the particular case of HGFs. These outperforming firms are nowadays a vibrant topic among entrepreneurship scholars and have attracted a huge attention from policy-makers, mainly because of their disproportionate impact on new job creation (Acs, Parsons, & Tracy, 2008; Anyadike-Danes, Hart, & Du, 2015; Bravo-Biosca, 2010; Henrekson & Johansson, 2010; Hölzl, 2014; Schreyer, 2000).

In general, the accumulated evidence concludes that HGFs represent only a small proportion of the whole population of firms - between 3% and 6%, depending on the country and the studied period – but are responsible for more than a half of the new jobs generated (Bravo-Biosca, 2010; Henrekson & Johansson, 2010). However, recent evidence demonstrates that HGFs have in general several difficulties to sustain their growth path during successive periods of time (Capasso et al., 2014; Coad & Hölzl, 2009; Coad, 2007a; Hölzl, 2014; Parker et al., 2010). This lack of persistent high growth periods, leads to the idea of HGFs as “one hit wonders” (Daunfeldt & Halvarsson, 2015; Hölzl, 2014) and brings back the previous debate on the autocorrelation of firm growth rates, particularly the highest ones.

Curiously, little attention has been devoted to analyze what happens to HGFs after their high growth episodes and estimate the impact of experiencing such high-growth episodes at the firm level. In particular, only two studies deal explicitly with the impact of high growth on profits (Markman & Gartner, 2002; Senderovitz, Klyver, & Steffens, 2015). However, their results show quite different images. Markman & Gartner (2002) do not find any statistically significant association between extraordinary growth and subsequent profits, whilst Senderovitz et al. (2015) report a general positive relationship. Hence, there is a need to continuing investigating on this topic as recent reviews claim (Moreno & Coad, 2015; Wennberg, 2013). Interestingly, Senderovitz et al. (2015) find that the impact of high growth on profits is moderated by the market strategy, opening a new research avenue about other possible contingent variables that may play such intermediate role.

Finally, it is important to state that this dissertation is only circumscribed to the case of young firms. Intuitively young firms are defined as those experiencing their earlier stages of development, where business models, routines and organizational forms are being established[1]. In other words, where the firm *"… becomes less an extension of one or few dominant individuals and more an organization per se with a life of its own..."* (Hannan & Freeman, 1977, p. 960). Several reasons make particularly interesting studying this stage of firm evolution. First, it has been well documented that most firms tend to die during these earlier phases of development, mainly because of the selection process and the effect of the liability of newness (Cressy, 2013; Freeman, Carroll, & Hannan, 1983; Persson, 2004; Saridakis, Mole, & Storey, 2008). Secondly, this is the period where the highest growth rates are observed at the firm level and where according to the literature HGFs are more frequently observed (Barba Navaretti, Castellani, & Pieri, 2014; Haltiwanger, Jarmin, & Miranda, 2013; Lawless, 2014).

In addition, from an organizational point of view, this period is a key one because the seeds of the future organization are sown. In fact, during these years firms become more structured and formal (Greiner, 1972; Kazanjian & Drazin, 1990; Lewis & Churchill, 1983) and a transition from an entrepreneurial to a managerial firm takes place (Flamholtz & Randle, 1990). In fact, qualitative evidence provides a rich description of the number of organizational challenges, difficulties and resources shortages that young firms face during these earlier years, particularly those which experience a high growth episode (Blackburn & Brush, 2009; Garnsey & Heffernan, 2005; Garnsey et al., 2006; Hambrick & Crozier, 1985). As a result, different

[1] However, the exact limits to this initial phase of development have not been clearly established and depend highly on the industry where the firm operates, the resources it controls and the strategy it adopts. Some authors have suggested that the limit to this stage should be between the 8^{th} and the 12^{th} year of operations(Kazanjian & Drazin, 1990).

growth paths and evolutions could be observed during this earlier phase, where it is likely that growth and profits could not be aligned. Indeed, the earlier years of a firm could be hardly characterized as a uniform period (Bhidé, 2000; Garnsey, 1998). Firm growth at earlier stages is usually non-linear and highly heterogeneous, presenting a series of interruptions, turning points, 'plateaus', setbacks and continuous growth phases. Therefore, a particular emphasis will be placed on analyzing the possible differences in the studied variables throughout this initial stage of evolution.

1.2 Purpose and research objectives

The general purpose of this dissertation is to contribute to the ongoing debate about young firms' growth by analyzing two major concerns, namely growth persistence and its impact on profits, where further theoretical reflection is needed and where the empirical evidence is scarce and inconclusive. Accordingly, the specific objectives of the dissertation would be:

(i) To examine the sign and direction of the relationship between firm growth and profitability, identifying in particular the existence of intra and inter-industry heterogeneity in such relationship

(ii) To analyze the level of autocorrelation among young firms' growth and, especially, to evaluate the moderating role of firm age on such correlation

(iii) To investigate growth persistence among high-growth firms and the effect that high-growth episodes have on subsequent profits, looking for differences as long as young firms mature.

In accordance with these objectives, the following research questions will be addressed throughout the present doctoral dissertation. Following the general focus of this dissertation, the main research questions are presented in three groups: (i) those related to the relationship between firm growth and profits; (ii) those related to firm growth persistence; and (iii) those related to the particular case of HGFs.

<u>As regards the business growth–profits relationship:</u>

- Do retained profits lead to firm growth in the case of young firms?
- Does young firms' growth affect subsequent profits? Is there any endogeneity between both variables?

- To what extent do these relationships vary across firms and industries?

As regards the growth persistence:

- Is young firms' growth a close-to-random phenomenon? To what extent current and past growth rates are autocorrelated?
- Which are the most frequent growth paths observed among young firms during their earlier years of life? Do they change as long as young firms mature?
- To what extent the relationship between previous and current growth is moderated by firm age?

As regards high growth firms:

- What happens to young high-growth firms after their high-growth episode? Are they able to sustain such high growth in subsequent years?
- What is the impact of such high-growth periods on subsequent profits?
- Does the impact of high growth on profits differ according to the age when such high growth phase takes place?

After having established the main objectives and research questions of this dissertation, it is time to focus on a brief presentation of the general theoretical framework that has guided this research work.

1.3 Theoretical background

What follows is a brief description of the main perspectives that constitute the theoretical framework on which this dissertation is based. These perspectives correspond to industrial economics, strategic management and organizational theory. Importantly, most of these theories are not originally conceived to deal with young firms' growth as a phenomenon. They were developed with a more general purpose, instead. As well, in some cases the relationships that lie at the heart of this dissertation were not explicitly treated. Therefore, some extensions were elaborated. Finally, it is ought to say that in some of the specific papers that made up this dissertation, other concepts and theories are also introduced in the discussion. These are not reviewed here keeping only those that form the theoretical skeleton of this dissertation.

1.3.1 The beginning: Penrose´s Theory of the Growth of the Firm

Undoubtedly, one of the milestones in the development of the literature about business growth was E. Penrose’s *Theory of the Growth of the Firm*, first published in 1959. Until then, business growth had only been marginally treated by the economic literature. Strictly speaking, Penrose’s book does not explicitly refer to the case of young firms. On the contrary, her ideas are thought in principle in the context of large firms. Nevertheless, her arguments have informed most of the contemporary theories used by the entrepreneurship literature and provide useful conceptual lens to study the relationship between growth and profits and growth persistence.

For Penrose, the concept of business growth is used with two alternative meanings. More often it denotes merely a change in some size measure of the firm, but it also reflects *“… an increase or an improvement in quality as a result of a process of development, akin to natural biological processes in which an interacting series of internal changes leads to increases in size accompanied by changes in the characteristics of the growing object…”* (Penrose, 1959, p. 1). The latter definition, which emphasizes the process-like nature of firm growth, is the one that underlies this dissertation.

She conceives firms not only as mere administrative organizations, but fundamentally as a *“… collection of productive resources the disposal of which between different uses and over time is determined by an administrative decision…”* (Penrose, 1959, p. 24). Importantly, she refers not only to physical, tangible resources but also – and particularly – to human resources. Most importantly, she pointed out that *“…it is never resources themselves that are the ‘inputs’ in the production process, but only the services that the resources can render…”* (Penrose, 1959, p. 25). The main distinction between resources and the productive services derived from them is that the former could be defined independently from the latter, whereas services cannot be defined in the same way. Services imply a function, an activity. Resources, in this sense, are defined as a ‘bundle’ of possible services. Notably, she affirms that the amount and kind of productive services that could be extracted from each type of resource are different, as well as the amount and kind of services obtained from each unit of the same resource type are different. Hence, the productive services obtained from each resource are a function of the way in which these resources are exploited. Hence, the productive services obtained from each resource are a function of the way in which these resources are exploited. The same resources exploited in different ways or in combination with other resources could generate different outcomes in terms of productive services. This distinction configures the ground of the uniqueness of each individual firm. Although Penrose recognizes that resources could be heterogeneous, she emphasizes that *"… it is the heterogeneity, and not the homogeneity, of the productive services available or potentially available from its resources that gives each firm its unique character…"* (Penrose, 1959, p. 75).

According to Penrose, firm growth is a process governed by what she called the 'productive opportunity' set, which comprises *"… all of the productive possibilities that its 'entrepreneurs' see and can take advantage of…"*(Penrose, 1959, p. 31). The term entrepreneur does not refer to a particular person or a particular position within the firm, but to a function. Entrepreneurial services are broadly defined as the introduction of new ideas, significant changes in technology or changes in the administrative organization of the firm, among other activities. The quality of such entrepreneurial services would depend on several 'temperamental' characteristics, namely versatility, fund-raising ingenuity, ambition and judgment. Penrose gives to these entrepreneurial services an important role in determining the expansion of the firm, which briefly consists in evaluating the external inducements and obstacles to expansion and, at the same time, assessing the internal obstacles to profit from these possibilities presented by the competitive environment.

By growing, managers become more aware of the most profitable use of each resource they control. At any time, *"… as long as expansion can provide a way of using the services of its resources more profitably than they are being used, a firm has an incentive to expand; or alternatively, so long as any resources are not used fully in current operations, there is an incentive for a firm to find a way of using them more fully…"* (Penrose, 1959, p. 67). Because of this learning-by-doing process, resources and services are continuously released and combined in different ways in order to create new profitable opportunities within the firm. In this vein, according to Penrose's ideas a positive relationship between growth and profits would be expected, where growth by means of learning effects would positively influence profits. In addition, managerial services are continuously released as managerial activities became routinized. Consequently, excess managerial services could be more efficiently applied in other value-creating uses. In this way, firms will grow in order to obtain the most profitable outcome of their unused resources (and services), which further creates new opportunities to profit from other yet unused resources (and services).

Since unused productive services have an opportunity cost close to zero, there is an internal continuous incentive for firms to expand their size. Accordingly, Penrose departs from the idea of growth to an 'optimal' size, which characterizes the neo-classical theory of the firm in economics[2]. Underlying these "economies of growth" lies the idea of growth as a self-reinforcing process, so a positive correlation between previous and current growth could be expected.

However, these "economies of growth" will face a limit. As the same Penrose has proposed, the same internal process that fosters growth establishes its own limit, what constitutes her most famous argument, i.e. the 'Penrose's effect' (or growth-curve). Accordingly, at any time firm growth is restricted by the available stock of managerial services. As firm grows, there is an increasing need for coordinating an extended amount of related activities. Hence, there could exist something like a 'diminishing rate of return' of the managerial services that may limit the expansion of the firm. In addition, the amount and kind of available unused productive services is decreasing, as they are successively recycled, increasing their opportunity costs. Consequently, new activities being incorporated or developed within the firm as it grows would imply an increase in the average cost, leading to a decrease of profits. The same is true for their abilities to perceive new growth opportunities (Lockett, Wiklund, Davidsson, & Girma, 2011). This process of growth where internal and external inducements to grow are confronted with internal and external limits to grow, provides a relevant explanation not only for a negative relationship between growth and profits, but also for those erratic patterns of growth observed at the firm level.

In sum, Penrose´s seminal book provides a real description of the process of firm growth where economies of growth and efficiency gains due to learning process may help explain why growth could positively influence profits and why there is an internal inducement for growth that may support the persistence of growth rates. Nevertheless, the effects of these economies of growth are transient and the same internal inducements to growth would eventually face some internal limits giving an explanation to the observed patterns of erratic growth.

[2] Under the basic assumptions of traditional microeconomics, growth would be positively related to profitability. Under these assumptions, firms will grow until they reach the *minimum efficient scale* (MES), i.e. the minimum level of the average cost curve, the point where the scale economies are fully exploited.

1.3.2 Evolutionary economics and the 'growth of the fittest' hypothesis

Evolutionary thinking was born as a reaction of several economists to the neoclassical mainstream, especially in what concerns to economic change. The most cited reference in evolutionary economics is Nelson and Winter's *Evolutionary Theory of Economic Change* (Nelson & Winter, 1982). Although the focus of this volume lies in the development of an evolutionary theory of economic growth as opposed to the neoclassical one, it also establishes the basic notions and ideas regarding firm characteristics and behaviors. The concept of firm in the evolutionary theory is mainly rooted in the previous tradition of managerial and behavioral theories of organization (i.e. Simon, Cyert and March), in the aforementioned Penrose's theory, and fundamentally in Schumpeter's work. Accordingly, they conceive firms as complex, heterogeneous and not profit-maximizing agents with bounded rationality operating in a context of dynamic increasing returns, where innovation is the key process.

Within the evolutionary context, firms are defined as bunches of 'organizational routines'. Routines are generally defined as what is regular and predictable about business behavior. More precisely, routines are persistent and regular features of the firm in the sense that they indicate 'what a firm does' and 'how productively' (Nelson, 1995). They consist in a list of functions that determine what a firm does in a myriad of activities (e.g. technology, product development, marketing, etc.) as a function of internal variables (level of accumulated profits, stock of machinery, etc.) and external variables (mainly, market conditions). Thus, at any point in time, routines may be regarded as the best the firm knows and can do at this time, conditioned by the evolutionary process that has molded them and the surrounding environmental context. Routines are also heritable in the sense that they are conceived as the organizational memory (Nelson & Winter, 1982). This firm-specific knowledge base that is accumulated throughout the organizational life is the result of an endogenous, experience-based learning process. Consequently, the evolutionary theory conceives firms as structurally heterogeneous. As a consequence, there would be persistent asymmetries among firms' capabilities and their learning trajectories, which in turn would led to persistent differences in firm performance (Capasso et al., 2014). Those firms with superior routines and capabilities would exhibit a superior performance and since the former would not change over time, a positive correlation of firm performance over time would be expected, unless until an environmental change happens.

Routines are also selectable and this fact introduces a final important aspect of the evolutionary theory: the selection process. In this context, firm performance would depend not only on what the firm is doing but also on what their competitors are doing, given the conditions of the environment. Therefore, it is the environment, in principle, what determines the rules for surviving and grow. Selection, in this context, operates via differential growth, in the sense that the most viable firms will survive and grow. Accordingly, *"…profitable firms will grow and unprofitable ones will contract, and the operating characteristics of the more profitable firms will account for a growing share of the industry's activity…"* (Nelson & Winter, 1982, p. 17). Hence, a positive causal relationship from profits to growth is established, supporting the *growth of the fittest* hypothesis (Coad, 2007c).

The causal mechanism implicit in Nelson and Winter's argument departs from the recognition that under an evolutionary model of Schumpeterian competition, those innovative firms are rewarded with above-normal profits. These profits are in turn, re-invested in the firm producing a reinforcement of firm's capabilities and an increase in its size, because investment decisions and growth at the firm level and intimately related. So, initial profits would generate via selection mechanism subsequent growth, which will reinforce firm's relative position producing additional profits, which in turn will be re-invested again, generating a virtuous circle as long as expansion reinforces firm's set of effective routines. Moreover, firms do not have any incentive to behave in another way. As Nelson and Winter describe *"… In the simplest evolutionary models profit-seeking firms invest because they can cheaply replicate their distinctive routinized ways of doing things and because the prevailing market signals indicate that it is profitable to do so; investment produces growth in capacity if not in sales revenue, and growth differences among firms are a mechanism of adaptive change in the mix of routines displayed in the industry...* (Nelson & Winter, 1982, p. 412).

Summarizing, evolutionary theory of the firm provides a sound theoretical explanation for a positive relationship between growth and profits, where the latter feeds the former by means of the selection mechanism. Likewise, since this approach tends to affirm the presence of persistent differences in firm performance it would also imply that growth would be autocorrelated.

1.3.3 The resource-based approach

The resource-based view of the firm (hereafter, RBV) was first proposed by B. Wernerfelt, (1984) as an alternative to the dominant structural approach of M. Porter. The theoretical antecedents of the RBV lie in Penrose's theory of the firm and the Chicago's tradition on Industrial Organization. Departing from Penrose, the underlying theoretical foundations of the RBV rest on the recognition that intra-industry differences in firm performance are derived from resources *"having intrinsically different levels of efficiency"* (Peteraf & Barney, 2003). Hence, sustained competitive advantage is the central concern of the RBV and is usually defined in terms of relative profitability.

As Peteraf (1993) suggests, sustained competitive advantage refers to the possibility for a firm to earn strictly positive differential profits in excess to the opportunity cost (including the cost of capital) that are sustained in equilibrium. Resources, are defined as *"… those (tangible and intangible) assets which are tied semi permanently to the firm..."* (Wernerfelt, 1984, p. 172) and they are the primary source of firm's competitive advantage (profitability). Following Penrose's ideas, RBV scholars state that not every resource could play such a role. Therefore, considerable attention has been given to describe under which conditions a resource might originate sustained competitive advantages. Barney (1991) defined that these resources must be: (i) valuable, (ii) scarce/rare, (iii) hard-to-copy, and (iv) non-substitutable, in the sense that there cannot be strategically equivalent substitutes for this resource. Precisely, the aforementioned attributes of firm resources and capabilities imply that inter-firm heterogeneity would be persistent and so does firm performance. In other words, due to persistent differences among firms' endowments, there would be firms that persistently outperform their competitors as well as others that would continuously be underperformers.

In sum, the RBV perspective provides a sound efficiency-based explanation of the differences in performance among firms in the same industry based on firm's heterogeneous resources and capabilities. As a result, those firms endowed with a richer resource platform would experience a superior profitability, as long as their strategies enable them to appropriate the yields generated by this resource platform. However, not every resource has the same potential effect on business profits. In fact, those resources that are more specific, complex and difficult-to-imitate will have the greatest potential effect on business profits.

Following the above mentioned RBV logic, Davidsson et al. (2009) affirm that firms with above-average profits but low growth are in better position to get the desired status of above-average profits and growth than firms with superior growth rates but low profits, suggesting a causal relationship from profits to growth. According to these authors, firms with higher profits have already a competitive advantage over their rivals. Therefore, unless the potential for the expansion on the current product market is exhausted, these firms are more likely to increase their market shares (i.e. to grow). Moreover, since these firms have superior profits, these gains could be reinvested, lowering the cost of the capital needed to finance the expansion plans.

Conversely, those firms that exhibit at the beginning a high growth rate but lower profits are less likely to make the transition to a high profit-high growth status. According to these authors, successive expansion, in those cases, could not be based on resource-based advantages but on price or cost cuts that will in turn affect negatively the future profits. As a result, Davidsson et al. (2009) affirm that those firms following a path of growing at expenses of profits are more likely to finish in a low growth-low profitability status than firms following a profitable path of growth. Nonetheless, it could be the case that some firms are not able to achieve a high profitability in the first place without exhibit high growth rates in advance to overcome cost disadvantages or liabilities of newness. Actually, this could be the case when experience and/or learning effects are particularly relevant.

1.3.4 The randomness of firm growth and the Gambler´s Ruin approach

In the last few years, some authors questioned the grounds of these theories by proposing that firm growth, and particularly, young firms' growth could be better described as a (close) to random process (Coad, Frankish, et al., 2013a; Storey, 2011). Their main argument derives from the low explanatory power of most models in the growth literature that – based on the previous theories – try to look for the main determinants of growth differences between firms. This debate resembles earlier discussions from industrial economics based on Gibrat's Law but in the context of large longitudinal data (Stam, 2010).

In fact, more than eighty years ago, Robert Gibrat (1931) proposed his famous Law of Proportional Effect, widely known as Gibrat´s Law. This Law derives from his observation of the skewed size distribution of French manufacturing firms, which according to this author tend to follow a lognormal distribution. Hence, Gibrat devoted his seminal publication to explain the underlying mechanism that may generate such kind of distribution. In its basic form, Gibrat´s Law postulates that the expected change in firm size of a given firm is independent of it size at the beginning of the studied period. Mansfield (1962) quoted in (Coad, 2007b, p. 9) re-expressed this enunciation as *"the probability of a given proportionate change in size during a specified period is the same for all firms in a given industry – regardless of their size at the beginning of the period"*. Consequently, changes in firm size could be purely explained by the history of multiplicative external shocks. As such, this postulate implies that growth rates would not be serially correlated and growth processes would tend to be random (Fotopoulos & Giotopoulos, 2010).

Gibrat´s Law has generated a huge amount of research trying to establish whether this empirical regularity holds or not. This Gibrat´s legacy shows mixed results as most reviews highlight (e.g. Lotti, Santarelli, & Vivarelli, 2003; Santarelli, Klomp, & Thurik, 2006). In general, Gibrat´s Law tend to hold among old and large firms whereas is rejected when small and young firms are included. In particular, these results has been proven in the Spanish case (Teruel-Carrizosa, 2010). As well, Lotti, Santarelli, & Vivarelli (2007) found that Gibrat´s-like processes tend to be observed among surviving firms as long as firm matures. In addition, it has also been proven that the extent to which Gibrat´s Law might be a valid heuristics differs between manufacturing and services firms (Audretsch, Klomp, Santarelli, & Thurik, 2004; Teruel-Carrizosa, 2010) and the industry context (Daunfeldt & Elert, 2011).

As said, just recently Coad, Frankish, et al. (2013a) revisit this question about the randomness in firm growth processes by developing a new conceptual framework based on Gambler's Ruin theory (Wilcox, 1971). Accordingly, firm growth is modeled as the result of a game of chance akin to what happens at a roulette wheel at the casino. Players (entrepreneurs, in this case) may differ at the beginning on the amount of resources they have and their willingness to stay playing. As Storey (2011) affirms, entrepreneurs are characterized by their over-optimism about their chances of a "big win", which make them stay for longer in business expecting it to happen. Therefore, they will remain playing until they run out of money (i.e. resources). Resources could be accumulated in two ways; either by having them before playing (at the start up) or by having some early "wins" (i.e. growth episodes). In the context of new and young firms, these authors stress the importance of such earlier wins since them allow winners to be in a better position to get additional resources by borrowing them from others.

Like in the casino metaphor, the sequence of "wins" and "losses" is by definition random and out of the control of entrepreneurs. So, the outcome of this game of chance (i.e. business growth) is randomly distributed. This fact has also some critical consequences on other well-grounded concept: learning. Again, the casino analogy is relevant since it shows that the circumstances of one round would not be repeated in the following, so there is no room for learning opportunities since it is impossible to know the future outcomes. In particular, Storey (2011) explains that under this framework only Jovanovic´s (1982) learning takes place. That is, by playing entrepreneurs do not become more talented in playing the roulette (i.e. how to play) rather they become more informed in knowing when to leave the game or alternatively, to continue playing.

Another theoretical implication of this framework is that the different growth trajectories are also randomly distributed, due to the independence between previous and current outcomes. In fact, Coad, Frankish, et al. (2013a) demonstrate that any possible growth path is as likely observed as it would be under a purely random and independent process. At the end, these authors conclude that *"… the more appropriate heuristic for conceptualizing firm growth is not that firms can be neatly arranged into a taxonomy of different growth trajectories, but that growth is predominantly a random phenomenon..."* (Coad, Frankish et al., 2013a, p. 628).

This approach has rapidly generated some debate on the literature. In fact, during the last couple of years a series of exchanges have been published on the *Journal of Business Venturing Insights* (Coad, Frankish, Roberts, & Storey, 2015; Derbyshire & Garnsey, 2014, 2015). Two main aspects are the most controversial. The first one poses a methodological note by signaling that in the aforementioned framework only two possible outcomes are possible: growth or decline. Hence, stasis, that is, zero growth is not considered. This omitted category is, according to Derbyshire & Garnsey (2014), the most frequently observed growth category among firms. Hence, these authors argue that by including stasis, it would account for a large proportion of growth states. So, growth paths become less random.

The second and more important concern raised by Derbyshire & Garnsey (2014) refers to the utilization of the terms random and randomness. These authors make a fundamental distinction between randomness (indeterminism) and deterministic chaos, arguing that underlying Coad, Frankish, et al. (2013a) paper what lies is the recognition that firm performance is indeed determined by a number of factors, although the final output is rather difficult or impossible to being accurately predicted. In Derbyshire & Garnsey (2014) terms, firm performance is "… *subject to deterministic chaos rendering prediction impossible…"* (Derbyshire & Garnsey, 2014, p. 11).

In sum, this debate is still open. In fact, Denrell, Fang, & Liu (2015) explain that introducing the role played by chance into the existing models of firm growth does not imply that entrepreneurs are passive or irrational agents. Rather, it emphasize that the results of their decisions are to some extent out of their control and heavily affected by randomness. In this vein, they are impossible to be predicted *ex ante*.

1.3.5 The case of young firms: erratic growth and the life-cycle models

Since the sixties, many authors have conceived growth as a developmental process analogous to the human experience of aging. This life-cycle approach states that like human beings pass through a number of stages form infancy to adulthood, so do firms. In this sense, business growth is viewed as a continuum where a number of growth events, stages, crises and transitions are identified and characterized (Greiner, 1972; Kazanjian & Drazin, 1990; Lewis &

Churchill, 1983). Usually, each of these stages are described in terms of some organizational features (structures, systems and management characteristics) and dominant problems that firms face in their evolution and adaptation to the general context. However, there is no consensus about how many stages of growth may describe a firm´s life. Most models include between three and five stages, being the latter the most frequent. Neither is there a unified framework to explain what a stage really is and how growth occurs over time. Again, most models derived from this approach assumed that transitions from one stage to the next one are linear and incremental (Levie & Lichtenstein, 2010). In this vein, a positive correlation between growth rates could be derived from this kind of models.

Despite the wide diffusion that these models have achieved both among academics and in textbooks, these models were heavily criticized mainly because they implicitly assumed that firms – as any other organism - grow in a "… *number of specific stages and that these stages represent an immanent program of development…"* (Levie & Lichtenstein, 2010). Instead, Levie & Lichtenstein (2010) propose their 'dynamic states' model of organizational change. This 'dynamics states' approach, captures the essence of life-cycle models but without implying their restrictive assumptions. Building on the idea of firms as complex adaptive systems, a dynamic state represents entrepreneurs´ attempt to match the internal resources and structures with the external environment. Therefore, organizational growth will be driven by firms' responses to demand changes as well as to internal transformations but without assuming a specific number and sequence of linear subsequent stages.

None of the previous frameworks has been particularly designed to account for the reality of the earlier years, except Garnsey´s (1998) model. Actually, inspired in Penrose´s ideas Garnsey (1998) proposes a model to illustrate the sequence of firm growth stages in the particular case of young firms. Her model departs from recognizing the fact that in order to be viable and survive, all firms must transit some common initial phases. These phases are not conceived in terms of configurations or managerial characteristics, but as manifestations of critical problems that need to be addressed. Firms must access to resources, build competences and mobilize resources before they can generate their own resources. Importantly, although some sequence is defined between these initial phases there is room for some overlapping and false starts, earlier failure and regressions.

Likewise, once the firm starts to generate their own revenues, a number of growth reinforcement as well growth reversal forces start to content. The outcome of such struggle may result in at last three possible scenarios: early failure, a growth plateau (which represent a period of stasis) with some oscillations and a growth reversal. Continuous growth is conceptually possible and reflects the ability of the firm to overcome the different challenges that the internal and external context imposed.

Although these models do not explicitly postulate a trade-off between profits and growth, they succeed in giving some qualitative evidence of the potential negative outcomes of firm growth on profits. In particular, all these models postulate that eventually leadership and human resource shortcomings would lead to a crisis as long as firm grows, like Penrose's has stated. Greiner (1972) defines this situation as leadership crisis whereas Garnsey et al. (2006) mentioned it as growth reversal stage or synchronization problems. Additionally, Garnsey, (1998) illustrates other situations in which growth and profits do not move together. Principally, she refers to 'plateau' phases in which firms decide not to grow in order to preserve and increase the level of profits previously attained.

This approach has been adopted in several qualitative studies showing that indeed, young firms' growth are characterized by a sequence of several ups and downs, setbacks, post-entry mistakes, reversals and turning points (Garnsey & Heffernan, 2005; Garnsey et al., 2006). These case studies also evidence that growth setbacks or reversals could be derived from resource shortages, synchronization problems and cash crises. However, not all the problems come from within the firm (i.e. internal dynamic and management problems). The higher dependence of young firms on their external environment (i.e. customers, competitors, partners, suppliers) only intensifies the scope of the internal problems. In the light of this evidence, a negative correlation between current and past growth could be established.

1.4 Structure and main contents of this dissertation

This dissertation is organized upon three different papers, each one corresponding to one of the aforementioned objectives. The first paper deals with the first objective of this dissertation. It focuses on the growth-profits relationship and departs from the recognition of the inconclusive empirical evidence about the underlying causal mechanism between retained profits and growth, and vice versa. By explicitly considering the endogeneity and heterogeneity aspects of the relationship between growth and profits of young firms, this study contributes to advance on the understanding of such association, bridging theory and evidence. In short, the results of this paper indicate that young firm growth has a positive impact on profits. In contrast, the effect of profits on growth is not significant, questioning some relevant implications from evolutionary and RBV approaches. Importantly, the results show that these relationships are strongly influenced by inter-firm heterogeneity, emphasizing the higher relevance of firm-specific variables *vis a vis* industry-specific variables.

Data for this study and the other two that complete the present dissertation is extracted from the SABI© (*Sistema de Análisis de Balances Ibéricos*) database, collected and provided by Bureau Van Dijk and based on the Official Registry of Spanish Companies. SABI© includes company accounts and financial information for more than one million Spanish registered firms. This database has been increasingly used by researchers in the small business economics literature (e.g. Barbero, Casillas, & Feldman, 2011; Nunes, Gonçalves, & Serrasqueiro, 2013) and particularly in previous research on firm growth in Spain (Coad, Segarra, et al., 2013; Coad & Teruel, 2012; Segarra & Teruel, 2012; Teruel-Carrizosa, 2010).

The longitudinal nature of the SABI© database makes it appropriate for the objectives of this dissertation, since it makes it possible to consider firm growth as a developmental process in the sense of Penrose (1959) instead of a mere change in some indicator of firm size (usually present in cross-sectional studies). This fact constitutes an advance in the comprehension of the dynamic nature of firm growth, as claimed by Davidsson, Delmar, et al (2006). Additionally, longitudinal data allow us to examine the evolution of cohorts of comparable young firms over the same period. This research strategy constitutes an appropriate approach to study the early growth of young firms, because it allows to observe different growth trajectories and follow them as the firm matures in the spirit of Garnsey's (1998) approach.

This first paper focuses on a single cohort of young manufacturing Spanish firms, born in 1996. These firms were followed over their first 14 years, from 1997 to 2010. Methodologically, Fixed-Effects estimators and a set of GMM models that explicitly deal with endogenous regressors and dynamic specifications were used, like Difference-GMM and System-GMM (Arellano & Bond, 1991; Arellano & Bover, 1995; Bond, 2002; Roodman, 2006). In addition, to evaluate the heterogeneity across firms and industry sectors, a novel approach based on Hurlin´s test is introduced (Dumitrescu & Hurlin, 2012; Hurlin & Venet, 2008; Hurlin, 2004). This test allows checking for the presence of heterogeneity in the causal relationship between profits and growth in the context of heterogeneous panels.

This paper entitled "The heterogeneous dynamics between growth and profits: the case of young firms" has been published in *Small Business Economics*, vol. 44(2): pp. 231-253. An earlier draft of this paper has been presented at the SIDPA (*Seminario Interdisciplinario de*

Desarrollo Productivo Argentino) organized by the University of San Andres, University of Buenos Aires and the National University of General Sarmiento.

The second paper, under the title “Unravelling growth persistence among young firms: the moderating role of firm age”, corresponds to the second objective of this dissertation. It has been developed to contribute to the emerging and renewed debate about randomness in young firms growth, initiated by Storey (2011) and then formalized by Coad, Frankish, et al. (2013a). This debate, rooted in the previous discussions about Gibrat´s Law, has produced an important number of contributions investigating the degree of autocorrelation among growth rates over time. In this vein, the novelty of this paper is that it proposes that firm age would act as a moderator of such relationship between past and current growth rates in young firms[3]. An earlier version of this paper was presented at the 2015 ISBE Conference in Glasgow and has benefited from several exchanges with relevant scholars like David Storey, Alex Coad and Michael Anyadike-Danes whose contributions are greatly appreciated.

The results of this paper show a general positive autocorrelation supporting earlier contributions from evolutionary theorists, the RBV and the economies of growth from Penrose. However, this correlation tends to be more erratic as long as firm matures. Specifically, like Coad, Daunfeldt, et al. (2015) such turning point appears around the fifth year of life.

Again, data from SABI© has been used to carry out the empirical analysis. In this case, services firms are also included and a multiple cohort approach has been adopted. Hence, four different cohorts 2000, 2001, 2002 and 2003 were followed over an 11-year period (i.e. 10 growth periods). This multiple cohort approach is one of the novelties of this study compared with previous research on the moderating role of firm age on the growth of the firm, which tend to compare firms from different age segments.

As regards the methods of analysis, this paper starts with a simple descriptive approach based on finding and analysing different growth paths throughout the entire period, divided into two stages, i.e. the first five years and the following five. Then, the attention moves to a multivariate approach based on LAD regressions. LAD regressions, also known as MAD (median regressions), are an alternative to OLS, suitable for those cases where the dependent variable shows fat-tailed distributions and where the presence of outliers could diminish the accuracy

[3] Given the conflicting theoretical predictions and the recent counterintuitive empirical evidence on this subject, a research proposition is placed in this study instead of a formal hypothesis, following Coad, Daunfeldt, et al. (2015) suggestion.

of mean regressions. These estimators are now widely used in growth studies (Coad, Daunfeldt, et al., 2015; Coad & Hölzl, 2009; Coad, 2007a). In particular, for estimating if there is a turning point around the fifth year the spline functions' approach (Greene, 2003) is introduced to model the possible non-linear effect of age on growth.

The third paper refers to the third objective and can be considered as a combination of the previous ones but specifically in the context of high growth firms. In the first place, the focus is on testing the degree of persistence of high growth episodes over a 15 years period, using data from the SABI© dataset on cohort 1996 , including both manufacturing and services firms. Following Eurostat-OECD (2008) Manual of Business Demography, high growth firms are defined as *"…all enterprises with average annualized growth greater than 20% per annum, over a three year period…"* (Eurostat-OECD, 2008: 61).

First, transition matrices are used to identify whether those firms that exhibited high growth episodes earlier in their lives are able to sustain such growth path 3, 6 and 9 years later. In accordance with previous studies, this paper shows that this is not the case, supporting the label that some authors have attached to these firms as "one-hit wonders" (Daunfeldt & Halvarsson, 2015; Hölzl, 2014)[4].

Then, the relationship between high growth and profits is analyzed. Using a regular OLS framework, a positive but weak association between high growth and profits is found. This contrasts most evidence based on organizational life cycle models and qualitative studies showing the difficulties that young firms have to manage and sustain high growth episodes for long periods. Interestingly, a moderator role of age is found, showing that this positive effect of high growth on profits would depend on when such high growth episode takes place. Briefly, this positive effect tends to be higher when the firm ages. That is, as firms mature, firms gain experience, knowledge, abilities and resources that enable them to better accommodate high growth in a profitable way.

Finally, after the three papers are presented, a conclusive section is included. The objective of this section is to put all the pieces together and extract the main results obtained in the different papers included in this dissertation. As well, the main theoretical, managerial and political implications of these results are detailed and further elaborated. The limitations of these studies are also described and some possible research topics and promising theoretical developments are mentioned. These topics may constitute the future research agenda to

[4] Unlike the previous paper, in this third paper formal hypotheses are placed because theory and evidence are more conclusive.

advance in the understanding of the underlying forces behind young firms growth and cope with the negative picture that offer some recent reviews of the field (Leitch et al., 2010).

As a corollary of the this section, the next table summarizes the structure and main contents of this dissertation showing the correspondence between objectives, theoretical backgrounds, methodology and results of the different papers that constitutes the central part of this dissertation.

Structure and main contents of the dissertation

	Objective/ focus	Main theoretical background	Sample	Methodology	Main results
Introduction	Summary of the main purposes, motivation, theoretical background, structure and contents of the dissertation				
Paper 1	Endogeneity and heterogeneity in the profit-growth relationship	RBV Evolutionary economics Penrose	Cohort 1996 of Spanish manufacturing firms followed during 14 years	OLS, Fixed Effects, Diff-GMM and SYS-GMM Hurlin's test of heterogeneity	Profits do not affect growth Growth positively affects profits Past growth does not affect current growth Intra-industry heterogeneity is present in both relationships; Inter-industry heterogeneity only appears in the growth to profit relationship
Paper 2	Autocorrelation in growth rates; moderating role of firm age	Gambler´s ruin Penrose Garnsey	Cohorts 2000 to 2003 of Spanish manufacturing and services firms followed during 11 years	Path analyses, LAD estimations Spline regressions	Positive correlation among growth rates (persistence) Persistence diminishes as long as firm matures The fifth year acts as a turning point Results are sensitive to initial size and cohort
Paper 3	Persistence of high growth firms and impact of high growth rates on profits; moderating role of firm age	Penrose Garnsey Life-cycle models	Cohort 1996 of Spanish manufacturing and services firms followed during 16 years	Transition matrices OLS and Fixed effects regressions	HGFs are not able to sustain their high-growth episodes in successive years High growth rates have a slightly positive effect on profits Firm age positively affects the impact of high growth episodes on profits
Conclusions	Stylized summary of the main findings, theoretical and practical implications, limitations and future research agenda				

2. THE HETEROGENEOUS DYNAMICS BETWEEN GROWTH AND PROFITS: THE CASE OF YOUNG FIRMS (PAPER 1)[5]

2.1 Introduction

The dynamics of growth rates and their interplay with other relevant measures of firm performance, such as productivity, profitability and survival is now at the heart of the debate among industrial economists and entrepreneurship scholars (Bottazzi, Coad, Jacoby, & Secchi, 2011; Bottazzi, Dosi, Jacoby, Secchi, & Tamagni, 2010; Coad & Broekel, 2012; Coad, Frankish, et al., 2013a; Coad, Rao, & Tamagni, 2011; Coad, 2007c; Delmar et al., 2013).

In particular, recent studies show a rather limited influence of profits on business growth (Bottazzi et al., 2010; Coad, 2007c; Delmar et al., 2013), thus questioning some well-established theoretical expectations derived from the resource-based view (Barney, 1991) and the evolutionary perspective (Nelson & Winter, 1982; Nelson, 1995) about the relationship between these two variables. Such results also challenge earlier research that reported a positive association between profits and growth (e.g. Brush, Bromiley, & Hendrickx, 2000; Capon, Farley, & Hoenig, 1990; Cho & Pucik, 2005; Cowling, 2004).

These inconclusive results can be explained by the difficulty of fully addressing the complex nature of such relationship. On the one hand, there are sound theoretical motivations to assume that this relationship may be affected by endogeneity, where retained profits may serve as prerequisite for a sustained growth trajectory and growth may reinforce firms' profits as well (e.g. Nelson & Winter, 1982; Penrose, 1959). On the other hand, the link between profits and growth is likely to be influenced by inter-firm heterogeneity, which has been highlighted by evolutionary scholars as the '*regular state of affairs*' (e.g. Bottazzi et al., 2010; Nelson & Winter, 1982; Nelson, 1995) and constitutes a necessary and sufficient condition for the existence of resource-based competitive advantages (Barney, 1991; Peteraf & Barney, 2003). However, only few studies have considered the endogeneity and inter-firm heterogeneity aspects of the growth-profits relationship (Bottazzi et al., 2010; Coad, 2007c; Cowling, 2004; Delmar et al., 2013; Roper, 1999).

In this paper, these two issues are purposefully addressed. More specifically, the following questions are answered: (i) Do retained profits lead to firm growth? (ii) Does growth affect subsequent profits? (iii) Are these relationships homogeneous across firms and industries? The

[5] This paper has been published as Federico, J. S., & Capelleras, J.-L. (2015). The heterogeneous dynamics between growth and profits: the case of young firms. *Small Business Economics*, *44*(2), 231–253.

first two questions refer to the endogenous nature of the relationship. The third one is related to the heterogeneity issue, which means that these relationships could exist for some firms and industries while for others could be inexistent.

The novelty of this study with respect to previous research stems from theoretical and methodological points of view. Theoretically, we examine the growth-profits nexus by explicitly considering both endogeneity and heterogeneity as key features of the relationship. Grounded on resource-based view (RBV) and evolutionary considerations, profitable firms will be more likely to grow. At the same time, business growth can generate opportunities to earn profits by means of learning by doing effects and dynamic increasing returns. Hence, we first argue that there will be an endogenous relationship between them. Both RBV and evolutionary economics also consider firm heterogeneity as a structural feature of firms that derive from their particular resources and capabilities or from their specific organizational routines. Thus, we also argue that such heterogeneity will determine whether (or not) profits and growth are related.

Methodologically, we profit from recent advances in econometrics such as System GMM estimators (Blundell & Bond, 1998, 2000; Roodman, 2006) to account for endogenous regressors. Then, we introduce a novel approach which helps us to test for the presence of heterogeneity across firms and industries in the profits-growth relationship (Dumitrescu & Hurlin, 2012; Hurlin, 2004).

Moreover, this paper focuses on the particular case of young firms by analysing a single cohort of Spanish manufacturing firms founded in 1996 and, following them throughout their first 14 years of life. While evidence suggest that the growth-profits relationship varies over time as the firm ages and evolves (Steffens, Davidsson, & Fitzsimmons, 2009), there is a scarcity of studies that have directly addressed this specific topic in the context of young firms (Delmar et al., 2013). In fact, there are several reasons to expect that this relationship may have unique features in the case of newly founded or young firms. First, some of these firms may decide to grow at the expense of profits, just for surviving reasons (Coad, Frankish, et al., 2013a; Garnsey, 1998). Likewise, it could be expected that growth and profits to be negatively related because of initial trial-and-error learning processes. Additionally, it is also plausible that young firms may not be able to obtain sizeable profits without growing enough first in order to overcome their initial cost disadvantages (Steffens et al., 2009).

The study provides several contributions to the literature on young firm growth. First, in contrast to well-established theoretical expectations we do not find support for the evolutionary *growth of the fitter* postulate where profits positively affect the ability of firms to grow (Coad, 2007c). On the contrary, it seems that in the case of young firms, selection operates more on growth than on profits. Indeed, once we control for endogeneity, we find that firm growth has a positive impact on profits due to learning by doing gains. Secondly, we make a strong point on the relevance of intra-industry, firm-specific heterogeneity in such relationship. In accordance with our theoretical framework, firms may differ not only in terms of their growth prospectus due to firm-specific resources and capabilities, but fundamentally if this growth could be translated (or not) into profits. Finally, we also contribute to the on-going debate on the randomness of growth rates in young firms (Geroski, 2005; Storey, 2011; Westhead & Wright, 2011) discussing the paradoxical situation where growth seems to be close to random but at the same time, it has a strong impact on non-random variables such as profits.

In the next section, we present and discuss the theoretical arguments on the nexus between profits and growth and review the empirical evidence in this regard. We also make a point for the existence of inter-firm heterogeneity in this relationship. The third section examines the estimation methods to deal with the issues of endogenous regressors and heterogeneity. The fourth section provides details on the data, variables and empirical models. We then turn to the results of our analyses. In the final section, we discuss the main findings derived from our study in the light of our theoretical expectations and previous research, as well as the limitations and future research directions for each finding.

2.2 Theoretical background and related literature

2.2.1 Revisiting the influence of profits on firm growth

The first research question of this study concerns the potential effect of profits on growth. Such relationship is at the heart of major theoretical perspectives from industrial economics and strategic management. While both the RBV and evolutionary approaches suggest that the former drives the latter, they differ in their explanations of how and why these initial superior profits are achieved and translated into further growth.

Since its inception, RBV has been concerned with the explanation of sustained intra-industry performance differences, and more specifically, firms' sustained competitive advantage. Inspired by Penrose's (1959) ideas, RBV scholars argue that the more specific, complex, and difficult-to-imitate the resources are, the greater their contribution to creating sustained competitive advantages would be (Barney, 1991, 1997; Peteraf, 1993; Wernerfelt, 1984).

Following a RBV logic, Davidsson, Steffens & Fitzsimmons (2009) develop a framework to analyse *profitable growth* trajectories, illustrated as configurations where firms show at the same time above-average growth rates and above-average profitability rates. Their starting point is that firms showing above-average profitability rates have demonstrated that are capable of creating value for their customers, establishing a resource-based competitive advantage over their competitors. In addition, they have been able to appropriate the value created within the firm by building an adequate business model. Therefore, unless the potential for expansion in the current product market is exhausted, these firms are more likely to grow by penetrating this market, increasing their market shares. Moreover, since these firms have been able to generate superior profits, these gains could be reinvested, lowering the capital needed to finance expansion plans. All these ideas suggest that profitability should come first if a *profitable growth* trajectory is to be achieved, as Davidsson et al. (2009) and Brännback et al. (2009) have empirically proven.

In spite of the attractiveness of the configurational approach proposed by Davidsson et al. (2009), there are some considerations to be made. First, this approach implicitly assumes that superior profits in one period are indeed the realisation of superior resource-based advantages, leaving aside the question of *how* firms could generate the above-average profitability rates that in turn leads them to a growth path. However, these superior profits may be a *transient* result that derives from factors that are external to the firm. Secondly, Davidsson et al. (2009) assumed that such a relationship between profits and growth holds *if and only if* the growth trajectory is based on the kind of resources that led to the initial superior profitability. However, firms may pursue other growth opportunities that may destroy rather than create value. Likewise, firms may enjoy superior profits and refuse to grow, disregarding opportunities for further value creation (Garnsey, 1998; Wiklund, Davidsson & Delmar, 2003).

Furthermore, young firms would have significant difficulties in establishing an initial competitive advantage that would enable them to enjoy an above-average profitability rate. Most young firms tend to face time compression diseconomies, making it difficult for them to accumulate a richer resource base in a short fixed period of time (Dierickx & Cool, 1989). Similarly, it is likely that most young firms will not be able to exhibit a superior performance in terms of profits without growing enough to overcome initial cost disadvantages (Steffens et al., 2009). Moreover, some young and newly created firms may decide to grow at the expense of profits, simply to survive, since growth and survival are closely related (Coad, Frankish, et al., 2013a).

Evolutionary economics (Nelson & Winter, 1982) also assumes that prior profits will drive subsequent growth, but from a different perspective. This approach assumes that firms operate in the context of a Schumpeterian economy, where they compete against each other in a turbulent and rapidly changing market environment. From the evolutionary perspective, firm performance would depend not only on what the firm does but also on what their competitors are doing, given the environmental conditions. Therefore, it is the environment, in principle, that determines the 'rules of the game'. Selection, in this context, operates via differential growth, in the sense that the most viable firms will survive and grow. Specifically, Nelson & Winter (1982) establish that profitable firms will grow and unprofitable ones will contract, giving rise to the *growth of the fitter* principle. Therefore, initial profits would generate subsequent growth via a selection mechanism that will reinforce the firm's relative position by producing additional profits that in turn will be re-invested again, generating a virtuous circle as long as expansion reinforces the firm's set of effective routines. As a result of these 'replicator dynamics' (Coad, 2007c), the economy would move towards a more efficient allocation of resources since the profitable firms (and their routines) would account for an increasing share of the market, and less viable firms would decline and eventually, close.

Although this *growth of the fitter* principle provides a sound theoretical explanation of industry dynamics, recent empirical evidence has failed to corroborate it as strongly as would be expected (Bottazzi et al., 2011; Coad, 2007c). As Bottazzi et al. (2010, p. 1985) suggest, *'… the absence of any strong relationship between profitability and growth militates against the "naively Schumpeterian" or "classic" notion that profits feed growth (by plausibly feeding investments)…'*.

Additionally, it has been empirically proven that growth rates are not as autocorrelated as may be expected (Bottazzi et al., 2011; Coad & Broekel, 2012). Indeed, the recognition that *'…lagged growth is a poor signal of future growth'* (Coad, Frankish, et al., 2013a) and the fact that models aimed at identifying growth determinants account for a rather limited explanatory power have led some authors to argue that growth rates seem to follow a random walk (Geroski, 2005). This goes back to the Gibrat's Law main implications (Stam, 2010) and re-inaugurates an important debate in the literature (Storey, 2011; Westhead & Wright, 2011).

To account for this new evidence Coad et al. (2012) recently developed a new framework based on Gambler's Ruin theory (Wilcox, 1971). The departing point of this model is that new firm growth can be considered as a game of chance where each growth event depends only on the stock of accumulated resources, i.e. those derived from previous "wins" and /or those present at start-up. Accordingly, growth is close to random and, thus, sustained growth paths may be the exception rather than the rule. Although, some recent evidence appears to support this view (Garnsey et al., 2006; Hölzl, 2014; Parker et al., 2010) challenging previous research and evidence on growth determinants.

In sum, both RBV and evolutionary perspectives provide arguments to expect that previous profits would positively affect subsequent growth. At the same time, there are some reasons to suggest that this effect may not be so strong in the case of young firms. Indeed, recent empirical evidence does not show such a positive relationship from profits to growth as strongly as would be expected, particularly in the case of young businesses. We subsequently argue that two major features of the profit-growth nexus, namely endogeneity and heterogeneity, may help to explain this inconsistency between theory and the empirical evidence.

2.2.2 The influence of growth on profits and the question of endogeneity

So far, we have argued for an effect of profits on growth according to resource-based and evolutionary considerations. However, it is also plausible that firm growth successively affects profits, leading us to the question of endogeneity (Cowling, 2004; Roper, 1999). Indeed, there are sound theoretical contributions supporting the endogenous nature of such relationship. Therefore, in this section we address our second research question on the effect of growth on profits.

First, from a Ricardian perspective, comparative advantages imply that as long as firms grow, they are moving toward less profitable segments of the market. Although this expansion will continue to generate additional profits, it might also result in a decrease of profit rates if this movement towards less profitable market segments is not accompanied by the generation of scale economies (Steffens et al., 2009).

Second, according to Penrose's (1959) seminal book, growth makes managers more aware of the resources they control, the most profitable use of each, and the productive services that could be obtained from them. Hence, the knowledge generated through the growth process will enable entrepreneurs to conceive new resource combinations and develop new productive services (Lockett et al., 2011). Because of this learning by doing process, resources and services are continuously released and combined in different ways in order to obtain the most profitable outcome of their unused resources.

However, these 'economies of growth' are by their very nature a transient phenomenon; they disappear as the firm become larger. In addition, as the same Penrose has proposed, the same internal process that fosters growth establishes its own limit, the well-known 'Penrose curve'. As the firm grows, there is an increasing need to coordinate an extended amount of related activities that diverts managerial attention from operating costs, leading to a decrease in the profit rate. Moreover, entrepreneurs' abilities to combine resources continuously in order to extract the most profitable usage of them are limited. The same is true for their abilities to perceive new growth opportunities (Lockett et al., 2011). This trade-off between profits and growth has been empirically proven in the case of Scottish young firms (Reid, 1995).

RBV scholars also recognize that growth positively affects profits as long as it reinforces firm's resource advantages. Static increasing returns derived from specialization will operate in the same way, increasing firm profits as the firm grows. In addition, dynamic increasing returns as described by the Kaldor-Verdoorn principle would also predict growth to have a positive impact on profits as long as growing firms may invest in new technologies and/or learn about new methods which will lead to an increase in firm productivity and profits (Coad, 2007c).

In sum, based on the preceding arguments (i.e. learning by doing effects, Penrose's transient "economies of growth" and dynamic increasing returns), we would expect a positive impact of current growth on profits, particularly in the case of the youngest firms. This expectation, together with our previous reasoning about the profit-to-growth relationship, suggests an endogenous relationship between these two variables.

2.2.3 Heterogeneity in the growth-profit relationship

In addition to endogeneity, heterogeneity is also an important aspect to be addressed in the relationship between growth and profits. Hence, our third research question is related to this issue. From a theoretical point of view, both RBV and evolutionary economics make a strong stand on the heterogeneous nature of firms. According to Penrose (1959) the ground of the uniqueness of each individual firm lies in the distinction between resources and the productive services derived from them. Although Penrose recognizes that resources could be heterogeneous, she emphasizes that precisely the way in which these resources are exploited by each firm gives them its unique character. Heterogeneity is also at the heart of the notion of resource-based competitive advantages popularized by RBV scholars, since these are derived from resources and capabilities which should be *by definition* valuable, rare, hard-to-copy, and non-substitutable, in the sense that there cannot be strategically equivalent substitutes for them (Barney, 1991; Peteraf & Barney, 2003; Peteraf, 1993).

In the same way, within the evolutionary thinking, heterogeneity constitutes a structural feature of firms, which is rooted in the notion of organizational routines. Routines are persistent and regular features of the firm in the sense that they indicate 'what a firm does' and 'how productively'(Nelson, 1995). Routines are also heritable in the sense that they are conceived as the organizational memory (Nelson & Winter, 1982; Nelson, 1991). This firm-specific knowledge base is accumulated throughout the organizational life as a result of an endogenous, experience-based learning process. Consequently, the evolutionary theory conceives firms as structurally heterogeneous entities. Nelson (1991) adds that heterogeneity may also arise as a reflection of differences in three strongly related firm features: strategy, structure and core capabilities. Accordingly, market selection would imply that different industries might require different strategies, structures and capabilities; thus, heterogeneity is also translated from the firm level to the industry level.

However, some authors argue that in complex and highly segmented markets, selection pressures would be less relevant and therefore we could find even greater levels of heterogeneity still in the same industry (Srholec & Verspagen, 2012). Moreover, the greater use of niche strategies by younger firms relative to mature firms may allow them to be less influenced by general industry trends (Short, Ketchen Jr, Palmer, & Hult, 2007). In this context, a number of recent studies have suggested that growth rates as well as profits tend to reveal large and sustained heterogeneity across firms, which does not diminish because of the competition process (Bottazzi et al., 2010; Bottazzi, Secchi, & Tamagni, 2007; Goddard et al., 2009; Peneder, 2008).

Overall, grounded on RBV and evolutionary economics considerations, we would expect that the relationship between growth and profits (and vice versa) would exist for some firms and not for others. In addition, we would also expect that this heterogeneity would be more likely to be present at the firm level rather than at the industry level.

2.3 Estimation methods to account for endogeneity and heterogeneity

2.3.1 The System GMM method

From a technical point of view, endogeneity appears when two variables exhibit a bi-directional relationship between them. In this context, OLS methods yield biased and inconsistent estimators, because endogeneity affects the orthogonality of the variables to the residual errors. One method to solve this problem is to introduce dynamic panel data models, i.e. models in which lagged values of the dependent variable are included as explanatory variables. As Bond (2002, p. 142) suggests, *'…even when coefficients on lagged dependent variables are not of direct interest, allowing for dynamics in the underlying process may be crucial for recovering consistent estimates of other parameters…'.*

However, dynamic panel data models introduces a further complexity since the lagged values of the dependent variable are correlated with the individual-specific fixed effects included in the error term, originating the 'dynamic panel' or 'Nickell bias' (Nickell, 1981). Importantly, this bias is not eliminated by using Fixed Effects (FE) estimators since the regressors and the error term continue to be correlated after such transformation (Bond, 2002; Roodman, 2006). This correlation between the transformed error and the transformed lagged dependent variable, though, does not diminish as the number of individuals in the sample increases, so the FE estimators remain inconsistent. Moreover, panel methods in general, and FE estimators in particular, can also be asymptotically biased (downwards) in panels where T is small (Bond, 2002).

In this context, Arellano & Bond (1991) proposed a GMM estimator for panel data which may deal with potentially endogenous regressors in dynamic panel data models. Regression equations are expressed in terms of their first differences, and endogenous variables are instrumented using lags of their own levels. This approach - which is known as 'Difference GMM' - has drawbacks of its own, however, as lagged levels may be weakly correlated with first differences. This may be the case when the lagged levels used as instruments are highly persistent. In our case, several studies affirm that firms' profits tend to be highly correlated (e.g. Bottazzi et al., 2006; Dosi, 2005).

To solve these problems, Arellano & Bover (1995) developed an improved estimator in which regressions are expressed in levels, and endogenous instruments in terms of their lagged differences, which is known as 'Level GMM'. Finally, Blundell & Bond (1998) combined both approaches to construct a system of equations known as 'System GMM', which includes both differences and levels to instrument endogenous variables.

System GMM has better asymptotic and finite sample properties than Difference GMM estimators (Arellano & Bond, 1991). In addition, System GMM uses differences equations to instrument endogenous regressors so they are also able to deal with time-invariant firm-specific attributes, i.e. heterogeneity. Therefore, System GMM estimators are suitable for this exercise because of their ability to deal with both endogeneity and heterogeneity. Finally, System GMM has been proposed as a suitable estimation method when the number of available time periods, *T*, is small, and the number of cross-sectional units, *N*, quite large, as in our case (Roodman, 2006)[6].

Nevertheless, the System GMM method has its own shortcomings. First, it requires additional moment conditions to be satisfied. It also requires orthogonality between the differences of the errors and the lagged levels of the variables used as instruments, and at the same time, orthogonality between firm-specific effects and the lagged differences of the variables used as instruments. Consequently, it is necessary to report specification tests on overidentifying restrictions to check the validity of the additional instruments. As well, System GMM requires that no second order serial correlation in the error terms is present. Finally, this type of GMM estimation could be harmed by employing too many instruments. This has been highlighted and analysed by Roodman (2009). Therefore, some attention should be taken when estimating such models since too many requirements must be in place to assure the desirable asymptotic properties of System GMM in finite samples.

2.3.2 The Hurlin test

In addition to the previous methods, we profit from a recent development in econometrics that helps us identify and test for the presence of heterogeneity in the relationship between two variables: the Hurlin test. Rooted in Granger causality literature, Hurlin (2007) and Dumitrescu & Hurlin (2012) propose an approach for evaluating causal relationships in heterogeneous panels that is increasingly used by the literature (Erdil & Yetkiner, 2009; Hood III, Kidd & Morris, 2008; Hurlin & Venet, 2008).

This approach suggests that, in the context of heterogeneous panel data, four different hypotheses could be established as regards causality. The first, homogenous non-causality (HNC) implies that no individual causality exists from *x* to *y*. Conversely, homogeneous causality (HC) occurs when there is the same causal relationship from *x* to *y* for all the individuals. The other two cases correspond to heterogeneous processes. Firstly, there is heterogeneous causality (HEC), which implies that for all the individuals in the sample one could find a causal relationship from *x* to *y*, but that this relationship is unique for any individual. Finally, the heterogeneous non-causality hypothesis (HENC) posits that there is a subgroup of individuals for which there is a causal relationship from *x* to *y*, while at the same time there is another subgroup of individuals for which *x* does not cause *y* (Dumitrescu & Hurlin, 2012; Hurlin, 2004).

[6] For a deeper discussion of the properties of GMM estimators, see Bond (2002) and Roodman (2006, 2009).

The proposed test starts from a linear model such as the following:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t}$$

where *y* and *x* are two stationary variables observed on *T* periods and on *N* individuals. For simplicity, individual effects α_i are assumed to be fixed. In addition, lag orders *K* are assumed to be identical for all cross-sections units of the panel, and the panel is balanced. Finally, parameters $\gamma_i^{(k)}$ and $\beta_i^{(k)}$ are different across individuals but constant, i.e. it is a fixed coefficient model with fixed individual effects.

The Hurlin test compares the null hypothesis of HNC against the alternative HENC. If the null hypothesis (HNC) is accepted, the variable *x* does not Granger-cause the variable *y* for all the cross-sectional units. Under the alternative hypothesis (HENC), we allow for some $N_1 < N$ individual processes with no causality from *x* to *y*.

$$H_1 \begin{cases} \beta_i = 0 & \forall_i = 1,...N_1 \\ \beta_i \neq 0 & \forall_i = N_1+1, N_1+2...N \end{cases}$$

where N_1 is unknown but satisfies $0 \leq N_1/N < 1$.

In other words, if HNC is rejected and if $N_1 = 0$, we can confirm that the variable *x* Granger-causes *y* for all the individuals in the panel. In this case, we also get a homogeneous result in terms of the causal relationship. Finally, if HNC is rejected and $N_1 > 0$, the causal relationship may be heterogeneous and differs according to the cross-sectional units in question[7].

This test is based on a new statistic which results from averaging individual Wald statistics, like the unit root test for heterogeneous panels widely used by the literature (Im, Pesaran, & Schin, 2003). In less technical terms, this test computes *N* individual regressions, one for each cross-sectional unit, estimating the individual Wald statistic for the explanatory variable of interest. Then it averages the *N* individual Wald tests to obtain the standardized average Wald statistic – the *Z-tilde* value - and finally compares this value with the corresponding critical value for a given level of confidence. Hurlin (2007) demonstrates that the standardized average Wald statistic – *Z-tilde* – converges to a normal distribution as long as $T > 5+2K$ where *K* is the

[7] Although we recognize that the whole idea of Granger causality that underlies Hurlin's approach may be criticisable, we consider this test to be of particular importance for testing the existence of inter-firm heterogeneity in the profit-growth relationship.

number of lags. In addition, for the moment conditions to hold, series are assumed to be cross-sectionally independent and panels must be strongly balanced[8].

In sum, endogeneity and heterogeneity are key aspects of the profits-growth relationship from a theoretical perspective. At the same time, both pose important technical issues that need to be properly addressed. In this vein, our empirical analysis is based on new estimation methods that allow us to explicitly take into account these features of the profit-growth link.

2.4 Data, variables and empirical models

2.4.1 Data and sample

Data for this study are taken from the SABI© (*Sistema de Análisis de Balances Ibéricos*) database, collected and provided by Bureau Van Dijk and based on the Official Registry of Spanish Companies. This database has been increasingly used by researchers in the small business economics literature (e.g. Hernández-Cánovas & Martínez-Solano, 2008; Nunes et al., 2013; Teruel-Carrizosa, 2010).

This paper is based on a single cohort of young Spanish manufacturing firms (i.e., NACE Rev. 2 2-digit Classification codes 10 to 33). All firms which were created from January 1 to December 31 1996 and were followed over a 14-year period, from 1997 to 2010. Since we are interested in young firm growth, we focus in 'organic' (i.e. internal) growth. Internal growth is not only the most common path of growth followed by young firms (Delmar, Davidsson, & Gartner, 2003) but it also reflects to a greater extent our theoretical framework. Consequently, those firms which control other firms and those controlled by another firm were removed from an initial list extracted from the SABI© database, leaving only those which are fully independent in the panel.

We started with an initial list of 2,446 firms from which we removed those firms without values in sales, results, added value and/or employment in the first two years (1997-98) i.e. firms with less than 2 consecutive years of data (or at least one year of growth). As a result, we had to eliminate 1,251 firms, leading to a list of 1,195 firms. From this list, we then eliminated those firms with interrupted spells in the series, which were 269, arriving at a final sample of 926 firms. The initial list and this final sample were compared in terms of industry sector and region and the results showed no statistically significant differences at the 5% level, except for four industries (out of 23) and one region (out of seventeen). Importantly, it should also be

[8] A full detailed discussion of the asymptotic properties of the average Wald statistic for fixed T samples can be seen in Hurlin (2007) and Dumitrescu & Hurlin (2012).

noted that our sample not only reflects to a great extent the industry and geographical composition of the Spanish manufacturing firms, but also it presents the same industry and regional composition than the original data drawn from the SABI© registers [9].

Survival (or attrition) bias has been pointed out as a major shortcoming in growth studies (Davidsson, Delmar, et al., 2006; Garnsey et al., 2006; Geroski, 1998). In order to avoid this, we use an unbalanced panel that starts with 926 manufacturing firms in 1997 of which 689 still exist in 2010. Although it is recognized that exit may result from different factors than failure, given the fact that this panel only comprises data from seemingly independent firms, it is more likely that those firms which cease to provide SABI© with information may constitute real failure-based 'exiters'. However, as SABI© includes mostly limited liability and public companies, there could be a certain underestimation of firm exit.

2.4.2 Variables and summary statistics

A variety of measures of firm growth have been used in the literature (e.g. Shepherd & Wiklund 2009; Weinzimmer et al. 1998). To facilitate comparability with other research (Bottazzi et al., 2011, 2006; Coad & Broekel, 2012; Coad, 2007c), we have adopted the following definition of growth, based on the differences in the logarithms of size.

$$GROWTH_{it} = \log(SIZE_{it}) - \log(SIZE_{it-1})$$

Where $SIZE_{it}$ is measured by SALES for firm i at time t. We decide to employ SALES GROWTH as our measure of young firm growth mainly for theoretical reasons. Since our conceptual framework is mainly based on the evolutionary perspective and the market selection mechanism, we choose sales growth because it better reflects firms' market activity and their capacity to sell their products. In effect, sales growth provides an indication of the acceptance of the new firm's products or services in the market (Gilbert et al., 2006). Therefore, it is the preferred indicator for founders and owner-managers of new and young firms, whereas other indicators such as employment growth are not seen by them as a goal in itself (Achtenhagen, Naldi, & Melin, 2010). In addition, we use this measure to ensure comparability with previous studies about the profit-growth relationship (Bottazzi et al., 2010; Coad, 2007c; Delmar et al., 2013).

[9] In order to check for the external an internal validity of this sample we estimate several tests for proportions (z-test) comparing this sample with the initial population drawn from the SABI© registers, the Spanish National Firms Registry *(Directorio Central de Empresas)* and other comparable statistics on the manufacturing sectors in other EU countries and the US. In all these cases, only few significant differences were found. These tests and tables are reported in the Statistical Appendix.

In the same way, our choice of a profit measure is consistent with our focus on the market selection mechanism for young firms. We therefore are interested in evaluating the commercial viability of young firms in its basic form, as an indicator of the degree of fitness between firms' activities and the market. Hence, we choose firms' gross operating surplus (GOS) as our profit measure. In particular, we have adopted the same profit ratio as Coad (2007b) where GOS is divided by value added. Specifically, gross operating surplus at *t* is divided by value added at *t-1* to '*avoid spurious results associated with the regression fallacy*' (Coad, 2007c, p. 375).

Table 2.1 shows a set of descriptive statistics for selected years, which offer the reader a first approach to the variables used in this research. Growth rates as well as the inter-firm variation of these tend to diminish as firms age, even in the case of young businesses like those included in this study, supporting previous research (e.g. Stam, 2010; Sutton, 1997). Likewise, profits – measured by our GOS/value added ratio – also diminish. Finally, it is worth noting that both growth and profit rates tend to be negative (on average) at the end of the period under study as a potential result of the downturn in macroeconomic conditions derived from the global financial crisis.

Table 2.1. Summary statistics

	Mean	SD	10%	25%	Median	75%	90%	Obs.
1998								
Sales (in 000 Euros)	1,031.73	12,214.14	81,0	142,0	292.3	550,5	1108,0	926
Sales Growth	1.08	1.17	-0.11	0.25	0.93	1.86	2.56	926
Gross Operating Surplus (in 000 Euros)	64.29	860.75	-5.0	3.0	10.0	31.0	78.0	926
Profit Ratio	0.25	1.47	-0.10	0.06	0.17	0.34	0.60	718
Employment	8.18	35.17	2.0	3.0	5.0	8.0	12.0	921
Growth-Profit Pairwise correlation (p-value)		0.0565 (0.1304)						
Growth-Profit Spearman´s rho (p-value)		0.2016 (0.0000)						
2003								
Sales (in 000 Euros)	1,642.75	19,610.66	125.0	234.0	460.0	876.0	1,873.0	882
Sales Growth	0.04	0.25	-0.22	-0.07	0.03	0.16	0.31	882
Gross Operating Surplus (in 000 Euros)	96.49	1,422.19	-5.0	4.0	15.0	42.0	102.0	884
Profit Ratio	0.13	0.26	-0.06	0.03	0.11	0.20	0.35	884
Employment	11.26	39.44	2.0	4.0	6.0	11.0	20.0	881
Growth-Profit Pairwise correlation (p-value)		0.2130 (0.0000)						
Growth-Profit Spearman´s rho (p-value)		0.2729 (0.0000)						
2010								
Sales (in 000 Euros)	1,883.54	21,532.84	92.0	190.0	406.0	867.0	1,662.0	689
Sales Growth	-0.06	0.40	-0.40	-0.18	-0.02	0.11	0.28	689

Gross Operating Surplus (in 000 Euros)	79.42	1,647.68	-49.0	-8.50	8.0	30.0	93.0	696
Profit Ratio	-0.03	1.48	-0.41	-0.09	0.06	0.15	0.28	696
Employment	10.01	35.01	2.0	3.0	5.0	10.0	17.0	699
Growth-Profit Pairwise correlation (p-value)		0.1362 (0.0003)						
Growth-Profit Spearman´s rho (p-value)		0.3555 (0.0000)						

Note: Following Coad et al. (2011), Spearman's rank coefficient is included since this is more robust to the presence of outliers and fat-tails.
Source: Own elaboration based on SABI©.

Table 2.1 also shows the contemporaneous correlation between sales growth and profits for selected years. As in previous research (Coad & Broekel, 2012; Coad et al., 2011), sales growth and profits appear to be contemporaneously correlated but this positive correlation is far from perfect. This result could also reflect the existence of industry-specific as well as individual attributes that affect the relationship between growth and profits. Table 2.2 shows the correlation coefficients between growth and profits according to the industry sector.

Table 2.2. Contemporaneous Correlation Matrix by Industry Sector

Industry Sector (NACE Rev. 2)	**Pairwise correlation**	**Spearman's rho**	**Obs.**	**Industry Sector (NACE Rev. 2)**	**Pairwise correlation**	**Spearman's rho**	**Obs.**
10	0.0458	**0.2840**	1200	23	**0.2240**	**0.4145**	725
11	0.0593	**0.3281**	173	24	**-0.3660**	**0.1803**	177
13	0.0841	**0.3278**	369	25	**0.2426**	**0.3870**	1797
14	**0.2497**	**0.2966**	311	26	**0.4164**	**0.5009**	166
15	**0.2080**	**0.3463**	302	27	**0.1844**	**0.4069**	155
16	**0.2320**	**0.3446**	726	28	0.0144	**0.4221**	647
17	**0.2297**	**0.4171**	181	29	**0.2962**	**0.3238**	133
18	0.0187	**0.3399**	1258	31	**0.1915**	**0.3526**	702
20	0.0969	**0.2603**	366	32	**0.3123**	**0.3282**	347
22	**0.2325**	**0.3350**	458	33	**0.0986**	**0.3895**	537

Note: Cells in bold are statistically significant at 95%. Following Coad et al. (2011), Spearman's rank coefficients are included since these are more robust to the presence of outliers and fat-tails.
Source: Own elaboration based on SABI©.

As can be seen, although almost all the coefficients are positive and highly significant, there is an important inter-industry heterogeneity. The largest correlation coefficient (Spearman's rho) is 0.50, while the lowest is 0.18.

2.4.3 Empirical models

In order to analyse the proposed relationship between profits and growth, we estimate the following general equations:

$$(1)\quad GROWTH_{it} = \alpha + \sum_{k=1}^{2} \beta_k GROWTH_{it-k} + \sum_{k=1}^{2} \delta_k PROFITS_{it-k} + $$
$$+ \gamma EMPLOYMENT_{it-1} + \sum \lambda_t YEAR_t + \sum \varphi_i INDUSTRY_i + \sum \rho_i REGION_i + \varepsilon_{it}$$

$$(2)\quad PROFITS_{it} = \alpha + \sum_{k=1}^{2} \beta_k PROFITS_{it-k} + \sum_{k=0}^{2} \delta_k GROWTH_{it-k} + $$
$$+ \gamma EMPLOYMENT_{it-1} + \sum \lambda_t YEAR_t + \sum \varphi_i INDUSTRY_i + \sum \rho_i REGION_i + \varepsilon_{it}$$

where $GROWTH_{it}$ refers to the sales growth rate for each firm in t and $PROFITS_{it}$ our profit ratio for each firm, measured by the GOS/value added. For comparison purposes, our model specifications resemble those used by Coad (2007b). Equation (1) represents our GROWTH model, where current growth is estimated using a set of lagged values of profits - more explicitly form *t-1* to *t-2* - to account for the importance of retained profits in explaining firm growth, as the main reviewed literature states. Equation (2), in turn, corresponds to our PROFIT equation, which not only includes lagged values of sales growth (*t-1* and *t-2*) but also includes the contemporaneous term of growth ($growth_{it}$) to test our theoretical expectation about a positive simultaneous effect of growth on profits derived from learning-by-doing gains and dynamic increased returns verified *as long as* firms grow.

In addition, lagged values of the dependent variables are introduced in each Equation to account for possible omitted variables, to attenuate any autocorrelation in the residuals and to improve the efficiency of the estimators in the presence of endogenous variables. In particular, following Bottazzi et al. (2011) suggestion we introduce two lags of the dependent variable as control variables. Adding further lags will reduce critically the number of observations and may not imply an improvement in the explanatory power of the model.

Lagged firm EMPLOYMENT is also included in both Equations to account for other firm-specific factors. In addition, we include YEAR dummies to consider cyclical macroeconomic influences, and especially the effect of the recent global crisis, which started in 2008 and still has some impact on the Spanish economy. Finally, INDUSTRY and REGIONAL dummies are also included as controls.

As we established in the previous section, we estimate equations (1) and (2) using a set of different estimation methods, including OLS, FE, Diff-GMM and finally System GMM, which is our preferred method, since it provides suitable estimations in the case of endogenous regressors and heterogeneous small T, large N samples. Arguably, one could suspect that the relationship between growth and profits could vary over the period under study. Therefore, we run the same regressions (equations 1 and 2) using different T (T=4 and T=7) in order to check the robustness of our results.

Finally, to calculate Hurlin's test of heterogeneity we estimate the following equations:

(3)
$$GROWTH_{it} = \alpha + \sum_{k=1}^{2} \beta_k GROWTH_{it-k} + \sum_{k=1}^{2} \delta_k PROFITS_{it-k} + \\ + \gamma EMPLOYMENT_{it-1} + \lambda AGE_{it} + \varepsilon_{it}$$

(4)
$$PROFITS_{it} = \alpha + \sum_{k=1}^{2} \beta_k PROFITS_{it-k} + \sum_{k=0}^{2} \delta_k GROWTH_{it-k} + \\ + \gamma EMPLOYMENT_{it-1} + \lambda AGE_{it} + \varepsilon_{it}$$

where $GROWTH_{it}$ and $PROFITS_{it}$ are the same variables explained before. We also add firm AGE and lagged firm EMPLOYMENT to avoid the risk of spurious causality[10]. Since the Hurlin test requires balanced panels, we only ran this test for those firms that survived the 14 years considered by this study and recognizing that this fact may introduce some bias in the data.

Following our expectations described in section 2.3, heterogeneity at the firm level could be more likely to be present than at the industry level. Hence, we calculated the median for each year and industry sector as an indicator of the average firm in each case and then we ran the Hurlin test on the medians. By doing so, we were able to separate inter- and intra-industry heterogeneity[11]. As well, this exercise would serve to check the robustness of the obtained results at the firm level. The next sections describe and discuss the main results obtained from these estimations.

2.5 Main results

2.5.1 The dynamics between growth and profits

Table 2.3 shows the results for the GROWTH equation, i.e. the effect of lagged profits on current growth. We first report pooled OLS and Fixed Effects estimators. However, as we describe in section 2.3, OLS and FE regressions do not provide suitable estimators in the presence of endogenous and dynamic relationships. Indeed, concerning the effect of both, retained profits and previous growth, on current growth the results are not entirely consistent, in particular looking at their statistical significance. While none of the OLS estimators shows a

[10] In this case, we use firm AGE instead of YEAR dummies because as Hurlin´s test performs one single equation for each firm, we only have 14 observations, so we do not have enough degrees of freedom to include 14 dummy variables, one for each year. Therefore, we include AGE, which is a variable that controls almost for the same effect of the YEAR dummies since we are dealing with only one cohort.
[11] This idea was suggested by Dr. Walter Sosa Escudero. However, mistakes and omissions remain our responsibility.

statistically significant relationship, most of the FE estimators did, mainly those related with lagged values of the dependent variable.

For this reason, we present the estimation using Difference and System-GMM methods in the third and fourth column of Table 2.3, since they are more appropriate for dynamic panel data models in which some regressors are assumed to be endogenous, as in our case.

Table 2.3. Regression Results: Profits on GROWTH (Robust standard errors are reported in parentheses)

Dependent variable: $GROWTH_{it}$	**OLS**	**Fixed Effects**	**Diff-GMM**	**SYS-GMM**
$GROWTH_{it-1}$	-0.0250 (0.0237)	-0.1086*** (0.0309)	0.0086 (0.0388)	0.0267 (0.0347)
$GROWTH_{it-2}$	-0.0125 (0.0117)	-0.0464*** (0.0101)	-0.0077 (0.0119)	-0.0012 (0.0097)
$PROFITS_{it-1}$	-0.0128 (0.0100)	-0.0206 (0.0155)	-0.0206 (0.0296)	-0.0018 (0.0081)
$PROFITS_{it-2}$	-0.0014 (0.0024)	-0.0063 (0.0047)	0.0025 (0.0033)	0.0037 (0.0028)
$SIZE_{it-1}$	0.0000 (0.0000)	-0.0032*** (0.0000)	0.0011 (0.0019)	0.0011 (0.0021)
YEAR DUMMIES				
2001	-0.0690*** (0.0188)	-0.1056*** (0.0166)	-0.0711*** (0.0173)	-0.0628*** (0.0157)
2002	-0.0925*** (0.0194)	-0.1331*** (0.0181)	-0.0888*** (0.0193)	-0.0757*** (0.0176)
2003	-0.0932*** (0.0189)	-0.1414*** (0.0180)	-0.0919*** (0.0200)	-0.0754*** (0.0178)
2004	-0.1084*** (0.0192)	-0.1563*** (0.0177)	-0.1087*** (0.0202)	-0.0928*** (0.0173)
2005	-0.0871*** (0.0181)	-0.1368*** (0.0175)	-0.0890*** (0.0219)	-0.0701*** (0.0179)
2006	-0.0782*** (0.0199)	-0.1265*** (0.0178)	-0.0856*** (0.0256)	-0.0581*** (0.0185)
2007	-0.0848*** (0.0195)	-0.1320*** (0.0172)	-0.0972*** (0.0220)	-0.0666*** (0.0182)
2008	-0.2381*** (0.0204)	-0.2867*** (0.0186)	-0.2567*** (0.0238)	-0.2228*** (0.0182)
2009	-0.4078*** (0.0222)	-0.4728*** (0.0203)	-0.4347*** (0.0253)	-0.3905*** (0.0203)
2010	-0.2106*** (0.0255)	-0.3023*** (0.0222)	-0.2348*** (0.0311)	-0.1734*** (0.0259)
INDUSTRY DUMMIES	YES	NO	NO	YES
REGIONAL DUMMIES	YES	NO	NO	YES
Constant	0.1630*** (0.0402)	0.2329*** (0.0177)		0.1213*** (0.0492)

R squared (overall)	0.1067	0.0308		
R squared (within)		0.1296		
F test (p-value)	18.77 (0.0000)	57.35 (0.0000)		
Wald Chi (p-value)			594.35 (0.000)	974.71 (0.000)
AR(1) z-test (p-value)			-10.34 (0.000)	-10.59 (0.000)
AR(2) z-test (p-value)			0.04 (0.971)	0.13 (0.899)
Number of instruments			21	63
Hansen test (p-value)			5.23 (0.515)	8.90 (0.632)
Difference-in-Hansen test for GMM instruments (p-value)				4.89 (0.430)
Number of Observations	8,871	8,871	7,954	8,871
Number of Groups		912	898	912

Note:*, **, and *** denote coefficients which are statistically significant at 10%, 5%, and 1%, respectively. Robust standard errors in System GMM report Windmeijer (2005) small-sample correction for the two-step standard errors. Following Roodman (2009)suggestions, we limited the lag length used as instruments to 3 years and we collapsed the instrument matrix. The corresponding tests of instrument validity used are also reported in each table. We report the Hansen J test instead of the more common Sargan test because it is more robust to heteroscedasticity and autocorrelation.
TIME DUMMIES are included in all specifications, using year 2000 as the reference category.
INDUSTRY and REGIONAL dummies are only introduced in the OLS and System GMM estimations. They are removed from FE and Diff-GMM equations since these methods use first differences of the variables.

The results of both equations indicate that, after controlling for endogeneity and dynamic panel bias, previous profits do not exert neither a statistically significant nor an empirically relevant influence on sales growth. In other words, coefficients are not significant and very small.

Additionally, under both GMM specifications none of the lagged values of growth shows an empirically relevant or statistically significant relationship with current growth. This provides evidence in favour of to the growth-as-a random-walk perspective. Year dummies, on the contrary, are the only variables that have a statistically significant effect on sales growth. As we anticipated in the descriptive statistics, growth rates tend to diminish throughout our studied period and particularly during the last three years reflecting the impact of the financial crisis over the Spanish economy. Indeed, the size of the coefficients for the 2008-2010 dummies are more than ten times higher than for the rest of the year dummies.

The influence of sales growth on profits is shown in Table 2.4. Again, we report different estimation methods, although our preferred estimation is System GMM for the same reasons explained before. In this case, the results confirm our expectation of a positive effect of sales growth on current profits. In fact, under the System-GMM estimation an increase in the growth rate of sales of 1% over the period t−1: t leads *ceteris paribus* to an increase in the profit rate at time t of about 0.26%. However, the relevance of this influence vanishes as we consider longer lags, suggesting that this effect is immediate.

Table 2.4. Regression Results: Growth on PROFITS (Robust standard errors are reported in parentheses)

Dependent variable: $PROFITS_{it}$	**OLS**	**Fixed Effects**	**Diff-GMM**	**SYS-GMM**
$PROFITS_{it-1}$	0.2762* (0.1651)	0.0569 (0.1055)	0.1250 (0.1254)	0.1174*** (0.0378)
$PROFITS_{it-2}$	0.0360 (0.0278)	0.0061 (0.0160)	0.0016 (0.0124)	-0.0020 (0.0092)
$GROWTH_{it}$	0.2547*** (0.0699)	0.2303*** (0.0866)	0.2838*** (0.0667)	0.2565*** (0.0558)
$GROWTH_{it-1}$	0.0212 (0.1102)	0.0411 (0.1265)	0.0823* (0.0466)	0.0550 (0.0455)
$GROWTH_{it-2}$	0.0048 (0.0530)	-0.0100 (0.0625)	0.0212* (0.0125)	0.0152 (0.0125)
$SIZE_{it-1}$	0.0001*** (0.0000)	-0.0005 (0.0007)	-0.0007 (0.0015)	0.0032 (0.0028)
YEAR DUMMIES				
2001	0.0011 (0.0596)	0.0080 (0.0549)	0.0175 (0.0269)	0.0000 (0.0261)
2002	0.0072 (0.0673)	0.0124 (0.0650)	0.0275 (0.0297)	0.0041 (0.0260)
2003	0.0044 (0.0725)	0.0066 (0.0712)	0.0231 (0.0304)	-0.0000 (0.0259)
2004	-0.0156 (0.0741)	-0.0175 (0.0743)	0.0074 (0.0323)	-0.0184 (0.0278)
2005	-0.0738 (0.0886)	-0.0812 (0.0916)	-0.0367 (0.0436)	-0.0522 (0.0336)
2006	-0.0179 (0.0658)	-0.0412 (0.0671)	-0.0130 (0.0334)	-0.0416 (0.0269)
2007	0.0332 (0.0699)	0.0121 (0.0710)	0.0433 (0.0345)	0.0133 (0.0269)
2008	-0.0246 (0.0826)	-0.0345 (0.0836)	0.0122 (0.0402)	-0.0165 (0.0324)
2009	-0.2790 (0.3136)	-0.3080 (0.3206)	-0.0758 (0.0519)	-0.0963 (0.0411)

2010	-0.0756 (0.1103)	-0.1527 (0.1455)	-0.0797 (0.0786)	-0.1076 (0.0677)
INDUSTRY DUMMIES	YES	NO	NO	YES
REGIONAL DUMMIES	YES	NO	NO	YES
Constant	0.0203 (0.0916)	0.1159 (0.0913)		0.1516 (0.1419)
R squared (overall)	0.0177	0.0084		
R squared (within)		0.0062		
F test (p-value)	9.44 (0.0000)	16.27 (0.0000)		
Wald Chi (p-value)			115.04 (0.000)	293.84 (0.000)
AR(1) z-test (p-value)			-1.27 (0.203)	-1.54 (0.124)
AR(2) z-test (p-value)			0.64 (0.525)	0.45 (0.651)
Number of instruments			22	65
Hansen test (p-value)			7.12 (0.310)	13.21 (0.354)
Difference-in-Hansen test for GMM instruments (p-value)				7.22 (0.301)
Number of Observations	8,871	8,871	7,954	8,871
Number of Groups		912	898	912

Note:*, **, and *** denote coefficients which are statistically significant at 10%, 5%, and 1%, respectively. Robust standard errors in System GMM report Windmeijer (2005) small-sample correction for the two-step standard errors. Following Roodman (2009)suggestions, we limited the lag length used as instruments to 3 years and we collapsed the instrument matrix. The corresponding tests of instrument validity used are also reported in each table. We report the Hansen J test instead of the more common Sargan test because it is more robust to heteroscedasticity and autocorrelation.
TIME DUMMIES are included in all specifications, using year 2000 as the reference category.
INDUSTRY and REGIONAL dummies are only introduced in the OLS and System GMM estimations.
They are removed from FE and Diff-GMM equations since these methods use first differences of the variables.

In addition, our results indicate a positive and statistically significant effect only for the one-year lagged value of profits on current profits. This shows that, unlike sales growth rates, profits may show some persistence over time, but fundamentally in the short run. Unlike the GROWTH equation, year dummies do not show here a statistically significant relationship with profits.

As noted before, one could suspect that the relationship between growth and profits may vary over the period under study and that the results we have found could be different if we take different T, reflecting the presence of some age-effects[12]. Therefore, we run the same equations using System GMM estimators for T=4 and T=7 and compared the results with the fourth column of Tables 2.3 and 2.4 (T=11). Tables 2.5 and 2.6 present the results for the GROWTH and PROFIT equations, respectively.

Table 2.5. Robustness tests: SYS-GMM Regression Results using different T (Robust standard errors are reported in parentheses)

Dependent variable: $GROWTH_{it}$	**T=4**	**T=7**	**T=11**
$GROWTH_{it-1}$	0.0355 (0.0420)	0.0192 (0.0340)	0.0267 (0.0347)
$GROWTH_{it-2}$	0.0038 (0.0102)	0.0149 (0.0120)	-0.0012 (0.0097)
$PROFITS_{it-1}$	-0.0389 (0.0422)	-0.0077 (0.0199)	-0.0018 (0.0081)
$PROFITS_{it-2}$	0.0022 (0.0022)	0.0038 (0.0023)	0.0037 (0.0028)
$SIZE_{it-1}$	-0.0000 (0.0003)	0.0003 (0.0005)	0.0011 (0.0021)
YEAR DUMMIES			
2001	-0.0535*** (0.0166)	-0.0477*** (0.0170)	-0.0628*** (0.0157)
2002	-0.0654*** (0.0174)	-0.0585*** (0.0187)	-0.0757*** (0.0176)
2003	-0.0681*** (0.0185)	-0.0597*** (0.0193)	-0.0754*** (0.0178)
2004		-0.0743*** (0.0184)	-0.0928*** (0.0173)
2005		-0.0559*** (0.0198)	-0.0701*** (0.0179)
2006		-0.0482*** (0.0211)	-0.0581*** (0.0185)
2007			-0.0666*** (0.0182)
2008			-0.2228*** (0.0182)
2009			-0.3905*** (0.0203)
2010			-0.1734*** (0.0259)
INDUSTRY DUMMIES	YES	YES	YES

[12] We thank an anonymous reviewer for this suggestion.

REGIONAL DUMMIES	YES	YES	YES
Constant	0.3209* (0.1783)	0.1074*** (0.0333)	0.1213*** (0.0492)
Wald Chi (p-value)	92.18 (0.000)	117.46 (0.000)	974.71 (0.000)
AR(1) z-test (p-value)	-9.94 (0.000)	-9.03 (0.000)	-10.59 (0.000)
AR(2) z-test (p-value)	-0.78 (0.436)	-1.26 (0.209)	0.13 (0.899)
Number of instruments	56	59	63
Hansen test (p-value)	8.11 (0.703)	14.33 (0.215)	8.90 (0.632)
Difference-in-Hansen test for GMM instruments (p-value)	3.34 (0.647)	6.41 (0.268)	4.89 (0.430)
Number of Observations	3,367	5,920	8,871
Number of Groups	911	912	912

Note:*, **, and *** denote coefficients which are statistically significant at 10%, 5%, and 1%, respectively. Robust standard report Windmeijer (2005) small-sample correction for the two-step standard errors. Following Roodman (2009) suggestions, we limited the lag length used as instruments to 3 years and we collapsed the instrument matrix. The corresponding tests of instrument validity used are also reported in each table. We report the Hansen J test instead of the more common Sargan test because it is more robust to heteroscedasticity and autocorrelation. TIME DUMMIES are included in all specifications, using year 2000 as the reference category.

Concerning the influence of previous profits on growth, the results for T=4 and T=7 confirm those reported previously. Neither retained profits nor lagged values of sales growth seem to affect current sales growth. Only the year dummies appear to be statistically related with growth. Similarly, the PROFIT equations (Table 2.6) show that the results do not change when considering shorter time periods. As we explained before, sales growth and previous profits positively affect current profits whilst none of the year dummies is statistically significant.

Table 2.6. Robustness tests: SYS-GMM Regression Results using different T (Robust standard errors are reported in parentheses)

Dependent variable: $PROFITS_{it}$	**T=4**	**T=7**	**T=11**
$PROFITS_{it-1}$	0.2412*** (0.0790)	0.1021*** (0.0246)	0.1174*** (0.0378)
$PROFITS_{it-2}$	0.0050 (0.0032)	-0.0004 (0.0063)	-0.0020 (0.0092)
$GROWTH_{it}$	0.2364*** (0.0507)	0.1957*** (0.0323)	0.2565*** (0.0558)

$GROWTH_{it-1}$	-0.0650 (0.0456)	0.0158 (0.0269)	0.0550 (0.0455)
$GROWTH_{it-2}$	0.0132 (0.0128)	0.0130 (0.0134)	0.0152 (0.0125)
$SIZE_{it-1}$	0.0005 (0.0003)	0.0007 (0.0005)	0.0032 (0.0028)
YEAR DUMMIES			
2001	-0.0156 (0.0237)	-0.0084 (0.0239)	0.0000 (0.0261)
2002	-0.0167 (0.0232)	-0.0096 (0.0249)	0.0041 (0.0260)
2003	-0.0219 (0.0228)	-0.0149 (0.0247)	-0.0000 (0.0259)
2004		-0.0340 (0.0263)	-0.0184 (0.0278)
2005		-0.0441 (0.0281)	-0.0522 (0.0336)
2006		-0.0553^{**} (0.0254)	-0.0416 (0.0269)
2007			0.0133 (0.0269)
2008			-0.0165 (0.0324)
2009			-0.0963 (0.0411)
2010			-0.1076 (0.0677)
INDUSTRY DUMMIES	YES	YES	YES
REGIONAL DUMMIES	YES	YES	YES
Constant	0.1441 (0.1607)	0.0215 (0.0596)	0.1516 (0.1419)
Wald Chi (p-value)	179.77 (0.0000)	195.48 (0.000)	293.84 (0.000)
AR(1) z-test (p-value)	-3.18 (0.000)	-1.16 (0.245)	-1.54 (0.124)
AR(2) z-test (p-value)	-0.53 (0.594)	-1.30 (0.194)	0.45 (0.651)
Number of instruments	58	61	65
Hansen test (p-value)	21.57 (0.043)	16.70 (0.161)	13.21 (0.354)
Difference-in-Hansen test for GMM instruments (p-value)	13.98 (0.030)	8.51 (0.203)	7.22 (0.301)
Number of Observations	3,367	5,920	8,871
Number of Groups	911	912	912

Note:*, **, and *** denote coefficients which are statistically significant at 10%, 5%, and 1%, respectively. Robust standard report Windmeijer (2005) small-sample correction for the two-step standard errors. Following Roodman (2009) suggestions, we limited the lag length used as instruments to 3 years and we collapsed the instrument matrix. The corresponding tests of instrument validity used are also reported in each table. We report the Hansen J test instead of the more common Sargan test because it is more robust to heteroscedasticity and autocorrelation. TIME DUMMIES are included in all specifications, using year 2000 as the reference category.
As the Hansen´s tests show the instrument matrix used in the T=4 regression do not satisfy the exogeneity and over identifying conditions, so these results should be taken with caution.

In sum, our results show that after accounting for endogeneity and dynamic panel bias, sales growth leads to profits but not the other way round. In addition, our results indicate that profits seem to exhibit a greater persistence over time than growth, which suggests some degree of randomness in young firm growth. Importantly, these results hold when using different time lengths.

2.5.2 Testing for heterogeneity in the relationship between growth and profits

In this section, we present the main results derived from Hurlin's (2007) approach to identify the presence of heterogeneity in the relationship between profits and growth. Table 2.7 shows the results for the Hurlin test at the firm level, presenting averaged Wald statistics and the standardized *Z-tilde* values. In this case, the homogeneous non-causality hypothesis (HNC) is significantly rejected by both the PROFITS and GROWTH equations. More precisely, for some firms among the sample lagged profits would affect growth whilst at the same time this not holds for others. Similarly, there would be a subgroup of firms for which growth affects profits and another subgroup for which this is not true. In other terms, the results of the Hurlin test at the firm level confirm our expectations showing that the relationship between profits and growth – in either direction – is significantly influenced by individual-specific heterogeneity. The same is observed when a second order lag is introduced.

Table 2.7. Hurlin test

From Growth to PROFITS	**1-Lag**	**2-Lag**
Average Wald statistic (W_{HNC})	4.8284	4.5155
Standardized Average Wald statistic (Z_{HNC})	40.4317***	15.2331***
From Profits to GROWTH	**1-Lag**	**2-Lag**
Average Wald statistic (W_{HNC})	2.2786	2.9021
Standardized Average Wald statistic (Z_{HNC})	11.3315***	7.0828***

Note:*, **, and *** denote coefficients which are statistically significant at 10%, 5%, and 1%, respectively. Z_{HNC} values are estimated according to Hurlin's (2007) specifications.

A different picture emerges when analysing the extent to which heterogeneity affects such relationship at the industry level. As Table 8 shows, HNC could only be significantly rejected in the PROFITS equation. That is, at the industry level we could only affirm the existence of a heterogeneous relationship from firm growth to profits but not vice-versa. In other words, this analysis reveals that the existence of an effect of growth on profits may differ across industries, while the same is not true regarding the effect of retained profits on firm growth. Overall, our results show that heterogeneity in the relationship between growth and profits – in either direction- derives from both inter- and intra-industry differences, but that it is mainly present at the firm-level, in accordance to our expectations.

Table 2.8. Hurlin test (using industry averages)

From Growth to PROFITS	**1-Lag**	**2-Lag**
Average Wald statistic (W_{HNC})	4.1281	3.0999
Standardized Average Wald statistic (Z_{HNC})	5.5268***	1.3769
From Profits to GROWTH	**1-Lag**	**2-Lag**
Average Wald statistic (W_{HNC})	1.3350	3.1825
Standardized Average Wald statistic (Z_{HNC})	0.0958	1.4481

Note:*, **, and *** denote coefficients which are statistically significant at 10%, 5%, and 1%, respectively. Z_{HNC} values are estimated according to Hurlin's (2007) specifications.

2.6 Discussion, limitations and future research directions

This paper has investigated the profits-growth relationship in the context of young firms by explicitly considering both endogeneity and heterogeneity issues. The main findings that emerge from our study are now presented and discussed, together with some limitations and future research directions.

2.6.1 The effect of profits on growth

First, while both resource-based and evolutionary perspectives suggest that past profits will enhance subsequent growth, we have argued that this may not necessarily be the case for young firms. Our results indeed show that, once we account for endogeneity, previous profits do not exert a significant influence on subsequent business growth. This finding contrasts with earlier evidence that showed a positive effect of profits on growth but did not account for endogeneity (e.g. Brush, Bromiley, & Hendrickx, 2000; Cho & Pucik, 2005; Cowling, 2004). However, this is in line with recent longitudinal studies controlling for endogenous regressors that found that past profits do not have a significant impact on firm growth rates (Bottazzi et al., 2010; Coad et al., 2011; Coad, 2007c; Delmar et al., 2013).

Our finding has a number of implications for theory. While previous research based on the RBV (Davidsson et al., 2009) affirm that above-average profitability is a prerequisite for achieving subsequent growth, we suggest two plausible arguments for why this could not be the case for young firms. Firstly, initial superior profits could be derived from firm strategic decisions undertaken in response to external (environmental) shocks rather than from superior resource-based differences in efficiency coming from within the firm. This is in consonance with the view that differential profits between firms may stem from the firm-specific responses to economy-wide shocks (Alessi, Barigozzi, & Capasso, 2013). As a result, these superior profits cannot be treated as sources of *sustained* competitive advantages. In fact, our results tend to support the volatility of such initial profits given the relatively low –but statistically significant- persistence observed in this variable over time.

Secondly, most young firms would have some difficulties to create an initial resource-based competitive advantage because of time compression diseconomies (Dierickx & Cool, 1989). Similarly, it is likely that young firms will not be able to exhibit a superior performance in terms of profits without growing enough to overcome their initial cost disadvantages (Steffens et al., 2009).

The lack of any significant effect of previous profits upon growth would also mean that the evolutionary 'growth of the fitter' principle does not hold for young firms (Coad, 2007c). The theoretical implication here is that market selection may operate on diverse degrees of efficiencies (fitness) and profits – in principle – could only provide a rather limited criterion for selection (Coad, 2007c; Srholec & Verspagen, 2012). In particular, we argue that for young firms market selection would operate initially on firm growth and survival rather than on profits. For entrepreneurs, this would explain why many of them tend to pursue growth-strategies in their earlier stages, because this constitutes a way of attracting angel investors and external capital (Mason & Stark, 2004). Also, they may be affected by the perception that growth is proof of a working business model and will eventually lead to profitability (Brännback, Kiviluoto, Carsrud, & Östermark, 2010). Looking ahead, there is still a need to advance in our understanding of entrepreneurs' view of the growth processes in young firms and their relationship with profits (Achtenhagen et al., 2010; Garnsey et al., 2006; Garnsey, 1998). This calls for future research that explores such processes combining quantitative data with a longitudinal case study approach.

2.6.2 The effect of growth on profits

The second main finding that can be derived from our empirical analysis is that growth has a positive impact on profits. This result contrasts with those from Lee (2014) and Steffens et al. (2009) who conclude that young firms pursuing high-growth strategies early on their lives may perform poorly in terms of profits. On the contrary, our results are consistent with those reported by a number of recent studies which show that the influence of growth on subsequent profits is more important than the effect of retained profits on firm growth (Coad et al., 2011; Coad, 2007c; Delmar et al., 2013). Therefore, once we properly account for endogeneity, the positive impact of growth on profits tend to prevail over the assumed effect of retained profits on growth.

From a theoretical point of view, this finding confirms our expectation that learning-by-doing effects may be at play for young firms. By growing, entrepreneurs may learn how to produce and organize activities more efficiently, releasing and combining resources in different ways to obtain the most profitable outcome from them (Penrose, 1959). These learning- and experience-based effects take on a critical role in the case of young and newly founded firms, since they do not have well-established organizational routines nor sustained resource-based competitive advantages.

Learning gains are not only circumscribed to internal resources and capabilities. It could be also the case that, new firms do not start out in the most profitable segments of the market, unlike the Ricardian postulate. They would rather learn about their market and their product-market fit while they start to operate and grow. Hence, the growth of the firm may involve changing the use of existing resources to exploit new market opportunities and thus increasing the chances to earn additional profits (Lockett et al., 2011).

However, our results also indicate that the positive effect of growth on profits is fairly immediate (i.e. only current growth affects positively profits) supporting the transient nature of these Penrosean 'economies of growth'. In effect, as Lockett et al. (2011) showed, firms which have grown in the past will find it more difficult to grow in the future. This is because the time and effort required to coordinate an increasing amount of activities within the firm and the abilities of entrepreneurs to perceive new growth opportunities, which in turn, may be limited and may not last for long periods of time.

For entrepreneurs, this result may imply that growth itself is not sufficient to secure profits. Our judgement is that a suitable and flexible business model should accompany growth in order to capture the most profitable outcome of firm resources and capabilities as well to fully exploit potential market opportunities. Moreover, the continuous development and renewal of such resources and capabilities is key to assure a translation of growth into successive profits.

2.6.3 Heterogeneity in the profits-growth relationship

Our third main finding is that the relationship between growth and profits and vice versa is highly influenced by inter-firm heterogeneity. This result confirms our previous theoretical expectation and is in consonance with the results found by Bottazzi et al. (2010) who suggest that the growth-profits nexus depends on specific attributes of the firm. As Delmar et al. (2003) claim, it is almost impossible to refer to a 'typical growth firm'. Rather, firms could follow different patterns or modes of growth with diverse implications in terms of profits.

Therefore, our finding offers support to evolutionary and resource-based theorizing, which argue that firms have heterogeneous internal resources and organizational routines, and, consequently, they differ in terms of performance. Indeed, this result suggests that young firms tend to adopt differing strategies, even in the same sector or country, because they start from different resource bases and tend to interpret the environment differently (Srholec & Verspagen, 2012).

We have also found some evidence for inter-industry heterogeneity, but only in the growth to profits association. Such finding is consistent with studies that suggest that the link between growth and profits varies according to the industry, either in the case of manufacturing industries (Nakano & Kim, 2011) or in sectors with distinct technological regimes (Peneder, 2008). However, we were not able to find heterogeneous results when it comes to the profits to growth relationship at the industry level. This result is in line with some variance decomposition analyses which show that firm-specific attributes are more important in explaining differences in performance than industry-specific features (Goddard et al., 2009; Short et al., 2007). From an evolutionary perspective, we could conjecture that in complex markets where many local niches are present, selection pressures are less important (Srholec & Verspagen, 2012). Therefore, individual firm level choices, resources and capabilities and their performance implications could be still different even within the same industry sector. Overall, our study points to the existence of heterogeneity in the growth-profit relationship heterogeneity at the industry level, but fundamentally at the firm level.

However, while we have provided some insights into the heterogeneous relationship between profits and growth of young firms, we were not able to go deeper into this aspect because of data limitations. In particular, our dataset does not include variables associated with specific firm resources and capabilities at the firm level. Access to resources is a key factor in explaining the growth and development of this type of firms (e.g. Capelleras & Rabetino, 2008; Gilbert et al., 2006). Future studies might focus their attention not only on the presence of heterogeneity, but also on examining *what* specific firm-level variables affect the growth-profits relationship and *how*. In other words, our results point to the need for studies focused on the sources of inter-firm heterogeneity within particular environments. The identification of industry variables that may act as moderators of this relationship also constitutes a promising line for future research (Delmar et al., 2013). Hence, it would be interesting to explore the moderating role of specific firm and industry variables in the profits-growth relationship.

In this context, it should be emphasized that our analysis only comprises manufacturing firms, thus it is valid only for this subset of firms. Recently, there has been an increased interest in services firms. Arguably, one would expect that the growth-profits nexus may be different for these firms. In fact, Jang & Park (2011) found that in the restaurant industry profit positively affects growth but growth impedes profitability. As well, Audretsch, Klomp, Santarelli, & Thurik (2004) showed that growth is not so crucial to overcome costs disadvantages for service firms as compared to their manufacturing counterparts and that Gibrat´s Law provides a useful benchmark to understanding growth among service firms. Hence, additional research in the service sector and other activities is needed to get a wider understanding of the dynamics of growth and profits and its specificities. In the same vein, it would be useful to explore further the role of firm age in explaining heterogeneity in the profit-growth relationship (Steffens et al., 2009).

2.6.4 The effect of past growth on current growth

Finally, our results are also interesting regarding the impact that previous growth have on current growth. In addition to profits, our empirical model has included past growth as a potential determinant of subsequent growth. The finding here is that lagged growth rates do not significantly affect current growth, which is in line with recent empirical evidence that point to a relatively small (or even negative) degree of autocorrelation among firm growth rates through time (Bottazzi et al., 2011; Coad and Broekel, 2012; Coad et al., 2012). This can be illustrated with the case of gazelles (fast growing firms) which tend to have difficulties in sustaining their rapid pace of growth (Garnsey et al., 2006; S. C. Parker et al., 2010). In other words, gazelle-like growth does not persist for relatively long periods of time.

This result is related to the ongoing discussion in the literature about the randomness of growth rates (Coad et al, 2012; Geroski, 2005; Storey, 2011; Westhead and Wright, 2011). The fact that random effects are dominant in the explanation of young firm growth is assumed in Gibrat's Law, since it implies that firm growth is not correlated over time. While we agree that this fact does not necessarily constitute a *'negative state of affairs'* (Coad et al., 2012:12), we find it necessary to reconcile this new perspective on young firm growth with the accumulated literature on the determinants of business growth (Westhead & Wright, 2011). As noted by Stam (2010), a reappraisal of randomness beyond the Gibrat interpretations would contribute to a better understanding of the antecedents of young firm growth. In particular, it would be interesting to analyze the potential moderator role of firm and industry level variables on the degree of autocorrelation among growth rates.

Reaching a better understanding of the randomness of growth is particularly important since young business growth has a significant impact on other relevant firm outcomes that are considered non-random variables. While others have shown that new firm growth has an impact on the survival chances of newly founded firms (Coad et al., 2012), here we have confirmed our expectation that growth positively affects profits. This coincides with entrepreneurs' judgements where growth is not viewed as a final outcome but rather as a means for achieving some ulterior purposes such as profitability or survival (Achtenhagen et al., 2010).

It should be also noted that our measures for young firm growth and profits are based on theoretical reasons and comparability with other studies. However, our study should be complemented in future research by adding other size measures, particularly employment growth, as this measure is highly relevant from a policy point of view (Davidsson et al, 2006; Gilbert et al, 2006).

Finally, it is worth noting that throughout this article we have examined the association between growth and profits and its dynamics by explicitly considering both endogeneity and heterogeneity issues, but without implying any definition about the causal relationship between the two variables. We acknowledge that the question of causality implies a much more complex kind of relationship (Atukeren, 2008; Granger, 2003) and calls for more complex approaches, such as structural equation models (Pearl, 2009).

3. UNRAVELLING GROWTH PERSISTENCE AMONG YOUNG FIRMS: THE MODERATING ROLE OF FIRM AGE (PAPER 2)

3.1 Introduction

Since the publication of Storey´s (2011) *Optimism and Chance* and Coad, Frankish, Roberts, & Storey (2013) article based on the Gambler's Ruin theory, an interesting debate about the randomness of firm growth rates has emerged among researchers (Coad, Frankish, et al., 2015; Derbyshire & Garnsey, 2014, 2015; Westhead & Wright, 2011). This debate resembles earlier discussions from industrial economics based on Gibrat's Law of proportionate effects but in the context of large longitudinal data (Stam, 2010). Instead of the traditional size-growth relationship, the focus now is moving towards the degree of serial correlation among growth rates (e.g. Coad & Hölzl, 2009; Coad, 2007a; Fotopoulos & Giotopoulos, 2010; Hölzl, 2014).

In general, management and organizational scholars do not prefer random explanations. Usually they are considered as null hypothesis to be rejected or alternatively as the result of measurement errors or unobserved heterogeneity, that needs to be controlled for in a proper way with sophisticated econometric models (Denrell et al., 2015). Nevertheless, random variations could offer suitable and parsimonious explanations for some relevant empirical regularities in management and organizational science, being one of them the persistence in firm performance, as Denrell et al. (2015) illustrate.

As noted by Stam (2010) this reappraisal of Gibrat´s Law has resulted in two different strands. One view, which is mostly based on economics and the Gibrat´s Law tradition, can be labelled as the 'randomness' approach and supports a null correlation among growth rates. The second view, which is primarily linked to Penrose's ideas and the management literature and can be termed as the 'strategy' perspective, sustains the existence of correlation, either positive or negative. The key challenge is how to account for randomness *and* strategy at the same time and how to improve our understanding of the empirical evidence to inform theory (Anyadike-Danes & Hart, 2014; Stam, 2010).

Indeed, reaching a better understanding of the autocorrelation of young firms' growth is particularly important since it has a significant impact on other relevant firm outcomes such as survival (Coad, Frankish, et al., 2013a) or profits (Federico & Capelleras, 2015). As well, investigating growth autocorrelation would allow us to test different theoretical expectations. On the one hand, the aforementioned Gibrat´s Law would imply a null serial correlation, whereas on the other hand, positive correlation would support the presence of 'economies of growth' (Penrose, 1959). Traditional approaches about 'optimal size' and the search for economies of scale would support a positive correlation as well. Finally, qualitative evidence about young growing firms illustrates that growth process tend to be erratic, that is, characterized by interruptions, stagnation periods and growth periods (Garnsey & Heffernan, 2005; Garnsey et al., 2006). Hence, a negative correlation is expected. Adjustment costs derived from lumpy and discrete resources (Coad & Planck, 2012) under-developed routines and/or trial-and-error based learning about firms' own capabilities during their earlier years, constitute other reasons to expect a negative correlation.

However, previous empirical research on growth rates correlation gives a mixed and apparently contradictory picture. Earlier contributions tend to support a positive correlation (Dunne & Hughes, 1994; Ijiri & Simon, 1967) while more recent evidence based on larger and better datasets tend to report more ambiguous results. Bottazzi, Cefis & Dosi (2002), report a positive but small autocorrelation whereas Coad (2007), Coad & Planck (2012) and Coad & Hölzl (2009) find a negative association between both variables. From a different perspective based on growth paths, Garnsey et al. (2006) show that around 6% of the studied firms show a continuing growth trajectory. In turn, the most frequently observed path is one where a setback or a plateau follows an early growth period. Finally, Coad, Frankish, et al. (2013a) observe that growth paths among young firms are almost equally probable and no so different form a benchmark where growth is assumed to be an independent random process.

In an attempt to explain these apparently contradictory results of previous research, a number of new studies start to explore the role played by some intermediate variables on the autocorrelation between growth rates. In fact, Fotopoulos & Giotopoulos (2010) find that correlation tend to be negative for small firms and positive for older firms. Others, in turn, show that the sign of the autocorrelation would depend on the rate of growth, i.e. high growth firms would tend to exhibit a higher negative correlation than the rest of the firms (Capasso et al., 2014; Coad, 2007a).

Only recently, some authors have started to investigate the potential moderating effect of age on growth autocorrelation, showing an initial positive autocorrelation that then changes into a negative one as firms get older (Coad, Daunfeldt, et al., 2015; Coad, Segarra, et al., 2013). To a great extent, this lack of attention towards the role of age can be explained by the limited availability of data on firm age and by the unsatisfactory coverage of young firms in the administrative registries (Decker, Haltiwanger, Jarmin, & Miranda, 2014; Headd & Kirchhoff, 2009).

In this context, we carry out this study trying to examine how serial correlation among growth rates varies as long as young firms mature. The novelty of this paper with respect to prior studies is that instead of comparing autocorrelation between young and mature firms, we focus on the case of young firms and investigate the differences in growth patterns according to different phases of firms' life cycle, conciliating theory with the recent contrasting evidence. Particularly, we argue that persistence would be more likely to happen during the earlier years as a consequence of the struggle to survive and the presence of some 'economies of growth'. However, this initial correlation does not hold for a long time. As long as firm matures, growth becomes more erratic because of adjustment costs, post-entry mistakes and the join influence of internal and external forces that may promote or inhibit growth in young firms. In particular, following previous studies we suggest that this turning point takes place around the fifth year of existence (Anyadike-Danes & Hart, 2014; Coad, Daunfeldt, et al., 2015).

We use a multiple cohort-based approach, which consists in following four different cohorts of Spanish firms born between 2000 and 2003 throughout their first ten years of life. By doing so, this study contributes to the literature in several ways. First, we advance our understanding of the dynamics that underlies correlation among growth rates as long as firms abandon the earlier phases of development and move towards their adolescence. Secondly, by exploring the different growth paths observed conditional to the stage of maturation, we were able to support prior qualitative evidence on the existence of turning points and setbacks (Garnsey et al., 2006). Finally, by introducing the spline approach into the regressions we also back the idea of the fifth year as a turning point in firms earlier years. Overall, we make a strong point on rejecting the idea of young firm growth as a close to random process. Rather, we affirm that the outcome of this growth will be more erratic and hard to predict as long as the firm evolves, in line with Coad, Frankish, Roberts, & Storey (2013b).

The remainder of this paper is organized as follows. The next section describes the related literature and our research proposition. The third section provides details on the data, variables and empirical approach of our study and section 4 describes the results of our analyses. In the final section, we discuss our main findings as well as the limitations and future research directions.

3.2 Literature review and research proposition

3.2.1 Is young firms' growth random? Gibrat revisited

Randomness in firm growth traced back to the Law of Proportionate Effects, popularized as Gibrat´s (1931) Law, which affirm that change in firm size over a single period is independent of the size class at the beginning of this period. This postulate implies that growth rates would not be serially correlated and growth processes would tend to be random (Fotopoulos & Giotopoulos, 2010). Although such Law has been quite controversial, it approximates well the skewed distribution of firm size that characterizes most industrial structures where small firms dominate with only few large firms.

The `legacy' of Gibrat´s Law has attracted a great amount of attention and research efforts among industrial economists over the last decades. A large number of studies have been devoted to test whether this Law holds or not. However, this empirical literature shows mixed results. In general, Gibrat´s Law tend to hold among old and large firms whereas is rejected when small and young firms are included[13]. Particularly relevant for our research objective, Lotti et al. (2007) find that Gibrat´s Law is rejected in the earlier years, although a convergence towards a Gibrat´s-like process is observed through time among surviving firms.

More recently, Coad Frankish et al. (2013a) revisit the problem of randomness in growth rates in a completely new way. Their starting point, also highlighted by Storey (2011) is the relatively low explanatory power of most of the firm growth studies carried out in the last decades. In contrast, they propose that growth rates could be better characterized as a *close-to- random* process. Conceptually, these authors developed a new framework based on Gambler's Ruin theory (Wilcox, 1971) where growth is modelled as a game of chance, played by different firms with different access to resources. As in the casino, players (entrepreneurs in this case) will enjoy to stay at the table playing. Therefore, they will remain playing until they run out of money (i.e. resources). Under this framework, resources will affect firm survival rather than its performance, unlike the RBV literature tends to affirm. Resources could be accumulated in two ways; either by having them before playing (at the start up) or by having some early "wins" (i.e. growth episodes). In the context of new and young firms, these authors stress the importance of such earlier wins since them allow winners to be in a better position to get additional resources.

[13] Exhaustive reviews about this literature can be found in Audretsch, Klomp, Santarelli, & Thurik (2004); Lotti, Santarelli, & Vivarelli (2003); Santarelli, Klomp, & Thurik (2006) and Sutton, 1997).

However, performance, in terms of “wins” and “losses”, remains random and out of the control of entrepreneurs. In particular, these authors affirm that the Gambler´s Ruin model is especially suitable for new and young firms as they are like *“…corks in the sea driven by a range of factors beyond their power to control…”* (Coad Frankish et al., 2013a, p. 628). The sequence of “wins” and “losses”, which under this framework would constitute different growth trajectories, is also randomly distributed. In fact, these authors demonstrate that any possible growth path over a two-dimension space (growth and decline) in five years is almost equally populated. Moreover, any of these possible 16 combinations (i.e. 2 outcomes x 4 periods of growth) is as frequent as the benchmark, that is, when growth is assumed as a purely random and independent process. In this vein, the authors suggest that *“… the more appropriate heuristic for conceptualizing firm growth is not that firms can be neatly arranged into a taxonomy of different growth trajectories, but that growth is predominantly a random phenomenon...”* (Coad, Frankish et al., 2013a, p. 628).

This approach has generated an interesting debate among researchers in this area (Coad, Frankish, et al., 2015; Derbyshire & Garnsey, 2014, 2015). Two main aspects are the most controversial. First, Derbyshire & Garnsey (2014) argue that randomness derives mainly from a methodological choice made by the authors when defining only two possible outcomes (growth or decline). Doing so, they left apart the most common scenario, which is stasis. Nevertheless, as Coad, Frankish, et al. (2015) later illustrate, including this third outcome make some growth paths more frequent than others, especially those which include a stasis period. However, continued growth paths remains as rare as before.

The second and more important issue raised by Derbyshire & Garnsey (2014) refers to the distinction between randomness (indeterminism) and deterministic chaos. Instead of the Gambler´s Ruin approach, these authors argue that considering firms as adaptive complex systems actually provides an alternative explanation for the failure of growth studies to account for those factors that determine firm performance, but without the implications of such gambling approach. Under this framework, firm performance is considered as *“… a deterministic process involving the iterative matching of internal firm resources to external opportunities, requiring entrepreneurial skill and effort but subject to deterministic chaos rendering prediction impossible…”* (Derbyshire & Garnsey, 2014, p. 11). This perspective also introduces agency into the debate, i.e. the active involvement of entrepreneurs in making decisions in response to feedbacks (Derbyshire & Garnsey, 2015).

Interestingly, this debate puts the question of the randomness of growth outcomes at the center of the scene. For years, the ambition for scholars has been to capture the systematic differences among growth rates. However, as Coad (2007b) and Storey (2011) noted, these efforts have proven to be unfruitful, as the low explanatory power of these models show. As a result, an important part of the explanation could not be attributed to industry- and/or firm-specific factors, offering some rationale for chance explanations. Like Coad, Frankish et al.(2013a) state this fact does not constitute *per se* a negative state of affairs. Even more, as Denrell et al. (2015) affirm *"… in contrast to what unguided intuition might suggest, randomness at the micro level often has systematic aggregate consequences…"* (Denrell et al., 2015, p. 3). Finally, assuming the role played by chance does not mean to deny the deliberate action of human beings. Neither does it imply that managers are passive or irrational agents (Denrell et al., 2015). Rather, it denotes that the outcomes of such deliberated efforts would be heavily affected by randomness and hence, difficult to predict *ex ante*.

3.2.2 Alternative views on the autocorrelation among growth rates

Growth persistence lies at the center of many theoretical approaches, though not explicitly mentioned. Strategic management scholars argue that firms with superior resources and capabilities as regards their competitors would have a competitive advantage that may be translated into superior performance. These resource-based competitive advantages are derived from resources and capabilities, which should be by definition valuable, rare, hard to copy and non-substitutable (Peteraf & Barney, 2003; Peteraf, 1993). Precisely, the aforementioned attributes of firm resources and capabilities imply that inter-firm heterogeneity would be persistent and so does firm performance. In other words, due to persistent differences among firms' endowments, some firms would persistently outperform their competitors as well as others would continuously be underperformers.

In addition, other authors argue that growth could be serially correlated because it is a self-reinforcing process. For instance, Bottazzi & Secchi (2003) developed a model in which the identification of new opportunities for growth will be positively associated with the number of opportunities previously identified and exploited. Underlying this idea is the recognition that a number of positive feedbacks may help explain such positive correlation in growth rates, such as economies of scale, network externalities and knowledge accumulation. In addition, from an evolutionary point of view (Nelson & Winter, 1982) proven, successful routines and path dependence would also contribute to this positive correlation, giving also a conceptual explanation for those long-lasting periods of inertia and stasis in growth rates, only disturbed by an external shock in the environment and selection process.

In the same vein, we could argue that the existence of economies of growth (Penrose, 1959) may also describe a positive correlation among growth rates. Economies of growth derive from the exploitation of firms' unique collection of resources and its productive services as firms grow. By growing, managers become more aware of the resources they control and the productive services that these resources could render. This learning-by-doing process implies that resources and services are released and combined in different ways in order to profit from new opportunities.

Finally, a positive correlation could be expected from the traditional microeconomic theory. Under this approach, firms would move alongside the cost curve in order to achieve the 'optimal size´, represented by the minimum efficient scale (MES). In particular, in the case of the youngest firms this trend to move downward along the cost curves until the MES is even more critical in order to overcome their initial cost disadvantages regarding their larger counterparts, trying to increase their survival chances. Therefore, a positive correlation could also be a consequence of the initial struggle to survive.

However, growth persistence is not frequently observed among industrial populations. Indeed, most empirical studies based on large populations show a negative correlation (Coad & Hölzl, 2009; Coad, 2007a) or alternatively, when a positive sign is reported it is of a small magnitude (Bottazzi, 2002). Continuous growth could not be expected to last for long periods of time and for a large number of firms because several reasons. First, because of the above-mentioned economies of growth eventually face a limit. The ability of managers to coordinate an increasing number of activities and resources decreases, posing an endogenous limit to this positive correlation (Penrose, 1959). As well, from a Penrosean perspective, growth will stop at some point because entrepreneurs are no longer able to identify or exploit growth opportunities (Lockett et al., 2011).

Theoretically, these growth setbacks could be explained due to the existence of adjustment process, that is, the need to re-allocate internal structures, resources and capabilities after a growth episode in order to be prepared to exploit new growth opportunities. Coad & Planck (2012) propose a model in which these adjustment costs are a consequence of the discrete (lumpy) nature of firm resources and their interconnectedness. According to these authors, initial growth could be accommodated within the firm because of organizational slack. However, as the firm approaches the full exploitation of their resources, they need to incorporate additional ones that are lumpy and discrete in nature and hence, make it necessary to incur in some adjustment costs.

Adjustment costs are also present in Jovanovic (1982) model. According to this model, firms are not aware about their ´true costs´ (i.e. their level of efficiency), so they enter the market and start a trial and error iterative process where they successively revise their expectancies based on market performance. Those firms who outperform their competitors will revise upwards their initial expectations and growth, whereas those with poorer results will decline.

On the other side, qualitative evidence successfully illustrates that continuous growth is not the rule rather an exception. This evidence based on case studies shows us possible situations at the very beginning that may end in a growth setback or reversal, for instance, resource shortages, synchronization problems and cash crises (e.g. Blackburn & Brush, 2009; Brush, Ceru, & Blackburn, 2009; Garnsey & Heffernan, 2005; Garnsey et al., 2006). Underlying this perspective lies the conceptualization of firm growth as a developmental process, similar to the also known life-cycle models.

According to this life-cycle approach business growth is viewed as a continuum where a number of growth events, stages, crises and transitions are identified and characterized (Greiner, 1972; Kazanjian & Drazin, 1990; Lewis & Churchill, 1983). Each of these stages is described in terms of some organizational features (structures, systems and management characteristics) and dominant problems that firms face in their evolution and adaptation to the general context. The ability of the firm to overcome those problems and move to the next developmental stage would be the key to explain the growth path of each firm. Some firms would be successful in this task and may experience a sustained growth. Others, in contrasts, may remain stuck on some stage and other would experience a growth reversal. Under these circumstances, young firms' growth could be better described as erratic (rather than random) and hence, serial correlation would be negative.

However, most of these approaches have been developed mainly for the case of large and established firms. Trying to match Penrose´s ideas in the context of young firms, Garnsey (1998) developed a model that follows to some extent the logic of the previous approaches about the life-cycle. According to her model, there is a number of some initial phases that young firms must transit in order to became viable and survive. They must access resources, mobilize them and deploy them in order to match opportunities and generate value.

Unlike life-cycle models, Garnsey´s approach considers these growth phases as manifestations of critical problems that need to be addressed rather than in terms of configurations or managerial characteristics. Therefore, her model emphasizes the need to build the necessary competences to face and solve these problems. Mastering these problems defines a sequence. Firms must access, mobilize and deploy resources before they can generate resources for growth. It is in the nature of these processes that they must take place sequentially. However, once firms start to generate their own revenues, a number of growth reinforcement as well growth reversal forces begin to content. The outcome of such struggle may result in at last three possible scenarios: early failure, a growth plateau (which represent a period of stasis) with some oscillations and a growth reversal. Importantly, these forces are not only endogenously determined but also they are a reflection of high vulnerability that new and young firms have as regard as the external environment. As shown by Garnsey & Heffernan (2005) the dependence of new and young firms on their customers, funders and suppliers intensifies the scope of the internal problems.

Overall, the general image drawn from Garnsey (1998) model is one in which an initial positive autocorrelation would be observed during the earlier phases until the point where the critical problems faced by firms become more diverse and hence, the competences needed to respond to them. Such processes make difficult to establish a priori a possible transition and several possible scenarios are opened. This image coincides with Coad, Frankish, et al. (2013b) conclusion that growth rates become harder to predict as long as the firm matures. Similarly, Coad, Segarra, et al. (2013) and Coad, Daunfeldt, et al. (2015) report a positive correlation during the first years turns to be negative around the fifth year and remains that way as firms get older.

Consequently, in the light of the previous theoretical contributions and the more recent empirical evidence we postulate the following research proposition[14]:

Firm age will act as a moderator in the relationship between current and past growth. More specifically, serial correlation among growth rates will be positive during a firm first years but after these initial years, growth rates will become more erratic.

[14] Following Coad, Daunfeldt, et al. (2015) suggestion, a research proposition is placed here instead of formal hypothesis given the conflicting theoretical predictions and the recent counterintuitive empirical evidence as well as the limited theoretical development on this subject.

3.3 Data, variables and methods

3.3.1 Data and sample

Data for this study is taken from the SABI© (*Sistema de Análisis de Balances Ibéricos*) database, collected and provided by Bureau Van Dijk and based on the Official Registry of Spanish Companies. This database is the same database used in previous research on growth and growth persistence in Spain (Coad & Teruel, 2012; Coad, Segarra, et al., 2013; Segarra & Teruel, 2012; Teruel-Carrizosa, 2010). This database includes data about the date of registration, which we use as the primary variable to calculate firm age and to group them into the different cohorts[15]. In this study, we choose to work with four cohorts 2000, 2001, 2002 and 2003 and follow them over an 11-year period (i.e. 10 growth periods). This multiple cohort approach is one of the novelties of our study compared with previous research, which tend to compare firms from different age segments. Cohort based studies are not commonly used in the literature with some recent exceptions like Anyadike-Danes & Hart (2014) and Headd & Kirchhoff (2009), among others.

Our sample comprises manufacturing firms (i.e., NACE Rev. 2 2-digit Classification codes 10 to 33) as well as services firms (i.e. NACE Rev. 2 2 digit Classification codes 49 to 79) adding new evidence to previous research in Spain, which only comprises manufacturing firms (Coad, Segarra, et al., 2013). Since we are interested in young firm growth, we focus on 'organic' (i.e. internal) growth. Consequently, those firms which control other firms and those controlled by another firm were removed from an initial list extracted from the SABI© database.

From an initial list of 15,488 firms, we first removed those firms with interrupted spells in the series and missing values in sales, leaving only 8,748 firms[16]. Then, we extract from the dataset those observations without information on sales for the first two years, i.e. firms with less than 2 consecutive years of data (or at least one year of growth). In other terms, we only include those firms, which survive the first two years and reported sales during these years[17]. Our final

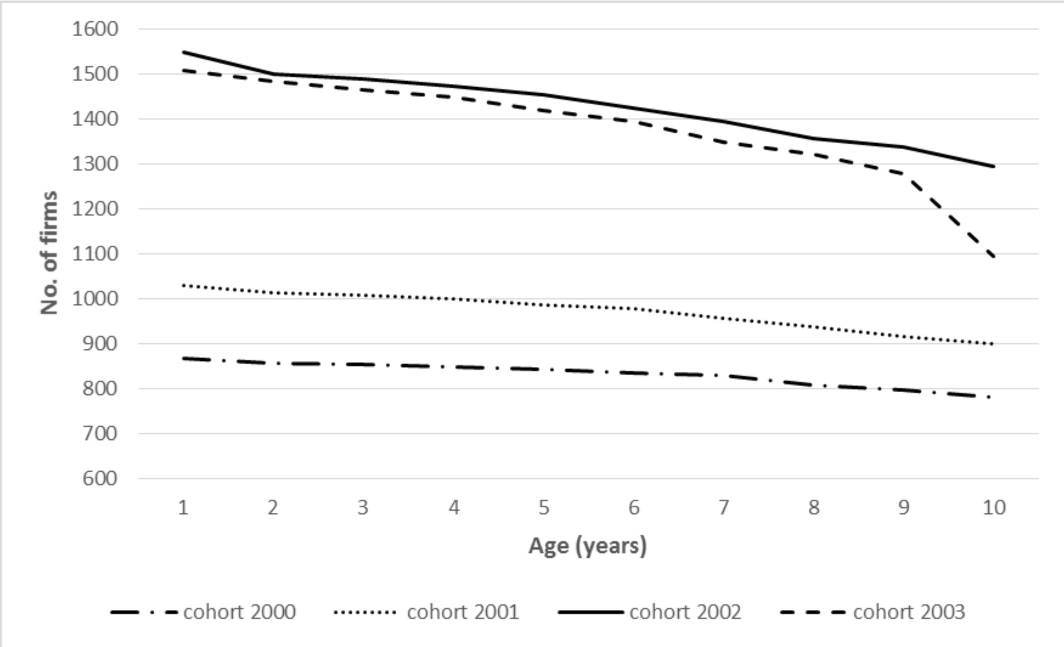
[15] Each cohort includes those firms born between January 1st and December 31st of a single year.

[16] As Coad, Segarra, et al. (2013) comment, data on smaller firms is particularly noisy. Therefore, we decide to exclude those observations with missing values or interrupted series, even though we admit the possible risk of selection bias. Nevertheless, we compare the industrial composition of our final sample with the official database from the National Statistical Institute – the Directorio Central de Empresas [Central Directory of Firms] - for these three cohorts and few significant differences are found, so we consider that this risk is minimum. These tables are available in the Statistical Appendix.

[17] We are also aware of the survivor bias that this decision may imply since our sample will overrepresented surviving firms. In the same vein, there could be certain underestimation of firm exit as SABI© includes mostly private and public limited companies. As well, Coad, Segarra, et al. (2013) warn about the difficulties of SABI© to fully capture business exits. Overall, some caution should be placed when interpreting the results and try to generalize them.

sample includes 4,957 firms. Figure 3.1 shows the number of firms included in this study by cohort and their evolution over time.

Figure 3.1. Firms by cohort and over time



3.3.2 Variables and summary statistics

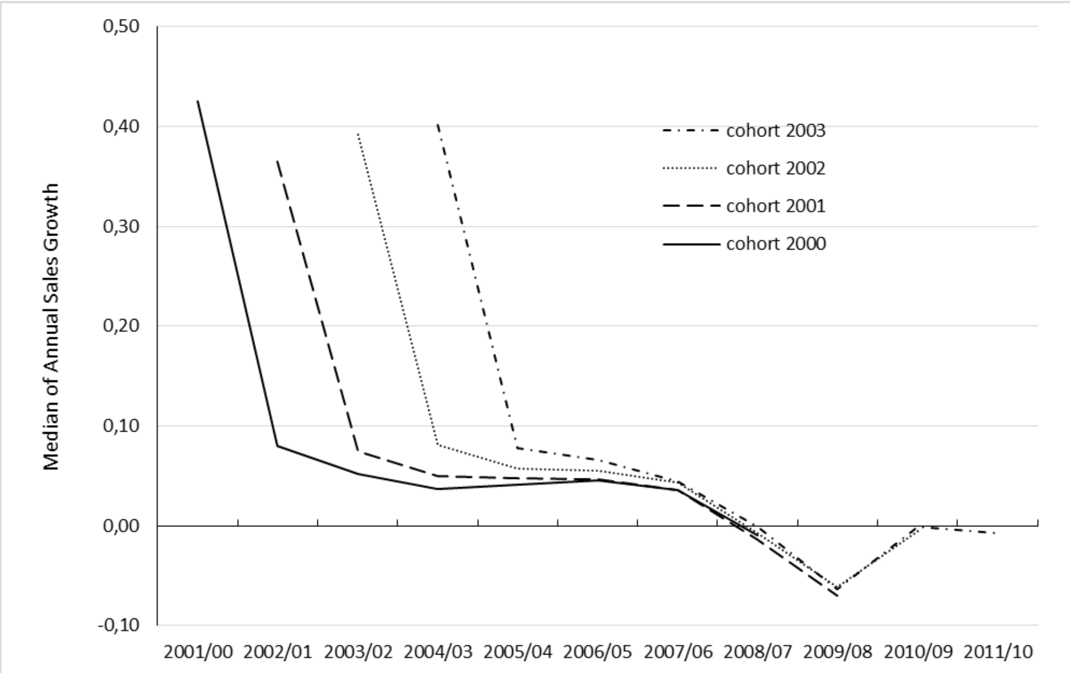
Our main variables of interest are firm age and growth. Firm age is calculated as the difference between the current year and the year of firms' registration and firm growth is calculated as annual sales growth. We use sales as our growth variable because of three main reasons. First, it reflects a direct indication of the acceptance of the new firm's products or services in the market (Gilbert et al., 2006). Secondly, sales (and sales growth) is the preferred success measure for founders and owner-managers of new and young firms, whereas they do not see other variables, such as employment growth, as a goal in itself (Achtenhagen et al., 2010). Finally, we focus on sales rather than employment as a proxy of size because the latter usually does not change as quickly as sales from one year to the other, due to the integer nature of headcounts. Therefore it may underestimates changes in firm size, especially in new and young firms that use to be rather small (Coad, Frankish, et al., 2013a).

We calculate sales growth following the usual definition adopted by previous research based on the differences in the logarithms of sales (e.g. Bottazzi, Dosi, Jacoby, Secchi, & Tamagni, 2010; Coad & Hölzl, 2009; Coad, 2007a, 2007c), i.e.

$$GROWTH_{it} = \log(SALES_{it}) - \log(SALES_{it-1})$$

Figure 3.2 shows the evolution of the median growth rates over the years, by cohort[18]. Two main results deserve to be mentioned. First, growth rates show a higher value in the first year and thereafter they start to move downwards and never return to such levels. This situation is observed in all the studied cohorts. This higher growth rate at the beginning may be a reflection of the negative relationship between firm age and growth (Barba Navaretti et al., 2014) due to the initial struggle that most newly born firms have in order to overcome the initial disadvantages (liabilities of newness).

Figure 3.2. Evolution of growth rates by cohort (mean values)



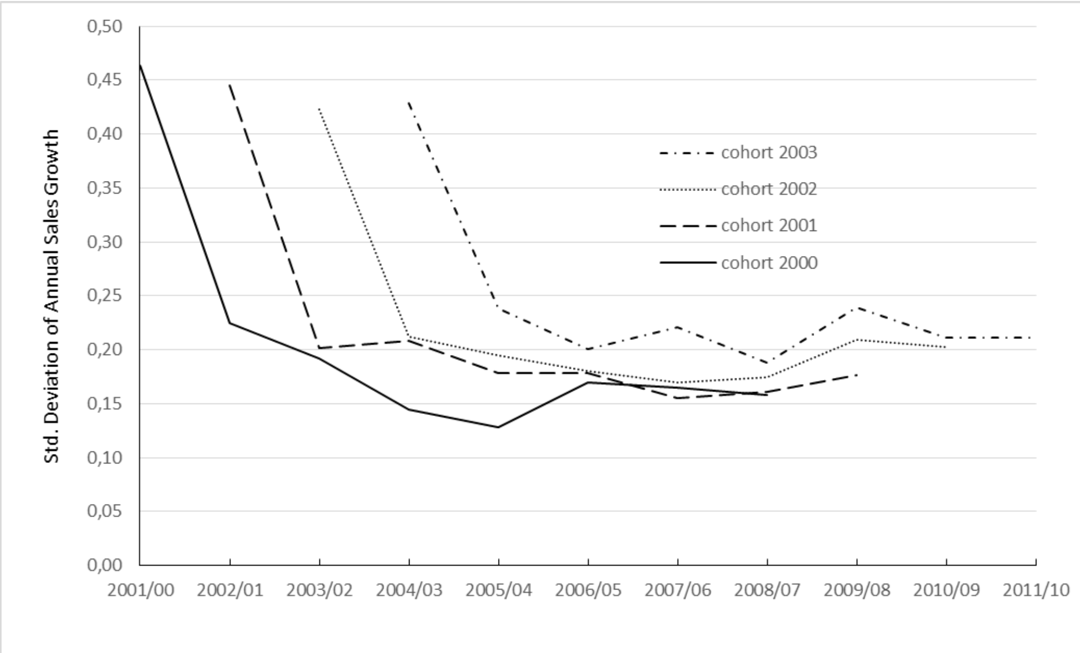
The second main finding observed from these graphs is that starting in 2008 we see a reversal in growth rates that turn to be negative and remain below zero until the end of the studied period, despite the short-run recovery observed between 2010 and 2009. This clearly illustrates the negative effects of the great global crisis that have heavily affected the Spanish economy. Interestingly, this pattern is observed in all the cohorts at the aggregate level, although we can expect that the impact of such crisis and its recovery have been highly heterogeneous across sectors, cohorts and firms. This point will be addressed in the next section when different growth trajectories by cohort are examined.

Figure 3.3 shows the standard deviation of growth rates over time and by cohort. All the studied cohorts tend to exhibit similar patterns. First, dispersion among growth rates is higher in the first year of each cohort, reflecting a great heterogeneity in firm performance during this

[18] More descriptive statistics on growth and sales are presented in the Statistical Appendix

period. Second, this dispersion tends to diminish from the second year onwards until the period of the great crisis, when it raises again because of different firm responses to an unfavourable environment. Nevertheless, the levels of dispersion observed during the crisis are quite lower than those corresponding to the initial years.

Figure 3.3. Evolution of the standard deviation of growth rates by cohort



3.3.3 Empirical approach and methods

With regard to the empirical approach, we will start with a simple descriptive analysis based on identifying different growth trajectories over our ten-year period and evaluating their relative importance in our sample. This “coin-flipping” approach is analogous to what Coad, Frankish, et al. (2013a) and Derbyshire & Garnsey (2014)use in their analyses.

Taken into account Derbyshire & Garnsey (2014) comments we will classify firm growth into three categories: growth, decline and stasis. “Growth” includes all firms with growth rates equal or higher than 5%, whereas “Decline” comprises those firms that have experiment a decline in their sales higher than 5%. As a result, the “Stasis” category embraces those firms with growth rates between 5% and -5%[19].

In addition, since we are dealing with a particular period of the Spanish economy in which most of the firms exhibit negative growth rates, we choose not to follow Coad, Frankish, et al.,

[19] Since growth is calculate as log differences of sales, this threshold of 5% is equivalent to a growth rate higher than 0.0212 or lower than -0.0212.|

(2013a) approach based on the median firm as benchmark. Doing that, would lead us to include in the growing group some firms that are not actually growing, i.e. they are reducing sales but in a smaller degree than the median firm. On the contrary, we estimate growth rates at the individual firm level. This fact has also been raised by Derbyshire & Garnsey (2014).

In addition, given the main objective of this study and in the light of recent research we, will analyse how the relative importance of these growth trajectories differs according to firm's age. Therefore we will split each of our cohorts using the fifth year of existence as a turning point as Anyadike-Danes & Hart (2014) and Coad, Daunfeldt, et al. (2015) studies suggested.

This preliminary analysis based on the frequency of the different growth paths, may illustrate the relative importance of each of them and if this relevance changes over time. Then, to confirm these results we move to a multidimensional setting by estimating some regressions. Following previous studies in this area, we will estimate a simple autoregressive model:

$$GROWTH_{it} = \alpha + \beta GROWTH_{it-1} + \delta AGE_{it-1} + \theta GROWTHxAGE_{it-1} + \gamma_t YEAR_t + \varphi SECTOR_i + \varepsilon_{it}$$

In this model, our main parameters of interest are β, the autocorrelation coefficient, and θ the coefficient of the interaction term between growth and age. In addition, we will include a set of year dummies to consider cyclical macroeconomic influences, and especially the effect of the recent global crisis, which started in 2008. We also include a set of dummy variables to account for industry differences. Finally, to identify differences in the autocorrelation between cohorts, we will estimate the model for each cohort individually.

Since we are interested in modelling the role played by age and investigate whether it changes throughout the studied period, we would represent age as a series of linear segments (i.e. age segments), but forcing these linear segments to meet at the endpoints of each one, assuring a piecewise continuous function, what is known as *spline functions'* approach (Greene, 2003)[20]. In our case, we define a single knot corresponding to the fifth year in order to capture the differences before and after this point. Using this approach would allow us to identify whether the identified knot of the fifth year act as a turning point. As a result, it would be expected that the interaction term between growth and each age segment changes after the fifth year.

[20] In addition, as a complementary analysis to the spline functions, we introduce the squared of age and the interaction between this term and previous growth in order to test a non-linear relationship. This suggestion was made by the internal evaluation. Errors, however, remain my responsibility.

Following the recommendations of the most recent studies (e.g. Capasso et al., 2014; Coad, Daunfeldt, et al., 2015; Coad, Segarra, et al., 2013; Coad, 2007a), we will estimate our models using LAD regressions, also known as median regressions, instead of OLS. Indeed, previous studies have demonstrated that firm growth estimations based on OLS would be affected by the presence of outliers, for instance fast growing firms in our case. Therefore, median regression appears more suitable because is less sensitive to outliers and gives more robust estimators than OLS.

Finally, we run some robustness checks by estimating the same models for each cohort but according to different size bands, defined in terms of sales[21]. This may indicate whether our results are consistent or if there is some size-effect.

3.4 Main results

3.4.1 A preliminary assessment under the coin flipping approach

In order to illustrate the relationship between past and current growth, we first follow Coad, Frankish, et al. (2013a) coin-flipping approach[22]. As we mentioned before, we will classify growth trajectories into three possible outcomes: Growth, Decline and Stasis. Additionally, we use the fifth year as a turning point, describing growth trajectories after and before this point[23].

Table 3.1 shows the results of the different growth trajectories for the first five years by cohort. Two main differences emerge from our results compared with those found in Coad, Frankish, et al. (2013a). First, not every possible growth trajectory is almost equally populated or likely. The number of observed trajectories in all the three studied cohorts is lower than those that are theoretically possible[24]. Second, continuous growth (GGGGG) is the most frequent observed trajectory. Almost one out of five young firms shows this pattern of growth during their first five years. The remaining trajectories are much less likely. In particular, Stasis

[21] Ideally, these size bands should be based on employment data to keep comparability with previous studies. Unfortunately, employment data in our dataset has an important number of missing values, reducing the available information. Descriptive statistics about these size bands are presented in the Statistical Appendix.

[22] To keep comparability with other studies we include in these exercises only surviving firms. This fact is important to keep in mind when interpreting the results, especially those for the second period (6 to 10 years old) where an important number of firms left the market.

[23] It is important to stress here that in this context “year” refers to “periods of growth”. So, the first year refer to the growth or decline between the initial and the first year of firm’s life.

[24] Since we have three possible outcomes (Growth, Decline and Stasis) and 5 periods of growth, the total number of possible combinations is $3^5 = 243$ and the number of observed trajectories by cohort is 113, 124, 130 and 135, respectively.

does not account for a significant share of our sample, contrasting Derbyshire & Garnsey (2014)[25].

Interestingly, these patterns are observed in all the studied cohorts except 2003, which is somehow different, showing a lower proportion of the continuous growth trajectory (13%). To certain extent, this difference could be due to the influence of the global crisis, whose effects started to be present during 2007/2008, i.e. the fourth and fifth year of this cohort of firms. In fact, for this cohort the second most frequent trajectory is GGGGD with a 12%. All in all, this examination shows that in general firm growth during the first five years could not be treated as random or even as close to random. In contrast, a positive correlation could be expected due to the predominance of the continuous growth trajectory, supporting our previous research proposition based on the existence of economies of growth and the 'growth to survive' mandate.

Table 3.1. Top 30 growth paths during the first five years, by cohort.

cohort 2000			cohort 2001			cohort 2002			cohort 2003		
Path	N	%	Path	N	%	Path	N	%	Path	N	%
GGGGG	157	18.6%	GGGGG	200	20.2%	GGGGG	298	20.5%	GGGGG	192	13.5%
GGGSG	49	5.8%	GGGDG	51	5.2%	GGGGD	79	5.4%	GGGGD	168	11.8%
GGGDG	46	5.5%	GGDGG	47	4.8%	GGGDG	73	5.0%	GGGGS	63	4.4%
GGGGS	43	5.1%	GGGGS	42	4.3%	GGGGS	64	4.4%	GGGDD	60	4.2%
GGDGG	38	4.5%	GGGSG	38	3.8%	GDGGG	55	3.8%	GGGDG	55	3.9%
GGGGD	31	3.7%	GGGGD	34	3.4%	GGDGG	55	3.8%	GGDGG	47	3.3%
GDGGG	24	2.9%	GGSGG	33	3.3%	GGSGG	40	2.8%	GDGGD	39	2.7%
GGSGG	22	2.6%	GDGGG	30	3.0%	GGGSG	36	2.5%	GGDGD	36	2.5%
GDGDG	19	2.3%	GGGDD	25	2.5%	GGDGD	34	2.3%	GDGGG	33	2.3%
GGDDG	16	1.9%	GGDDG	22	2.2%	GGGDD	30	2.1%	GGSGG	33	2.3%
GSGGG	16	1.9%	GDDGG	19	1.9%	GSGGG	28	1.9%	GDGDD	32	2.3%
GGDGD	15	1.8%	GGGSS	18	1.8%	GDGDG	26	1.8%	GGGSG	32	2.3%
GGGSS	15	1.8%	GSGGG	18	1.8%	GGDDG	26	1.8%	GGGSS	27	1.9%
GDGGD	14	1.7%	GDGDG	15	1.5%	GDDGG	24	1.7%	GGGSD	26	1.8%
GGGDD	14	1.7%	GGDGD	15	1.5%	GDGGD	24	1.7%	GGDDD	22	1.5%
GGDDD	12	1.4%	GGDGS	15	1.5%	GGSGD	21	1.4%	GSGGG	21	1.5%
GGGDS	11	1.3%	GDGGD	13	1.3%	GGGSS	20	1.4%	GGSGD	19	1.3%
GGDGS	10	1.2%	GSGGD	12	1.2%	DGGGG	18	1.2%	GGGDS	18	1.3%

[25] Taking sales instead of employment as our measure of growth may explain largely, the lack of importance of Stasis in our sample.

GGGSD	10	1.2%	GGDDD	10	1.0%	GSSGG	18	1.2%	GDDGD	17	1.2%
GGSGD	10	1.2%	GGGDS	10	1.0%	GGGSD	17	1.2%	GSGGD	17	1.2%
GDGSG	9	1.1%	GGGSD	10	1.0%	GDDDG	14	1.0%	GDGDG	15	1.1%
GDDGD	8	1.0%	DGGGG	9	0.9%	GDGGS	14	1.0%	GDGGS	15	1.1%
GDDGG	8	1.0%	GGDSG	9	0.9%	GGGDS	14	1.0%	GDDGG	14	1.0%
GGDSG	8	1.0%	GGSDG	9	0.9%	GSGGD	14	1.0%	GGDSG	14	1.0%
GGSSS	8	1.0%	GDDDG	8	0.8%	GDDGD	13	0.9%	GDGSD	13	0.9%
GSGDG	8	1.0%	GSGGS	8	0.8%	GGSGS	13	0.9%	GGSDG	13	0.9%
GSGSG	8	1.0%	GDDGD	7	0.7%	GDGDD	12	0.8%	GGDSD	12	0.8%
DGDGG	7	0.8%	GDGSG	7	0.7%	GGDSG	12	0.8%	GGSDD	12	0.8%
GGSDG	7	0.8%	GDSGG	7	0.7%	GGSSG	12	0.8%	GSGSD	11	0.8%
DGGGG	6	0.7%	GGSGS	7	0.7%	GSGDG	12	0.8%	GGDDG	10	0.7%
Total	**842**	**100%**		**988**	**100%**		**1,454**	**100%**		**1,420**	**100%**

Note: In this table, we report only the top 30 (most frequent) growth paths. The complete table is available in the Statistical Appendix.

In contrast, the picture is quite different when examining the growth trajectories from the 6th to the 10th year (see Table 3.2, below). In all the studied cohorts this period coincides with the main direct effects of the great global crisis. As a result, it is hard to identify some common paths within the same cohort and between cohorts. These results are in line with what Coad, Frankish, et al. (2013b) label as “fog”, i.e. the increasing difficulty to predict growth trajectories as long as the firm evolves.

Table 3.2. Top 30 growth paths from the 6th to the 10th year, by cohort.

cohort 2000			cohort 2001			cohort 2002			cohort 2003		
Path	N	%	Path	N	%	Path	N	%	Path	N	%
GGDDG	38	4,9%	GDDDD	45	5,0%	DDDDD	68	5,3%	DDDDD	46	4,2%
GGDDD	35	4,5%	GDDGD	34	3,8%	GDDDD	40	3,1%	DGDDD	42	3,8%
GGGDG	34	4,4%	GDDDG	30	3,3%	GDGDD	39	3,0%	DDGDD	39	3,6%
GGGDD	21	2,7%	GGDGG	26	2,9%	DDGDD	38	2,9%	DDDDG	27	2,5%
GGSDG	19	2,4%	GGDDD	22	2,4%	DDGGD	38	2,9%	DDGDG	26	2,4%
GGDDS	18	2,3%	GDDSD	18	2,0%	DDDGD	37	2,9%	DGDGD	25	2,3%
GDDDG	17	2,2%	DDDDD	17	1,9%	DDSDD	25	1,9%	DGGDD	24	2,2%
GGGDS	16	2,0%	GGDGD	17	1,9%	DDGDG	23	1,8%	DDDGD	23	2,1%
GGGGG	16	2,0%	GGGGG	17	1,9%	DGDDD	22	1,7%	DGDDG	23	2,1%
GGSDD	16	2,0%	GSDGG	16	1,8%	SDDDD	20	1,5%	DGGDG	23	2,1%
GDDDD	14	1,8%	SDDDD	16	1,8%	DDDSD	19	1,5%	DGGGD	18	1,6%
GDGDG	14	1,8%	GDDDS	14	1,6%	GGGGG	18	1,4%	GGGGG	17	1,6%

GSDDD	14	1,8%	GDDGG	14	1,6%	DDGGG	17	1,3%	DDDGG	16	1,5%
DDDDD	12	1,5%	DGDDD	13	1,4%	DGDGD	17	1,3%	DDSDD	15	1,4%
DGGDG	12	1,5%	GGDDG	13	1,4%	DDDDG	16	1,2%	DGGDS	15	1,4%
GGGGD	12	1,5%	DDDGD	12	1,3%	DDDGG	16	1,2%	DGGGG	15	1,4%
SGGDG	12	1,5%	DGDGD	12	1,3%	DDGSD	16	1,2%	GGDDD	14	1,3%
GSDDG	11	1,4%	DDDDG	11	1,2%	GDDGD	16	1,2%	DDDDS	13	1,2%
DGDDG	10	1,3%	GDGDD	11	1,2%	GDGGD	16	1,2%	DDDSD	13	1,2%
GDGDD	10	1,3%	GSDDG	11	1,2%	GDGDG	15	1,2%	DGGGS	13	1,2%
DGGDD	9	1,2%	DDDGG	10	1,1%	GDGGG	15	1,2%	DGSDD	13	1,2%
GDDGD	9	1,2%	GDDGS	10	1,1%	GDDDG	14	1,1%	DDGGD	11	1,0%
GGGSS	9	1,2%	GGDGS	10	1,1%	GDDGG	14	1,1%	DGDGG	11	1,0%
DGDDD	8	1,0%	GGDSG	10	1,1%	SDDSD	14	1,1%	DSGDD	11	1,0%
DGDGG	8	1,0%	GSDSD	10	1,1%	DDGGS	13	1,0%	GDDDG	11	1,0%
GDSDD	8	1,0%	DGDDG	9	1,0%	GDSDD	13	1,0%	GGDGG	11	1,0%
GGGGS	8	1,0%	GDDSG	9	1,0%	SDDGD	13	1,0%	SDDDD	11	1,0%
SGDDG	8	1,0%	GGDDS	9	1,0%	GGDGD	12	0,9%	DDGDS	10	0,9%
DDDDG	7	0,9%	GGSDD	9	1,0%	GDSSD	11	0,8%	DGDDS	10	0,9%
GGDGD	7	0,9%	GSDDD	9	1,0%	GGDDD	11	0,8%	DSDDD	10	0,9%
Total	**781**	**100%**		**899**	**100%**		**1,295**	**100%**		**1,096**	**100%**

Note: In this table, we report only the top 30 (most frequent) growth paths. The complete table is available in the Statistical Appendix.

However, a number of interesting facts are worth to mention. First, unlike the previous five-year period, continuous growth is quite rare. In contrast, continuous decline is among the leading paths, especially in cohorts 2002 and 2003. Second, in all the studied cohorts, the most frequent trajectory represents no more than 5% and a significant number of patterns that are almost equally probable. These trajectories use to combine growth and decline periods. Again, Stasis does not appear as frequently as expected. Overall, what seems to emerge from this table is that during these last five years, sales growth tends to be more erratic. Possible explanations refer to the presence of adjustments process (Coad & Planck, 2012) and/or internal transformations resulted from growth reinforcement and growth reversal forces (Garnsey, 1998). As well, these patterns could also reflect the consequences of the great global crisis whose effects over the Spanish economy have been quite serious. Unfortunately, this approach based on the single examination of growth trajectories does not allow us to separate and identify whether or to what extent this change in the growth trajectories observed during the first five years and the five years afterwards is due to the macroeconomic factors or due to developmental factors of the studied firms. This fact has also been raised by Coad, Frankish, et al. (2013b) in their study of UK firms during 2004-2010.

3.4.2 A multivariate regression approach

The previous section shows that growth trajectories could hardly be considered as random. In contrast, we identify some evidence of a positive correlation until the fifth year that afterwards turns into a more erratic trend, supporting new empirical studies (Coad, Daunfeldt, et al., 2015). However, the previous coin-flipping approach is for the most descriptive. This section would advance in our understanding by moving to a multivariate approach. In particular, we are interested in estimating the influence of age on the autocorrelation between past and current growth. Therefore, we adopt two different strategies. First, we would estimate our basic model including an interaction term between lagged age and lagged growth that would capture the autocorrelation coefficient as long as firm ages[26]. Then, we introduce the spline functions approach.

Table 3.3 shows the results for our estimations, each column corresponding to one cohort. In general, our results tend to confirm largely the picture emerged from the coin flipping approach. In all the four studied cohorts, lagged growth tends to be positive correlated with its current realizations. Additionally, age has a negative impact on growth, confirming recent research on young firms age (Barba Navaretti et al., 2014; Lawless, 2014). In particular, the join influence of lagged age and growth, exhibits a negative sign. Our interpretation is that while there is a general positive association among sales growth rates, this tends to be more erratic as long as firms evolve. This result tends to hold for all the studied cohorts.

Table 3.3. Regression results- basic models. By cohort

Dependent variable: $Growth_{it}$	Cohort 2000	Cohort 2001	Cohort 2002	Cohort 2003
$Growth_{i,\,t-1}$	0.0419***	0.0702***	0.0595***	0.0521***
$Age_{i,\,t-1}$	-0.0078***	-0.0070***	-0.0124***	-0.0095***
(Age x Growth)$_{i,\,t-1}$	*-0.0073****	*-0.0100****	*-0.0049****	*-0.0049****
Constant	0.0789***	0.0604***	0.0906***	0.0920***
N	7.452	8.702	12.730	12.259
Pseudo R^2	0.0592	0.0696	0.0705	0.0609

Note: Year and Industry dummies are included in the estimation but not reported here for simplicity. The full output of the regressions is available in the Statistical Appendix.

Legend: * p<.10; ** p<.05; *** p<.01

[26] For these estimations, we use the complete panel instead of only survivor firms as in the previous section.

These results tend to coincide with recent studies showing that young firms' growth at the beginning of their life cycle tend to be positively related because of the effect of economies of growth and their struggle for survive and overcome their initial disadvantages (Coad, Daunfeldt, et al., 2015; Coad, Segarra, et al., 2013). However, as long as firm evolves it would be increasingly difficult to sustain such positive cumulative growth process and growth become more erratic. Overall, our regression results may provide suitable evidence to Garnsey's (1998) model of growth in young firms. Nevertheless, some caution is advisable when interpreting these results and make generalizations due to the possible sample selection bias, the small magnitude of the coefficients and the low overall R^2, which barely exceeds the 6%.

Table 3.4 show the results of the spline functions approach. Our purpose with these extended models is to find out whether the fifth year constitutes a turning point in the autocorrelation of growth rates, i.e. showing different signs before and after this point. We will model this moderator role of firm age using spline functions as suggested by Greene (2003).

Table 3.4. Regression results- spline regressions. By cohort

Variable	Cohort 2000	Cohort 2001	Cohort 2002	Cohort 2003
Growth t-1	0.0096	0.0707***	0.0868***	0.0338***
Lag_age1 [1.5]	-0.0076***	-0.0032**	-0.0152***	-0.0097***
Lag_age2 [6.10]	-0.0107***	-0.0108***	-0.0083***	-0.0110***
Lag_age1 x Growth t-1	0.0098*	-0.0107**	-0.0195***	0.0014
Lag_age2 x Growth t-1	-0.0345***	-0.0081	0.0159***	-0.0098**
Constant	0.0862***	0.0565***	0.0883***	0.1016***
N	7.452	8.702	12.730	12.259
Pseudo R^2	0.0598	0.0696	0.0708	0.0605

Note: Year and Industry dummies are included in the estimation but not reported here for simplicity. The full output of the regressions is available in the Statistical Appendix.

Legend: * p<.10; ** p<.05; *** p<.01

Again, a general positive influence of lagged growth on current growth is observed, supporting the idea of a positive correlation. However, the interaction between age and growth shows different results than in the previous specification, due to the inclusion of the spline functions. In this case, no uniform patterns emerge among the studied cohorts. For instance, cohorts 2000 and to a lower degree in 2003, show an initial positive sign that from the fifth year onwards turns into negative. In other words, the previous general negative coefficient of the interaction is divided into two different segments: a positive one at the beginning and then a negative one, showing that indeed the positive correlation derived from economies of growth and learning effects has certainly, a limit.

In cohort 2002 correlation goes in the opposite way from negative to positive, meaning that young firm growth would tend to have an initial erratic period after which some persistence could be observed following the premises of evolutionary routines and RBV´ superior resource endowments. Finally, cohort 2001 displays a negative correlation, which then becomes non-statistically significant in the last five years.

As a complement to the spline functions' approach, we run an additional model including the squared of age and the interaction between this term and previous growth. Doing so, we are able to test for the presence of a non-linear effect between both variables. In general, the results for these regressions are similar to those obtained by the spline functions[27]. In all the cohorts a general positive correlation is observed. However, once the non-linear moderating role of age is considered, by means of a quadratic term, results tend to coincide with those for the spline functions. In cohort 2000 previous growth would positively affect current growth until some age where the sign changes. On the contrary, in cohort 2002 the interaction between previous growth and age shows a negative sign at the beginning that after certain point turns into positive. Cohorts 2001 and 2003 show no statistically significant association. Overall, including this term proves to be a complementary approach to model the non-linear moderating role of firm age on growth autocorrelation.

In sum, the results of the regressions tend to confirm the persistence of growth rates among young firms. Nevertheless, we were able to show the importance of age as a moderator of such correlation, supporting our research proposition. In fact, our spline functions' approach revealed the differences in the sign of the correlation between the first five years and the following five ones. In addition, we find out that each cohort exhibits a quite different pattern concerning the way in which past and current growth are related.

Finally, to test the robustness of our results, the same regressions are run but dividing the sample into four groups according to firms' initial size - defined in terms of sales[28]. Table 3.5. shows the results for our basic model according to the size disaggregation, by cohort.

[27] The complete outputs for these regressions are included in the Appendix.

[28] Due to data limitations on employees, sales are used to build the size bands. For doing that, initial size was calculated as average sales of each firm for each cohort for the first three years. Then, for each cohort firms were divided into quartiles according to this initial size measure. Descriptive statistics about these size bands are presented in the Appendix.

Table 3.5. Regression results according to size bands. By cohort

Cohort	Variable	Size				Full sample
		1° quartile	2° quartile	3° quartile	4° quartile	
2000	lag_growth	+	+	+	+	+
	lag_age	–	–	–	–	–
	lag_age x lag_growth	–	–	–	–	–
2001	lag_growth	+	+	+	+	+
	lag_age	–	–	–	–	–
	lag_age x lag_growth	–	–	–	–	–
2002	lag_growth	+	+	+	+	+
	lag_age	–	–	–	–	–
	lag_age x lag_growth	–	–	–	–	–
2003	lag_growth	+	+	+	+	+
	lag_age	–	–	–	–	–
	lag_age x lag_growth	–	–	–	–	–

Note: cells in bold are those statistically significant at the 10% level. The full regression outputs are presented in the Statistical Appendix.

In general, the growth persistence observed in the full sample also holds when dividing firms according to their initial size. In all the studied cohorts, the coefficient of lag_growth tends to be positive. Concerning the moderator role of age, captured by the interaction term, the results are also in the same direction of the full sample, although some coefficients are not statistically significant. Results are less robust when introducing the spline functions' approach as Table 3.6 illustrates. Hence, some additional caution should be placed when generalizing these results since they could be affected by firms' initial size.

Table 3.6. Regression results according to size bands. By cohort

Cohort	Variable	Size				Full sample
		1° quartile	2° quartile	3° quartile	4° quartile	
2000	lag_growth	–	+	+	+	+
	lag_age1 x lag_growth	+	+	+	+	+
	lag_age2 x lag_growth	–	–	–	–	–
2001	lag_growth	–	+	+	+	+
	lag_age1 x lag_growth	+	–	–	–	–
	lag_age2 x lag_growth	–	–	+	+	–
2002	lag_growth	+	+	+	+	+
	lag_age1 x lag_growth	–	–	–	–	–
	lag_age2 x lag_growth	–	+	+	+	+
2003	lag_growth	+	+	+	+	+
	lag_age1 x lag_growth	–	–	–	–	+
	lag_age2 x lag_growth	–	+	–	+	–

Note: cells in bold are those statistically significant at the 10% level. The full regression outputs are presented in the Statistical Appendix.

In sum, the previous analysis allow us to conclude that while the positive autocorrelation among growth rates tend to be similar regardless the initial size, the moderator role of age in such autocorrelation could be indeed affected by initial size. This would suggest that heterogeneity is a key point that deserves more attention and that the join effect of age and size as moderator should be investigated. In the same vein, we find that each cohort tend to exhibit different results, which reinforces the need for advancing in cohort studies.

3.5 Discussion and implications

The departing point for this paper was the recent debate about young firm growth as a random process and the Gambler´s Ruin approach (Coad, Frankish, et al., 2013a; Storey, 2011) which challenges most of our convictions about firm growth and its determinants or, at least, force us to think in how to conciliate theory and evidence.

One of the main points in this debate refers to the degree of autocorrelation of growth rates, i.e. firm growth persistence. Under the randomness perspective, growth rates should not be correlated over time, the same principle that supported Gibrat´s Law. Therefore, a reappraisal of the Gibrat´s debate has emerged in the literature, with two “contenders”. On the one hand, the random perspective where no correlation should be expected and, on the other, the strategic perspective under which growth rates are correlated but the sign is not clear (Stam, 2010).

Most theories from economics and management tend to support the existence of a positive correlation. In particular, in the case of young firms, the struggle to survive and the existence of economies of growth (Penrose, 1959) lead us to expect that a growth period would be followed by another growth period.

However, this positive association does not last forever. Indeed, the same E. Penrose affirms that growth processes would face at some point an endogenous limit caused by the increasing complexity and difficulty to continuously release and recombine resources in order to profit from new emerging opportunities. As well, empirical evidence on young business growth trajectories clearly illustrates that young firms growth is characterized by growth setbacks, plateau stages, crises and reversals (e.g. Blackburn & Brush, 2009; Garnsey & Heffernan, 2005; Garnsey et al., 2006). Finally, as Garnsey's (1998) model affirms, after an initial period of some sequential stages, growth could assume different patterns. All this, would lead to us expect a negative correlation.

In this context, we advance this study trying to contribute with new evidence to inform this debate, focusing particularly on the case on young business growth. Particularly, we argue for a moderator role of firm age in the correlation between past and current growth rates.

3.5.1 Summary of results

Two are the most important results from our study. First, firm growth hardly could be characterized as random. On the contrary, our regression results and the coin flipping analysis confirm the existence of a positive correlation. Theoretically, this result would support the struggle of young firms to reach some minimum efficient scale and survive. In addition, it could be an indication of intensive learning effects and economies of growth (Penrose, 1959) at the firm level that take place during the initial years, just as Coad, Daunfeldt, et al. (2015) and Coad, Segarra, et al. (2013) find in their studies.

However, this positive correlation does not hold as long as firm matures. This is the main contribution of our study, i.e. the moderator role of firm age. In fact, our results show that growth rates become more erratic with age. In particular, our spline regressions show that this moderator role does not tend to be uniform between age segments and also between cohorts, being the fifth year a turning point as Anyadike-Danes & Hart (2014) suggest.

These result goes in line with the most recent evidence implying that as long as firm matures growth is increasingly erratic and hence, harder to be predicted (Coad, Frankish, et al., 2013b). In the same vein, these results are compatible with Lotti et al. (2007) who find that Gibrat's Law could be a valid heuristic in the long term as long as cohorts of firms mature.

As well, this lack of persistence of growth as firm evolves points out the difficulties of sustaining continuous growth during several years, as Penrose (1959) has already stated. This fact has also been shown in several studies (e.g. Capasso et al., 2014; Coad & Hölzl, 2009; Hamilton, 2012; Parker et al., 2010) and constitutes a relevant research topic on its own which deserves more research since it has important policy implications given the amount of public attention that has been posed on young growing firms. In addition, as Frankish, Roberts, Coad, Spears, & Storey (2013) affirm, the lack of persistence could be associated with the complexity of sustaining effective learning processes during these initial years of higher volatility and turbulence at the micro-level and where the context changes rapidly, as in our case.

3.5.2 Implications and future research agenda

Both results have relevant implications, mostly for theory development. The first issue to be raised is the same that Derbyshire & Garnsey (2014) pointed out in their critic to the Gambler´s Ruin approach and refers to the difference between randomness and unpredictability. We share with Coad, Frankish, et al. (2013a) and Storey (2011) that the explanatory power of most of the growth studies is rather low (and this one is not an exception). However, we do not agree that this fact, that reveals a methodological limitation, may imply that growth is (close to) random. On the contrary, leaving aside this methodological issue for a while, this fact may imply that predicting future growth paths is too difficult, particularly for young firms. This is so, because young firms are affected not only by external factors but also by internal crises, setbacks and trial and error processes.

Changing Coad, Frankish, et al. (2015) words, we think that neither randomness (alone) nor determinism (alone) would constitute suitable approximations to young firm growth. Like some scholars suggest it is necessary to overcome this "competition" and move towards the complementation between both approaches (Anyadike-Danes & Hart, 2014; Stam, 2010). One particular interesting avenue has been proposed by Derbyshire & Garnsey (2014) by considering firms as complex adaptive systems, whose performance is subjected to deterministic chaos.

Nonetheless, this does not mean to minimize the role played by randomness on firm growth. On the contrary, the challenge is to develop new conceptual models that can accommodate randomness in the context of the previous literature about firm growth and its determinants. Denrell et al. (2015) offers several examples from strategy and organizational theory in that direction.

Likewise, from an empirical point of view, this reappraisal of Gibrat´s legacy about the randomness of firm growth should be complemented by new evidence and new methods that allow us to take full advantage of the information of large panel datasets and considering the heterogeneity and dynamics of growth rates autocorrelation. New developments in quantile regressions in panel data suggested by Capasso et al. (2014) could be a way of deal with these issues. Another improvement could be developing more cohort studies and Markov chain transitions analyses like Anyadike-Danes & Hart (2014) did. Additionally, more qualitative research is needed to get a deeper understanding of the whole process of growth from entrepreneurs' perspective and its implications.

Finally, it is ought to say that this study is not free of limitations. First, as it was mentioned throughout the text, the database used has several weak points and possible bias that make us cautious in generalizing our results. Secondly, this study would be greatly improved by adding employment data. This variable is highly relevant from a policy point of view and would allow us to analyse the sensitivity of our results to different growth specifications. In addition, including employment headcounts as an independent variable would allow us to analyse the moderator role of size and age at the same time and advance our understanding of the complexity and heterogeneous nature of the growth process. Finally, the period under study was a singular one, where a huge volatility at the macro level has been registered, questioning the generalization of the obtained results.

In spite of these limitations, we contribute with a novel insight to this new debate about growth autocorrelation that continues open and vibrant. There is still much work to do in this regard and many questions remain looking for answers.

4. PERSISTENCE AND IMPACT OF HIGH GROWTH ON PROFITS: THE CASE OF YOUNG FIRMS (PAPER 3)

4.1 Introduction

High growth firms (hereafter, HGFs) constitute nowadays a vibrant topic among entrepreneurship scholars and has attracted great attention from policy-makers. In general, HGFs represent only a small proportion of the total population of firms, between 3% and 6%, depending on the country and the studied period (Bravo-Biosca, 2010; Henrekson & Johansson, 2010). Limited, though, this group of HGFs is responsible for a disproportionate amount of new jobs as many studies have shown (Acs et al., 2008; Anyadike-Danes et al., 2015; Bravo-Biosca, 2010; Henrekson & Johansson, 2010; Hölzl, 2014; Schreyer, 2000). In addition, recent studies show that HGFs often are likely to employ those groups with higher barriers to enter into the labor markets (Coad, Daunfeldt, Johansson, & Wennberg, 2014). Finally, other studies reveal the importance of such HGFs for innovation (Coad & Rao, 2008; Coad, Segarra, & Teruel, 2016; Colombelli, Krafft, & Quatraro, 2013; Hölzl, 2009; Segarra & Teruel, 2014; Stam & Wennberg, 2009).

Precisely, because of the importance of HGFs to economic growth, policy-makers started to promote specific policies and programs towards this group of firms (Mason & Brown, 2011; Shane, 2009). To inform these policies, a number of studies has emerged trying to characterize these HGFs and searching for the main determinants or antecedents of such extraordinary growth (e.g. Acs et al., 2008; Barbero et al., 2011; Capelleras, Mole, Greene, & Storey, 2007; Hoxha & Capelleras, 2010; Lopez-Garcia & Puente, 2012; Moreno & Casillas, 2007; Parker et al., 2010). One salient 'stylized fact' from this literature is that HGFs tend to be more frequent among the youngest firms but not necessarily among the smallest (Coad, Daunfeldt, Hölzl, Johansson, & Nightingale, 2014; Daunfeldt, Elert, & Johansson, 2014; Haltiwanger et al., 2013; Moreno & Coad, 2015).

Nevertheless, some recent studies call for a less enthusiastic approach towards HGFs (Daunfeldt, Elert, & Johansson, 2014; Nightingale & Coad, 2013). These authors highlight the biases that the policy discourse has when interpreting the evidence about the contribution of HGFs, which in turn, is affected by a number of methodological issues (Nightingale & Coad, 2013) and also by the choice of the growth measure (Daunfeldt et al., 2014).

In the same vein, recent evidence demonstrates that HGFs have in general several difficulties to sustain their growth path during successive periods of time (Capasso et al., 2014; Coad, 2007a; Hölzl, 2014; Parker et al., 2010). This fact leads to the idea of HGFs as "one hit wonders" (Daunfeldt & Halvarsson, 2015; Hölzl, 2014) and challenges many of the aforementioned policy implications of such firms. In particular, from a policy perspective, the low persistence of high growth episodes would make difficult to identify HGFs *ex ante* based on their current performance and even harder to predict their mid-term outcomes.

One plausible explanation of the incapacity of firms to sustain successive periods of high growth refers to the relationship between (high) growth and profits. The conventional wisdom affirms that retained profits would finance future expansion; therefore, a positive relationship would be expected. Indeed, Davidsson et al. (2009) find that those firms with superior profits are more likely to experience high growth afterwards. Nevertheless, the empirical evidence is mixed and inconclusive (Coad, 2007c; Delmar et al., 2013; Federico & Capelleras, 2015). Importantly, in a recent contribution, Daunfeldt, Halvarsson, & Mihaescu (2015) reveal that before their growth period, HGFs did not exhibit a superior financial performance, making more difficult to sustain such pattern of growth.

Our study addresses these two conflicting facts about HGFs where empirical evidence is still limited. First, we analyze what happens to HGFs after their high growth episodes. For doing that, a single cohort of Spanish firms will be followed throughout four successive 3-year period (1997-2000, 2001-2004, 2005-2008 and 2009-2012) and transition matrices will be estimated to trace the different paths followed by them. Unlike previous studies that only compare HGFs with non-HGFs, we introduce several categories of growth (decline, stasis, low growth, moderate growth and high growth) in order to see the broader picture and analyze where HGFs come from and to which category they move afterwards.

Then, in a second stage, we estimate the impact of experiencing such high-growth episodes at the firm level, specifically on profits. Most available evidence on HGFs refers to the impact of high growth on job creation (for a review see, Henrekson & Johansson, 2010). Just a few studies point to the effect on the survival rate of HGF after their high growth episode (Acs et al., 2008; Hölzl, 2014) and only two (as far as we know) deal explicitly with the impact of high growth on profits (Markman & Gartner, 2002; Senderovitz et al., 2015). It follows that empirical evidence about this relationship in the case of HGFs is still scarce and more research is needed (Moreno & Coad, 2015; Wennberg, 2013).

The novelty of our study is to examine the role of firm age as a moderator of such relationship. In fact, we expect that during the initial years of a firm, high growth could be negatively associated with profits due to the existence of trial and errors learning processes and adjustment costs. However, by the same logic as long as firms mature they would become more capable to accommodate such growth without losing profits. Hence, a positive relationship between high growth and profits may be expected.

The results of our study tend to confirm previous evidences about the lack of persistence in high growth rates but contrast our expectation on a negative impact on profits. On the contrary, our study shows a positive yet small effect, which tends to increases slightly as firm matures, supporting our hypothesis on the moderating role of firm age. This is the main contribution of this study.

The remainder of this paper is organized as follows. Next, we discuss our theoretical background and justify our research hypotheses. In the following section, we describe the sample and variables used in our study. Then, we analyze our main empirical results. First, we deal with the issue of high growth persistence and later on, with the impact of such high growth episodes on profits. Finally, we discuss the main findings of our study in the light of the reviewed literature.

4.2 Theoretical background and hypotheses

4.2.1 On the (high) growth persistence

From a theoretical perspective, several approaches tend to sustain a positive correlation among growth rates. In the RBV tradition (Barney, 1991; Peteraf & Barney, 2003), this autocorrelation derives from persistent differences among firms' resources and capabilities that lead to persistent differences in firm performance. With the same logic, strategic management advocates, would sustain that persistent differences in firm performance derive largely from the adoption of more appropriate strategies, given the general business environment they face. In the same vein, the existence of established organizational routines – main foundations of the evolutionary theory of the firm (Nelson & Winter, 1982; Nelson, 1991) - also tends to favor a positive correlation on firm performance due to persistent asymmetries among firms' capabilities and their learning trajectories (Capasso et al., 2014).

Bottazzi & Secchi (2003), in turn, also support a positive correlation by considering growth as a self-reinforcing process. In fact, these authors mention a number of positive feedbacks, such as scale economies, network externalities and knowledge accumulation, which could help explaining the 'tent-shaped' distribution of firm growth rates observed in many studies where a number of fast-growing firms are identified. Penrose's 'economies of growth' and the learning by-doing process they implied could also be considered as part of these positive feedbacks that contribute to justify why growth could be serially correlated. Finally, growth persistence could also be viewed as a rejection of Gibrat's (1931) Law, which postulates that firm growth rates are independent across firms and through time. In other terms, growth rates will be random.

However, recent empirical contributions emphasized that growth trajectories are less persistent than expected, especially during the earlier years. Conversely, young firm performance appears to be quite volatile, that is, characterized as a sequence of several ups and downs, setbacks, post-entry mistakes and reversals (Garnsey & Heffernan, 2005; Garnsey et al., 2006; Santarelli & Vivarelli, 2007). This quite erratic path of growth would imply a negative correlation between growth rates through time, indeed. Actually, many recent studies show a negative relationship between past and current growth (Capasso et al., 2014; Coad & Hölzl, 2009; Coad, 2007a).

In the particular case of HGFs, the vast majority of recent studies show that high growth is markedly episodic and hard to be sustained for more than one period, giving the idea that they are "one hit wonders" (Coad & Hölzl, 2009; Coad, 2007a; Daunfeldt & Halvarsson, 2015; Hamilton, 2012). Acs et al. (2008), for instance, affirm that after their high growth episode, the most likely scenario for HGFs is to return to the industry average. More recently, Daunfeldt, Elert, & Johansson (2014) and Hölzl (2014) highlight that this lack of persistence tends to hold with some nuances regardless the HGF definition adopted and the type of growth measure used.

Parker et al. (2010) also report evidence on the difficulties to sustain such high-growth periods in their study of British gazelles. More importantly, these authors are one of the fewest that offer a conceptual explanation for this lack of persistence. They center their attention on the need of having a flexible, dynamic strategic management. Actually, their study shows interesting insights on sound strategies that had led to high growth periods in the past and that do not assure growth periods in the present due to the changing environment.

Qualitative evidence from case studies, in turn, also reveal that sustained high-growth trajectories, though feasible, are not dominant (Garnsey & Heffernan, 2005; Garnsey et al., 2006). In particular, some of these studies illustrate the myriad of difficulties that entrepreneurs face to manage such growth path for a long period (Blackburn & Brush, 2009;

Brush et al., 2009; St-Jean, Julien, & Audet, 2008). Thus, in the light of the previous discussion, we propose our first hypothesis:

H1: High growth rates among young firms are not persistent over time.

4.2.2 On the impact of (high) growth on profitability

One of the possible explanations for the lack of persistence in high growth rates may refer to how to finance such continued expansion, something that brings us to the relationship between high growth and subsequent profits. Indeed, a positive relationship between growth and profits is favored by several traditional economic theories. First, according to neoclassical firm theory, successive increments in firm size along the cost curves would imply successive gains in terms of profits, as long as the firms are approaching the MES, due to the exploitation of scale economies (Hart, 2000). Secondly, dynamic increasing returns as described by the Kaldor–Verdoorn principle would also imply a positive impact of growth on profits. In this logic, growth would foster firms' investments in their own capabilities and in new technologies, generating an increase in firm productivity and ultimately, profits (Coad, 2007c). In the same vein, Markman & Gartner (2002) argue that high-growth firms may attract highly trained CEOs and employees, and thus, improving their efficiency and productivity levels and hence, their profitability.

First mover advantages may play a role too (Lieberman & Montgomery, 1998; Steffens et al., 2009). Getting privileged access to commercial channels, imposing a brand or limiting customers' perceptual space are some examples of ways in which those firms that experienced a quick enter into the market and have rapidly achieved a dominant market position may profit from this growth trajectory and translate it to higher profits.

However, the empirical evidence on the impact of growth on profits is inconclusive. On the one hand, some studies conclude that firms pursuing high-growth strategies early on their lives may perform poorly in terms of profits (Brännback et al., 2009; Davidsson et al., 2009; S. Lee, 2014; Steffens et al., 2009). But, on the other hand, there is evidence of a positive relationship between growth and profits (Bottazzi et al., 2010; Coad, 2007c, 2010; Delmar et al., 2013). In a previous contribution, we also find evidence of a positive influence of sales growth on profits in the case of young firms, but highly influenced by inter- and intra-industry heterogeneity (Federico & Capelleras, 2015).

In the particular case of HGFs, the empirical evidence is not only inconclusive but also scarce. In one of the few articles on this subject, Markman & Gartner (2002) did not find any statistically significant association between extraordinary growth and subsequent profits by analyzing three cohorts of *Inc 500* companies. More recently, Senderovitz et al. (2015) report a general positive relationship between high-growth and profitability among a sample of Danish gazelles. Quite interestingly, they find that this positive effect is moderated by the market strategy. In fact, those firms with a broader market focus will experience a higher effect on profitability than those with a niche approach.

Qualitative studies, on the other hand, clearly illustrate that HGFs face a number of organizational challenges, difficulties and resources shortages that make it difficult not only to manage such high growth episodes but also to translate them into higher profits (Blackburn & Brush, 2009; Brush et al., 2009; Hambrick & Crozier, 1985). High growth often implies building new organizational structures, adjusting the organizational procedures and systems as well as decision-making processes. Trying to accommodate the needs for a growing firm also implies some risks. As Brush et al. (2009) state, HGFs are *'cash hungry machines'* and therefore, new sources of finance as well as accounting systems should be rapidly put in motion. Additionally, these firms may need to hire new employees that should be quickly trained and combined with the existing taskforce. All this increased managerial and organizational complexity may lead to new and higher costs that in turn, would have a negative impact on profits. Therefore, we propose our next hypothesis:

H2: High growth among young firms has a negative impact on subsequent profits.

4.2.3 The moderating role of firm age

Firm age is a relevant variable in organizational studies and tends to proxy the maturity of organizational processes. Indeed, there are sound reasons to expect that the relationship between (high) growth and profits varies over time as the firm ages and evolves (Steffens et al., 2009). These authors found that although young firms tend to show at the beginning a superior performance in terms of growth *and* profits, three years later they were less likely to sustain this state and perform poorer than older firms. In the same vein, S. Lee (2014) finds that the positive effect of growth on profits is verified only within older firms.

In particular, life cycle models tend to highlight that during their earlier years firms do not exhibit established routines, processes and structures (Garnsey, 1998). Neither do they have the necessary managerial and financial resources. In addition, young firms' managers often tend to rely on excessive trial and error experimentation without a clear strategy, which may have a negative effect on profits (Markman & Gartner, 2002). Moreover, Steffens et al. (2009)

argue that new firms often lack the most critical element: a product that creates value for the customer and from where they may start a profitable growth trajectory. Hence, one could argue that as a reflection of these trial and errors, early entry mistakes and under-developed structures and procedures, having a high growth episode during the earlier years of a firm could be detrimental in terms of profits. On the contrary, once the firm has certain established routines, more accumulated experience and resources, it would become more capable to accommodate such high growth episodes without losing profits. Therefore, we propose our third hypothesis on the moderating role of firm age.

H3: The effect of high growth on profits among young firms is moderated by firm age, such that it is negative in their earlier years and then, turns to be positive as long as the firm ages and matures.

4.3 Data and variables

4.3.1 Sample

Data for this study is taken from the SABI© (*Sistema de Análisis de Balances Ibéricos*) database, collected and provided by Bureau Van Dijk and based on the Official Registry of Spanish Companies. This database has been increasingly used by researchers in previous growth studies in Spain (e.g. Barbero et al., 2011; Coad, Segarra, et al., 2013; Coad & Teruel, 2012; Segarra & Teruel, 2012).

Our study is based on the analysis of a single cohort of young Spanish firms, including manufacturing firms (i.e., NACE Rev. 2 2-digit Classification codes 10 to 33) as well as services firms (i.e. NACE Rev. 2 2-digit Classification codes 49 to 79). All firms were created from January 1 to December 31 1996 and were followed over a 16-year period, from 1997 to 2012. Since we focus in 'organic' (i.e. internal) growth, those firms which control other firms and those controlled by another firm were removed from an initial list extracted from the SABI© database.

From an initial list of 9,487 firms, we first removed those with interrupted spells in the series and missing values in sales, profits and/or employment. Then, we extract form the dataset those observations without information on sales and/or employment for the first two years, i.e. firms with less than 2 consecutive years of data (or at least one year of growth), arriving at a final unbalanced panel of 1,298 firms in 1997, from which 743 managed to survive until 2012[29].

Table 4.1 shows some descriptive statistics of sales and employment of our panel and its evolution over time. As it could be observed, our panel includes firms from all sizes, with a relative dominance of small companies (i.e. the median number of employees is on average seven, throughout the studied period)[30].

4.3.2 Variables and summary statistics

This study focuses on the persistence of high-growth rates as well as on the impact of high growth on profit. Our measure of high-growth is based on sales growth. Despite the criticism made by Derbyshire & Garnsey (2014) about the utilization of sales as a size measure, we use sales because it is the preferred and most used success measure among entrepreneurs (Achtenhagen et al., 2010). In addition, using employment instead of sales may underestimates changes in firm size, especially in new and young firms that use to be rather small, due to the integer nature of headcounts (Coad, Frankish, et al., 2013a).

Following Eurostat-OECD (2008) Manual of Business Demography, we define in principle high growth rates as *"…all enterprises with average annualized growth greater than 20% per annum, over a three year period…"* (Eurostat-OECD, 2008, p. 61)[31]. However, we introduce a variation over such definition by not considering the threshold of 10 employees at the beginning of the period.

[29] One of the shortcomings of SABI© dataset is that it tend to underestimate business exists, because it includes mostly private and public limited companies. As Coad, Segarra, et al. (2013) explain, SABI© may have difficulties to capture exits because firms must report their exit to the Mercantile Register and it is frequent that some of them forget this obligation. However, these authors affirm that this fact may only represent a small proportion of firms.

[30] Due to the limitations of the SABI© mentioned before, it is also possible to have to some extent of sample selection bias. In order to test the relevance of that, we run some comparisons with the database from the National Statistical Institute – the Directorio Central de Empresas [Central Directory of Firms] - for this cohort and some significant differences are found, especially among services. Therefore, some caution should be advisable when interpreting and generalizing the results. These tables are presented in the Statistical Appendix.

[31] Note that this definition excludes those firms that did not survive the third year of operations. Hence, a further survival bias could be identified, but this should be common to all those studies that use the Eurostat-OECD definition.

Table 4.1. Summary statistics (sales & employment), by year

Annual Sales (000 Euros)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
mean	570	749	860	1,029	1,104	1,160	1,193	1,266	1,345	1,450	1,587	1,556	1,334	1,453	1,461	1,477
sd	2,539	2,982	2,914	3,824	3,845	3,809	3,771	4,127	3,984	4,117	4226,38	3,863	3,515	4,228	4356,95	4,440
p10	69	97	116	129	139	140	148	161	168	168	170	159	138	140	120	114
p25	140	187	218,5	239	263	279	295	304	316	354	386	356	285	289	254	239
p50	269	369	426	513	543	570	619	666	713	757	804	722	596	627	609	573
p75	558	753	906	1,038	1,099	1,186	1,226	1,312	1,420	1,563	1,691	1,620	1,379	1,363	1,333	1,375
p90	1,064	1,463	1,774	2,048	2,199	2,262	2,463	2,602	2,797	2,995	3,208	3,178	2,655	3,067	3,035	3,211
N	1,298	1,296	1,288	1,275	1,213	1,167	1,119	1,080	1,046	1,019	986	916	872	829	797	743

Employees	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
mean	7	9	10	11	11	11	12	12	12	13	13	12	12	12	12	11
sd	12	14	17	18	18	18	19	19	19	19	20	19	19	19	19	20
p10	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
p25	2	3	3	4	4	4	4	4	4	4	4	4	3	3	3	3
p50	4	5	6	7	7	7	7	8	8	8	8	8	7	7	6	6
p75	8	10	11	12	13	13	14	14	15	14	15	15	14	14	14	14
p90	14	18	20	22	24	24	24	25	26	27	27	27	26	26	27	26
N	1,298	1,296	1,288	1,275	1,213	1,167	1,119	1,080	1,046	1,019	986	916	872	829	797	743

The threshold has been suggested in order to avoid small firms with negligible changes in the number of employees to be considered as high-growth firms. Certainly, this is not our case since we are computing growth in terms of sales rather than headcounts, lowering indeed such risk. But more importantly, the same manual affirms that "… *if at any time (xx-1 or xx-2, and xx for turnover based measures) the number of employees falls below the employee threshold the enterprise can still be regarded as a high-growth enterprise so long as between xx-3 and xx total growth is 72.8% or higher…"* (Eurostat-OECD, 2008, p. 62). Hence, it appears that the threshold is not operative when sales are used as the growth measure.

The formula defining the average annualized growth rate is:

$$growth = \sqrt[3]{\frac{sales_t}{sales_{t-3}}} - 1$$

Based on this calculation, we build a categorical variable that captures different growth status, as Table 4.2 describes. In addition to high growth, we consider other growth categories such as moderate growth (i.e. between 10% and 20%) and low growth (i.e. between 5% and 10%). We also include stasis (i.e. between 5% and -5%) and decline (i.e. less than -5%) to complete all the possible growth status.

Table 4.2. Description of the different growth status

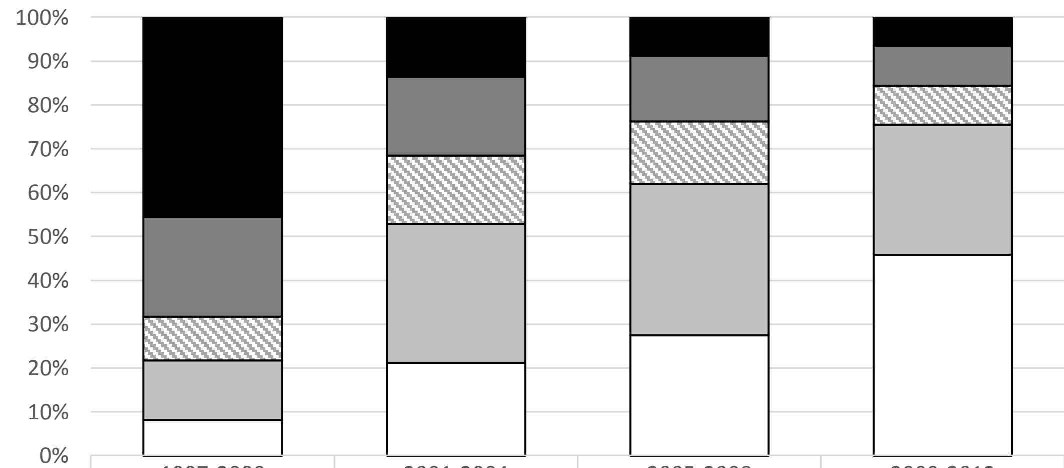
Status	Definition	Calculation
Decline	Those firms that experienced a decline of 5% or more in the last three years	$\sqrt[3]{Sales_t / Sales_{t-3}} - 1 < 0.8573$
Stasis	Those firms that either experience a decline in sales up to 5% or a growth of less than 5%	$0.8573 \leq \sqrt[3]{Sales_t / Sales_{t-3}} - 1 < 1.1576$
Low growth	Those firms that experience an average annualized growth greater or equal than 5% per annum but lower than 10%	$1.1576 \leq \sqrt[3]{Sales_t / Sales_{t-3}} - 1 < 1.331$
Moderate growth	Those firms that experience an average annualized growth greater or equal than 10% per annum but lower than 20%	$1.331 \leq \sqrt[3]{Sales_t / Sales_{t-3}} - 1 < 1.728$
High growth	Those firms that experience an average annualized growth greater or equal than 20%	$\sqrt[3]{Sales_t / Sales_{t-3}} - 1 \geq 1.728$

Next, we present the growth composition of each of the four 3-year periods considered in our study (1997-2000; 2001-2004; 2005-2008 and 2009-2012)[32]. As Figure 4.1 shows the percentage of high-growth firms is much higher during the first period, capturing the negative

[32] For the calculation of the growth rates we took the first entire year as our initial year, that is, growth rates are measured starting from 1997 (i.e. year 2 of the cohort).

relationship between growth and firm age and the struggle of newly born firms to survive. Then, in the next 3-year period, stasis appears to be the dominant state, whereas the proportion of high growth firms drops until 13%. This pattern is deepened in the last two 3-year period. On the one hand, it evidences a general decrease in the average growth rate of the cohort as it ages, with more firms moving to the stasis or declining status. On the other hand, it reflects the downturn in the economic cycle due to the global crisis, which had serious impacts on the Spanish economy.

Figure 4.1. Growth composition, by period



	1997-2000	2001-2004	2005-2008	2009-2012
high	45,5%	13,5%	8,7%	6,5%
moderate	22,8%	18,1%	15,0%	9,2%
low	9,9%	15,5%	14,3%	8,9%
stasis	13,6%	31,9%	34,5%	29,6%
decline	8,2%	21,1%	27,5%	45,9%

Growth composition by different size class is presented in Table 4.3. We differentiate four size bands based on employment data (0 to 4, 5-9, 10-20 and more than 20). The results of Table 4.3 show that even in the last periods where the number of high growth firms declines, larger firms (+ 20 employees) usually account for a higher proportion of growing firms (moderate & high growth). Conversely, smaller firms tend to be overrepresented among stasis and declining status.

Table 4.3. Growth composition by size class, by period (in %)

	1997-2000				2001-2004				2005-2008				2009-2012			
	0 – 4	5 - 9	10 - 20	+ 20	0 – 4	5 - 9	10 - 20	+ 20	0 – 4	5 – 9	10 - 20	+ 20	0 – 4	5 - 9	10 - 20	+ 20
decline (1)	12.4	8.3	4.3	3.1	29.7	21.6	14.3	15.7	36.9	31.7	22.4	11.4	60.4	47.1	31.2	28.7
stasis (2)	15.2	13.2	13.0	11.7	31.6	33.0	31.7	30.2	32.8	36.2	34.7	34.2	21.8	31.9	38.9	32.2
low (3)	11.5	9.0	9.4	8.6	11.3	16.4	16.4	20.1	11.8	11.9	17.8	17.7	5.4	7.9	11.5	15.7
moderate (4)	24.1	25.9	20.2	16.0	13.9	17.3	24.0	17.0	12.2	14.2	15.1	20.9	5.4	7.9	10.8	18.3
high (5)	36.8	43.5	53.1	60.5	13.5	11.7	13.6	17.0	6.3	6.0	10.0	15.8	7.1	5.2	7.6	5.2
total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Based on this categorization of business growth, a number of transition matrices are estimated. The length of the studied period allow defining four consecutive 3-year periods (i.e. 1997-2000; 2001-2004; 2005-2008 and 2009-2012) and hence 3 transition matrices. The rows of the matrices describe the different growth states at the end of the first 3-year period and the columns the corresponding growth states at the end of the 2nd, the 3rd and the 4th 3-year period. A final state, which includes business exits, is also included. These analyzes will provide the evidence to test the first hypothesis, namely, to what extent high-growth episodes could be sustained over more than a 3-year period.

The second and third research hypotheses deal with the impact of high growth episodes on successive firm profits. In other terms, whether or not experiencing a high growth period "pays" its benefits in terms of increased profits. Specially, the third hypothesis states that that firm age acts as a moderator of such relationship. In order to test these hypotheses, a couple of econometric models are estimated. Formally, the estimated model is the following:

$$profit_{it} = \alpha + \beta_1 profit_{it-1} + \beta_2 highgrowth_{it-1} + \beta_3 age_{it-1} + \beta_4 size_{it-1} + \phi Sector_i + \theta year_t + \varepsilon_{it}$$

$Profit_{it}$ is the dependent variable measured in terms of the profit margin, i.e. the quotient between gross operating surplus and sales. A relative measure, such as profit margin, is preferred in order to avoid spurious associations and the effect of firm size. The main variable of interest is a dummy variable that assumes the value 1 if the firm is considered as a HGF (using the criteria established in Table 4.2) and 0 otherwise. As control variables lagged values of the dependent variable, firm age, and firm size (measured by the log of employees) are included. As well, a set of industry dummies are introduced to capture the differences among sectors and a set of time dummies to control for the presence of macroeconomic shocks that affect all firms, which are very relevant in the Spanish case during this period.

Then, in a second specification, an interaction term between high growth and age is introduced in order to test the existence of a moderating role of firm age on the effect of high growth on profits. The next section summarizes the main results of all these analyses.

4.4 Main results

4.4.1 On the persistence of high-growth firms

The first objective of this paper is to study to what extent HGF are able to maintain high growth episodes for more than one period. In the same spirit of Hölzl (2014), this study analyzes whether firms that experience high growth during their earlier years are able to repeat this pattern, three, six or nine years in the future. In other words, denoting with *t* the final year of the initial 3-year period of growth, the focus is to investigate what happens with HGFs in *t+3*, *t+6* and *t+9*.

Table 4.4 resumes the different transition probabilities between *t, t+3, t+6* and *t+9*. Panel A indicate that just 12% of the high-growth firms in *t* remain in the same group in *t+3*. Interestingly, more than 40% of such firms move to the stasis or declining groups (24% and 20%, respectively). A meaningful proportion (18%) continues to growth, but in a slightly lower rate. On the other hand, the same Panel A shows that high-growth firms constitute a kind of 'members-only' club in the sense that only 11% of the firms from the rest of the states were able to move to high growth three years later. Finally, HGFs do not show a survival rate significantly different from the other categories, except those firms that started their lives with declining growth rates.

Table 4.4. Transition matrices (t, t+3); (t, t+6); (t, t+9).

	Panel A. Growth status (t+ 3)					
growth status (t)	(1)	(2)	(3)	(4)	(5)	exit
decline (1)	11.5	16.3	9.6	4.8	10.6	47.1
stasis (2)	14.9	36.2	8.6	11.5	12.1	16.7
low (3)	17.5	28.6	15.9	18.2	10.3	9.5
moderate (4)	18.2	29.9	15.1	14.8	11.0	11.0
high (5)	20.0	24.3	13.4	18.1	11.5	12.6
	Panel B. Growth status (t+6)					
growth status (t)	(1)	(2)	(3)	(4)	(5)	exit
decline (1)	9.6	14.4	1.9	9.6	6.7	57.7
stasis (2)	23.0	24.7	10.9	6.3	5.2	29.9
low (3)	19.0	32.5	11.9	14.3	4.8	17.5
moderate (4)	21.6	25.4	10.6	13.7	4.5	24.0
high (5)	19.8	24.7	11.0	10.0	7.8	26.7

	Panel C. Growth status (t+9)					
growth status (t)	(1)	(2)	(3)	(4)	(5)	exit
decline (1)	20.2	6.7	1.0	1.9	3.9	66.3
stasis (2)	21.3	21.3	7.5	2.9	1.7	45.4
low (3)	32.5	18.2	3.2	7.1	7.9	30.9
moderate (4)	28.2	18.6	6.2	5.1	3. 8	38.1
high (5)	27.6	17.1	5.2	6.4	3.4	40.3

The abovementioned results tend to be intensified when the transition between *t* and *t+6* is considered (Panel B). Almost 8% of the high growth firms tend to repeat this pattern and nearly 45% has moved to declining or stasis states. Finally, these results are even more pronounced in *t+ 9* (Panel C). Here, only 3% of the initial high-growth firms remain in this category. The most frequent state is the declining one (28%) and nearly 40% ceased operations. Here it is important to stress that this last 3-year period coincides with the great global crisis whose negative effects over the Spanish economy have been very important. However, this approach does not allow us to isolate the consequences of the downturn in the macroeconomic conditions from the internal firm-specific factors. Overall, the results for these transition matrices would give strong support for our first hypothesis.

One interesting question worth to be asked is whether the previous results may change if the high-growth period is not verified during the earlier years but during the second 3-year period, i.e. from year 4 to 6 of firm´s life? It could be argued that initial high growth period is a consequence of the struggle for survive and overcome initial disadvantages, whereas high growth during this second period might be more likely a response to market success. Therefore, it could be expected this growth path to be more long lasting. This conjecture is analyzed in Table 4.5.

Table 4.5. Transition matrices (t+3, t+6); (t+3, t+9)

	Panel A. Growth status (t+ 6)						Panel B. Growth status (t+9)					
growth status (t+3)	(1)	(2)	(3)	(4)	(5)	exit	(1)	(2)	(3)	(4)	(5)	exit
decline (1)	24.4	22.7	9.6	7.0	7.9	28.4	24.6	13.6	2.6	5.7	7.9	45.6
stasis (2)	25.0	31.4	11.9	13.1	6.1	12.5	29.7	23.3	6.1	5.2	4.1	31.7
low (3)	19.2	42.5	11.4	13.8	4.2	9.0	32.9	22.8	6.6	7.8	4.2	25.7
moderate (4)	23.0	28.1	14.3	14.3	9.2	11.2	34.9	22.6	9.2	9.7	1.5	22.1
high (5)	22.9	20.8	14.6	17.4	11.1	13.2	41.1	18.5	6.8	3.4	4.1	26.0

Like in the previous period, only a limited proportion of high-growth firms (11%) are able to sustain their high growth status three years afterwards. In addition, most of them tend to move to the stationary state (21%) or even worse, they exhibit negative rates of growth (23%).

Three years later, the results are quite the same (Panel B). That is, only few firms manage to sustain their high growth rates six years after they experienced the first high growth episode. In summary, the results of these matrices illustrates that high growth episodes do not persist on following periods, regardless when the first high-growth episode occurs in firm´s life.

As a final approach to test the first hypothesis, the analysis of growth paths is introduced. That is, instead of focusing on transitions, the interest now is on paths. Each possible growth status over the four consecutive 3-years period that are included in the studied period is labeled as decline (0), stasis (1), low growth (2), moderate growth (3) and high growth (4) using the same criteria described in Table 4.2. Again, a final state that reflects business exits (9) is included. This exercise could be considered as an extension of the approach followed by Coad, Frankish, et al. (2013a) and (Derbyshire & Garnsey, 2014) but with more categories and hence, possible paths.

Table 4.6 shows the first 50 growth trajectories from the 387 observed and 1,080 ideally possible[33]. A salient feature of this exercise refers to the huge heterogeneity observed in terms of growth paths. On average, three firms follow each path and the most frequent (4999) only represents 6% of all the firms.

Table 4.6. Growth patterns over four consecutive 3-years periods (top 50)

Rank	Path	N	%	Rank	Path	N	%
1.	**4999**	**73**	**5.7%**	26.	4309	8	0,6%
2.	**0999**	**49**	**3.8%**	27.	4300	8	0.6%
3.	**4099**	**32**	**2.5%**	28.	4130	8	0.6%
4.	**3999**	**32**	**2.5%**	29.	4000	8	0.6%
5.	**1999**	**29**	**2.3%**	30.	2210	8	0.6%
6.	**4110**	**21**	**1.6%**	31.	1110	8	0.6%
7.	**4199**	**20**	**1.6%**	32.	1109	8	0.6%
8.	**3099**	**13**	**1.0%**	33.	4310	7	0.5%

[33] The complete list of the observed patterns is not reported here form simplicity but is displayed in the Statistical Appendix.

9.	**4410**	**12**	**0.9%**	34.	4301	7	0.5%
10.	**4399**	**12**	**0.9%**	35.	4299	7	0.5%
11.	4111	12	0.9%	36.	4109	7	0.5%
12.	4100	12	0.9%	37.	4101	7	0.5%
13.	4009	12	0.9%	38.	3399	7	0.5%
14.	2999	12	0.9%	39.	3211	7	0.5%
15.	4499	11	0.9%	40.	3111	7	0.5%
16.	4311	11	0.9%	41.	3010	7	0.5%
17.	4010	11	0.9%	42.	1199	7	0.5%
18.	3199	11	0.9%	43.	4431	6	0.5%
19.	3109	11	0.9%	44.	4420	6	0.5%
20.	3100	11	0.9%	45.	4400	6	0.5%
21.	4210	10	0.8%	46.	4219	6	0.5%
22.	3310	9	0.7%	47.	4211	6	0.5%
23.	1111	9	0.7%	48.	4129	6	0.5%
24.	1099	9	0.7%	49.	4020	6	0.5%
25.	4330	8	0.6%	50.	3131	6	0.5%

Note. Growth status is labeled as (0) decline, (1) stasis, (2) low growth, (3) moderate growth, (4) high growth and (9) exit.

As it was shown previously, a 45% of all firms exhibit an initial (1997-2000) high-growth period. However, only 5% have experienced a second successive high-growth period. If we compute all the firms that managed to have two successive high growth periods, whenever these high growth episodes occur, the proportion reaches the 6%. None of the studied firms was able to show 4 consecutive high-growth periods and only in the 0.6% of the cases we observe three consecutive high growth periods.

The most frequent growth pattern (with the 6% of the cases) is the one in which a high growth episode is followed by a second period where the firm has ceased operations. Other similar patterns such as high growth – decline – exit or high growth – stasis – exit are also among the most common in the context of a great dispersion with a 2.5% and 1.6%, respectively.

Finally, other 5% of the cases show at least two high growth episodes but not consecutive. For instance, they experience a high growth period, then a plateau or declining state and then, again a high growth period. Looking in this way, it is even clearer how difficult is to manage high growth episodes and be able to replicate them over more than one period. In sum, the results confirm the first hypothesis. That is, high growth episodes among young firms are seldom repeated for more than one period.

4.4.2 The impact of high growth on profit

The second main objective of this study is to analyze the effect of such high growth episodes on profits. As it has been said, this important topic needs more research due to the scarcity of empirical studies that explicitly deal with this relationship. In particular, this study postulates that this relationship could be moderated by firm age. Table 4.7 shows the main results of our estimated models, using OLS and Fixed effects estimations[34]. Both estimations yield the same results. First, profits tend to be highly persistent as it was presented by previous literature (Cowling, 2004; Goddard, Molyneux, & Wilson, 2004; Goddard & Wilson, 1999; Nakano & Kim, 2011). In addition, as Markman & Gartner (2002) show, age is negatively associated with profits, while size has a positive effect on profits.

Table 4.7. Regressions results

Dependent variable: Profit margin	OLS estimations			Fixed-Effects estimations		
	(1)	(2)	(3)	(1)	(2)	(3)
Profit margin (t-1)	0.4312***	0.4269***	0.4266***	0.2160**	0.3351**	0.3345**
Age (t-1)	-0.0058**	-0.0038*	-0.0045*	-0.0047	-0.0083***	-0.0093***
Size (t-1)	0.0431***	0.0460***	0.0463***	0.0851***	0.1148**	0.1106**
High growth (t-1)		0.0192***	-0.0085		0.0129	-0.0290
High growth x Age (t-1)			0.0037*			0.0055*
constant term	-0.0023	-0.0369	-0.0286	-0.0218	-0.0441	-0.0270
N	13,752	12,477	12,477	16,336	12,477	12,477
Groups	1,275	1,213	1,213	1,296	1,213	1,213
R^2	0.1083	0.1263	0.1264	0.0453	0.0836	0.0838

Note: Year and Industry dummies are included in the estimation but not reported here for simplicity. The full output of the regressions is available in the Statistical Appendix.

Legend: * p<.10; ** p<.05; *** p<.01

To test the second hypothesis about the effect of high growth on profits a dummy variable to identify those firms that exhibited a high growth episode in the previous period is introduced (model 2). As it could be seen, the effect is rather modest (β = 0.0192) and only statistically

[34] All models were estimated using the *cluster(id)* option to produce robust standard errors in the presence of heteroscedasticity and autocorrelation in the disturbance.

significant in the OLS estimation. Nevertheless, it is sufficient to reject our second hypothesis, which stated that a negative effect could be expected. Rather, a weak positive impact of high growth on profits is observed.

Finally, the interaction term between age and high growth is introduced in order to test the third hypothesis that the high growth-to- profit relationship is moderated by age (model 3). In both estimations, the coefficient of the interaction is positive and statistically significant. However, some caution should be placed when analyzing these results due to the smaller magnitude of such coefficients and the lower confidence level. Therefore, although it could be affirmed that the impact of high growth on subsequent profitability tends to be positive as long as firm matures, this impact is rather small. Hence, our third hypothesis only receives a weak support from the data.

4.5 Discussion and implications

This paper has addressed two relatively unexplored issues related to the phenomenon of HGFs. The first one refers to the persistence of high growth periods and the second refers to the impact of such high growth episodes on subsequent profits. This section discusses the main results of this paper in the light of previous research and elaborates their main implications and future research agenda.

4.5.1 Stylized findings

In order to test whether those firms identified as high growth firms at the beginning of the period are also high growth firms 3, 6 and 9 years after this initial high growth episode, a single cohort of Spanish young firms has been followed during four consecutive 3-year periods.

The results of the transition matrices show that the likelihood of sustaining a high growth path 3 years later is around 11%, almost as likely as business closure and half the probability of experiencing a stable or declining period. This probability of staying in the high growth category is even lower 6 or 9 years after the initial high growth period has occurred. Interestingly, being on the high-growth group does not have a clear impact on the likelihood of survive as in Hölzl (2014).

In the same vein, growth paths analyses shows that most of the firms have their first (and only) high growth period earlier in their lives and that only a limited proportion (around 10%) are able to repeat such growth episode. Half of them exhibits two consecutive high growth periods and a similar proportion shows a bounced trajectory with high growth periods followed by declining or plateau stages and then high growth again, all that in a general context characterized by a huge heterogeneity in growth paths at the firm level.

These results are in line with recent empirical studies using large panels which tend to confirm that high growth episodes are rare and hard to be replicated in consecutive years (Coad, 2007a; Daunfeldt & Halvarsson, 2015; Hölzl, 2014; Parker et al., 2010). This evidence is also consistent with previous qualitative studies showing that a period of high-growth is often followed by period of relative stability or "plateau" (Blackburn & Brush, 2009; Garnsey et al., 2006; Garnsey, 1998).

From a conceptual point of view, the inability to sustain this early growth may be compatible to those who sustain that firm growth could be better described as a *close to* random process (Coad, Frankish, et al., 2013a), recasting the main postulates of Gibrat's Law. This result also contrast relevant theories from management and economics that tend to favor a positive correlation among firm growth rates due to the existence of resource-based competitive advantages, established routines and superior capabilities at the firm level.

A plausible explanation could be that these theories have been primarily developed in the context of large firms and their adoption in the field of entrepreneurship and young firms may be problematic. In fact, some authors affirm that young firms could have problems in established sustainable competitive advantages at the very beginning of their lives, due to time-compression diseconomies (Dierickx & Cool, 1989). Alternatively, it could be alleged that this initial high growth period does not derive from competitive advantages. They are a consequence of the initial struggle to survive and overcome the cost disadvantages that firms face on their earlier years. Hence, it would not be expected such behaviors to be repeated once survival has been somehow achieved.

As regards the relationship between high growth and profits, results show a positive but weak association between both variables, contrasting the second hypothesis based mainly on the observation of the organizational challenges and limits that high growth poses on firm structures and procedures. In contrast, the results tend to support the idea that by growing, companies start to profit from the existence scale economies and dynamic increasing returns from learning and investments in firm´s capabilities. So, profits and growth use to be aligned. Nevertheless, estimated coefficients are rather small, so a cautionary note should be placed when generalizing this result. In addition, this fact could also be an indication of the presence of compensatory effects. Finally, as Senderovitz et al. (2015) affirm, the gains of high growth due to the exploitation of scale economies should be short-lived and hence, the positive effect of growth on profits would be limited.

Interestingly, we found some evidence supporting the idea that this positive effect of high growth on profits would depend on when such high growth episode takes place, so firm age may act as a moderator as the third hypothesis proposes. Accordingly, when high growth periods coincide with those stages where the internal structure of the firm is almost developed and established, it is more likely that economies of scale and dynamic increasing returns may play a role on translating growth into profits. In other terms, we could conjecture that in order to profit from high growth episodes, certain time has to go by. As firms mature, they gain experience, knowledge, abilities and resources that enable them to better accommodate high growth in a profitable way. Again, some caution should be placed on generalizing these results due to the limitations of the estimations commented before.

4.5.2 Implications and future research agenda

The lack of persistence in high growth rates led some authors to investigate why young firms could not maintain such high growth trajectories. Thus far, Parker et al. (2010) emphasize the relevance of changing strategies in order to embrace the new challenges that high growth periods put on the firm. Others, in turn, point to the important difficulties that imply to manage such high growth period (Blackburn & Brush, 2009; Brush et al., 2009; St-Jean et al., 2008; Wennberg, 2013). This opens a very interesting research avenue that refers to the way in which newer strategies, resources and organizational challenges are taken and solved by firm practices and decisions (for a review, see Wennberg, 2013).

In addition, the results of this paper highlight that the debate about growth autocorrelation (and specially, high growth rates correlation) is still in its earlier phases (e.g. Coad, Frankish, et al., 2013a; Derbyshire & Garnsey, 2014a; Storey, 2011; Westhead & Wright, 2011). In particular, further theoretical developments are needed to embrace this new evidence. In this vein, taking stock of the accumulated evidence like Moreno & Coad (2015) is a good starting point. Secondly, overcoming the limitations of previous frameworks with newer ideas and developments such as the dynamic states approach (Levie & Lichtenstein, 2010) could be also a promising area that deserves more research. Finally, another possible route for theory development could be the adoption of Complexity science ideas by considering firms as adaptive complex systems subject to deterministic chaos, like Derbyshire & Garnsey (2014) propose.

However, it is curious that nobody (as far as we known) has discussed before why the bulk of the literature implicitly (or explicitly) expect that high growth rates *should* be persistent over time. Is it organizationally viable to adjust structures, resources, people and systems, to accommodate continuous high growth periods? Moreover, is it a desirable goal for entrepreneurs? Regarding the later, previous studies tend to show that often academics and entrepreneurs do not consider business growth in the same way (Achtenhagen et al., 2010) and even more, that growth would not be always desirable because the organizational and personal consequences it may imply (Wiklund et al., 2003).

The relevance of the external macroeconomic factors should also be placed in the discussion of our results. Particularly, the last period of our analysis is highly affected by the general economic downturn because of the big crisis that affects most of the economies since 2008 and that in the particular case of Spain had serious consequences (Capelleras, Contín-Pilart, Larraza-Kintana & Martin-Sanchez, 2016). Leaving this external contingencies aside and focus on the internal limitations to manage high growth or transform it into superior profits, would lead to biased interpretations. Although we try to control for such effects in the regressions, the impossibility of separating each effect, namely internal and external factors constitutes a limitation of our study. Another limitation concerns to the sample used and particularly the possibility of generalizing these results to other context and other cohorts. In the same vein, it could be interesting to test the robustness of these results by adopting other profits measures, such as ROA or ROI.

Nevertheless, what this study has proven is the importance of looking for variables that can mediate in the impact of growth on profits. In this vein, Senderovitz et al. (2015) finds that market strategy, and particularly, wide market orientation vs. niche strategies, also affects the way in which high growth impacts profits. Other contingency factor such as size, initial resources and abilities could also play a similar role, constituting an interesting avenue for future research in order to have a deeper understanding of the underlying factors that moderate the relationship between high growth and profits.

Finally, our results also point important policy implications. In particular, the lack of persistence and the modest impact of high growth episodes on profitability may call for a more critical and less enthusiastic approach towards HGFs in the political discourse, as Nightingale & Coad (2013b) advise. Most authors highlight the importance of HGFs and their persistence for job creation. In fact, if sustaining HGFs and enhance their impact constitute a primary objective then public policies should focus on removing the obstacles that make difficult for entrepreneurs to manage this high growth periods. On the top on this list, we may include to facilitate the access to suitable sources of financing (working capital, seed capital, business angels and VC) that allow firms to overcome the cash crises that use to characterize such high growth states.

Nevertheless, money is not the big problem. Human and relational capital is as relevant as financial capital for these HGFs and their entrepreneurs. Therefore, mentorship and networking programs should be right in place. Finally, several studies highlight the difficulties that HGFs experience in recruiting, hiring training and retaining talented people (Wennberg, 2013). Therefore, an agenda of human resources management and organizational development should also be part of the policy menu for HGF. However, these policies should be complemented by a focus on enlarging the future number of HGFs instead of merely assure the persistence of the current ones. In this regard, identifying and characterizing potential high growth firms (N. Lee, 2014) or ´sleeping gazelles´ (Bornhäll, Daunfeldt, & Rudholm, 2013) arises as a key issue for the future research agenda.

5. CONTRIBUTIONS, IMPLICATIONS AND FUTURE RESEARCH AGENDA

In this final section, the main results of the different papers that make up this dissertation are summarized. Recalling the main objectives, this dissertation was aimed to contribute to young firms' growth literature by focusing on two major topics: growth persistence and the impact of growth on profits. In addition, throughout the dissertation a strong point was made on the moderating role of firm age, arguing that the earlier phases of a firm's development is far from being uniform and stable.

5.1 Revisiting the main findings

Three were the specific objectives of this dissertation. The first one refers to explicitly examining the direction of the relationship between firm growth and profitability, particularly investigating the existence of intra and inter-industry heterogeneity in such relationship.

Accordingly, one of the most salient results from the first paper is that once endogeneity is controlled, previous profits do not exhibit a significant effect on young firms' growth. This result contrast some well-established theoretical expectations from evolutionary as well as strategy approaches, but is aligned with the most recent empirical evidence (Bottazzi et al., 2010; Coad et al., 2011; Coad, 2007c; Delmar et al., 2013). In contrast, the results show that growth has a positive impact on profits, which contrasts Steffens et al. (2009) who conclude that young firms pursuing high-growth strategies early on their lives may perform poorly in terms of profits. Taking as a whole, the results of the first paper of this dissertation are consistent with those reported by a number of recent studies that show that indeed, the influence of growth on subsequent profits is more important than the effect of retained profits on firm growth (Coad et al., 2011; Coad, 2007c; Delmar et al., 2013).

In addition, it has been proven that the relationship between growth and profits and vice versa is highly influenced by inter-firm heterogeneity, supporting previous theoretical expectations from evolutionary and RBV theory as well as empirical studies (Bottazzi et al., 2010) who suggest that the growth-profits nexus depends on specific attributes of the firm. Some evidence for inter-industry heterogeneity is also found, but only in the growth to profits association. This result is in line with some variance decomposition analyses which show that firm-specific attributes are more important in explaining differences in performance than industry-specific features (Goddard et al., 2009; Short et al., 2007).

The second objective was to analyze the level of autocorrelation among young firms' growth. This issue was initially raised in the first paper, but it is largely developed in the second study. The results tend to conclude that young firms' growth could not be considered as a (close) to random process, contrasting recent developments (Coad, Frankish, et al., 2013a). In fact, the analysis of growth paths as well as the regressions show a positive and statistically significant correlation between past and current growth, supporting the presence of economies of growth and in opposition with some recent evidence showing a general negative autocorrelation (Coad & Hölzl, 2009; Coad, 2007a).

As regard the moderating role of firm age, this second paper show that as long as firm matures growth becomes more erratic. More strictly, the positive autocorrelation is lowered by the interaction between age and growth. In particular, the coin flipping analysis illustrates that growth persistence is the most frequent path only until the fifth year. Afterwards, the patterns started to be quite different and no dominant trend emerges. In line with Coad, Segarra, et al.(2013) and Coad, Daunfeldt, et al. (2015) this paper argues that growth correlation could differ according to the specific age phase that is under analysis. This kind of evolution also resembles Garnsey's (1998) model inspired in Penrose (1959) theory of firm growth. Regression results using the spline approach tend to confirm these results but at the same time, they highlight the relevance of some differences according to size and cohorts.

Finally, the third paper analyses the case of HGFs confirming that only a limited proportion of high growth firms are able to sustain a high growth path in successive years as most studies shown (Moreno & Coad, 2015). Moreover, this third paper illustrates that after a high growth period the most likely scenario is to display a "plateau" or decline path, corroborating qualitative evidence about the difficulties to manage and sustain such high growth periods (St-Jean et al., 2008).

Concerning the impact of such high growth episodes on profits, this third paper reports a positive yet small impact of high growth on profits. Although this result may be an indication of the beneficial outcomes of high growth episodes at the firm level, the limited magnitude of the coefficient and the low statistical significance impose some caution when interpreting the result.

Some evidence of a moderating role of firm age in this relationship is also found. In fact, the results tend to reveal a positive influence of firm age, meaning that the translation of high growth in terms of profits is slightly higher if this episode happens at an older stage. Although the magnitude of the coefficients is rather small, this positive interaction may reflect the relevance of having established routines, experience and resources to accommodate rapid growth phases in a profitable way.

5.2 Contributions and implications of this dissertation

Without doubts, two are the most important contributions of this dissertation taken as a whole. First, it advances in the understanding of the underlying relationship between business growth and profits by explicitly taking into account the endogenous nature of such relationship. In addition, this dissertation also demonstrates the extent to which intra and inter-industry heterogeneity affects the way profits affect growth and vice versa, highlighting the superior relevance of firm specific attributes rather than industry-specific differences. Overall, a more complex picture of the profits-growth interplay is presented. Finally, considering these two aspects of the profit-growth relationship helps to discuss the extent to which some well-established theoretical expectations such as the 'growth of the fitter' and the RBV's competitive advantage may apply to the case of young firms.

A second and most important contribution to the literature of this dissertation is to propose and test the role of firm age as a local moderator, or intermediate variable. Hence, the common idea of taking firm age as a control variable is changed by incorporating it as an interaction term affecting the main variables of interest. In the same vein, this dissertation proposes and successfully tests the idea of considering the initial years of a firm´s life as a non-uniform period, where different forces may be in competition. As a result, the evolution of certain variables such as sales or profits could be neither linear nor continuous. As regards previous studies, the novelty of this dissertation was the idea of comparing the evolution of certain variables *throughout* rather than *between* different age segments. This dissertation is one of the fewest studies that treats firm age in that way and propose a moderating role of this variable.

Thirdly, this dissertation offers a more balanced position in the debate about the randomness of growth rates by integrating both postures, i.e. the "random" and the "strategic" perspective. Proposing a moderating role of firm age in the correlation among growth rates opens the possibility that both patterns of autocorrelation could exist throughout the earlier years. In fact, results from the spline regressions analyses show that correlation in growth rates can be positive during the first years reflecting the initial struggle to survive. However, once some position in the market is achieved growth becomes more erratic because of the content between growth reinforcement and growth reversal forces (Garnsey, 1998). Therefore, the final outcome in terms of performance is hard to be anticipated as some authors illustrate (Coad, Frankish, et al., 2013b; Lotti et al., 2007). Nevertheless, it is ought to say that the explanatory power of the estimated models remain limited, questioning to what extent these phenomena under study could be fully determined and how much of the explanation would remain as random.

In the same vein, this thesis proposes a more balanced and less enthusiastic assessment of high-growth episodes and their contributions at the firm level. Actually, the obtained results have proven that such periods are not only difficult to be sustained but also that the rewards of such high growth in terms of subsequent profits are at best, of a small magnitude.

Another contribution of this dissertation is methodological. Recent advances in panel data econometrics like System-GMM estimators are adopted to deal in a better way with endogenous regressors. Additionally, the Hurlin test, which was originally designed in the context of macro-panels, is introduced in the context of micro-panels, like SABI©. This is one of the few examples of using this test in the context of firm-level data.

Finally, this dissertation also contributes to the literature enlarging the empirical base of growth studies by focusing exclusively on the case of young firms. The findings of this dissertation make a strong point of the non-uniformity of the earlier years of a firm and have a number of implications for theory development, for entrepreneurs and young firms' managers and for policy makers, which are detailed in the following sections.

5.2.1 Theoretical implications

One of the most controversial results in this dissertation is that retained profits do not affect subsequent business growth once endogeneity and heterogeneity are taking into account. This contrasts most implications from well-known theoretical frameworks like the RBV or the evolutionary theory. These frameworks have been primarily developed in the context of large firms and their adoption in the field of entrepreneurship and young firms may be problematic. First, the RBV implication that above-average profitability is a prerequisite for achieving subsequent growth (Davidsson et al., 2009) is discussed. In the case for young firms, initial superior profits could be derived instead from other sources besides superior resource-based differences in efficiency coming from within the firm. For instance, they may stem from firm-specific responses to economy-wide shocks (Alessi et al., 2013). Consequently, these superior profits cannot be treated as sources of *sustained* competitive advantages. In fact, these results tend to support the volatility of such initial profits given the relatively low –but statistically significant- persistence observed in this variable over time. In the same vein, most young firms would have some difficulties to create an initial resource-based competitive advantage because of time compression diseconomies (Dierickx & Cool, 1989). Similarly, it is likely that young firms will not be able to exhibit a superior performance in terms of profits without growing enough to overcome their initial cost disadvantages.

Additionally, the lack of any significant effect of previous profits on subsequent business growth would also question the relevance of the evolutionary 'growth of the fitter' principle in the case of young firms (Coad, 2007c). This would mean that market selection may operate on diverse degrees of efficiencies (fitness) for different segments and profits – in principle – could only provide a rather limited criterion for selection (Coad, 2007c; Srholec & Verspagen, 2012). In particular, it could be that for young firms market selection would operate initially on firm growth and survival rather than on profits.

On the other hand, the positive influence that previous growth exhibits on profits may be an indication of the relevance of learning-by-doing gains for young firms. Based on Penrose´s (1959) ideas, entrepreneurs may learn how to produce and organize activities more efficiently, releasing and combining resources in different ways to obtain the most profitable outcome from them. These learning- and experience-based effects may be also a reflection of the existence of increasing returns economies *à la* Kaldor-Verdoorn at the firm level. These effects may play a critical role to secure young and newly founded firms' survival, since they do not have well-established organizational routines nor sustained resource-based competitive advantages. Hence, they must growth first in order to be more efficient and as a result, increase their likelihood of surviving.

However, these learning gains are not only circumscribed to internal resources and capabilities. On the contrary, young firms also learn about their market and their product-market fit while they start to operate and grow. Growing may often involve changing the use of existing resources to exploit new market opportunities and thus increasing the chances to earn additional profits (Lockett et al., 2011).

To a lesser degree, this positive impact of growth on profits is also present in the case of HGFs. Nevertheless, the small magnitude of the coefficients may be an indication of the presence of compensatory effects, i.e. learning and scale economies on the one hand, and increasing costs and managerial diseconomies on the other. In addition, some authors argue that gains of high growth due to the exploitation of scale economies should be short-lived (Senderovitz et al., 2015), supporting the limited positive effect of growth on profits. Overall, there is a need for more empirical research and most importantly, theoretical development for this segment of firms whose relevance has been widely demonstrated (e.g. Bravo-Biosca, 2010; Henrekson & Johansson, 2010).

In addition, a strong point has been made on the importance inter-firm heterogeneity in the relationship between growth and profits and vice versa. This supports evolutionary and resource-based theorizing, which argue that firms have heterogeneous internal resources and organizational routines, and, consequently, they differ in terms of performance. Therefore, individual firm level choices, resources and capabilities and their performance implications could be still different even within the same industry sector (Srholec & Verspagen, 2012). Also from an evolutionary perspective, some authors argue that in complex markets where many local niches are present, selection mechanisms are less important and hence heterogeneity rather than homogeneity would become the rule (Srholec & Verspagen, 2012).

The second main point of this dissertation refers to growth persistence (or autocorrelation). More precisely, the idea of firm growth as a random process is rejected. Unlike Coad, Frankish, et al. (2013a) a positive correlation of growth rates over time is found. In addition, a moderating role of firm age on such correlation is present. Accordingly, during the earlier years the presence of economies of growth (Penrose, 1959) and feedbacks make that growth entails successive growth. In the same vein, this positive correlation could be a reflection of the initial struggle to achieve the minimum scale and secure firms' survival. Nevertheless, after certain point (the fifth year in our case) correlation becomes less positive, i.e. it appears to be more erratic.

The results of this dissertation tend to confirm on the one hand, the transient nature of these Penrosean 'economies of growth'. As Lockett et al. (2011) showed, firms which have grown in the past will find increasingly difficult to grow in the future. On the other hand, this pattern is compatible with the existence of adjustment costs due to discrete resources and the difficulties of successively combine them efficiently (Coad & Planck, 2012). Also, as Frankish, Roberts, Coad, Spears, & Storey (2013) affirm, for young firms, the lack of persistence could be associated with the complexity of sustaining effective learning processes during these initial years of higher volatility and turbulence at the micro-level. Overall, what becomes clear for some studies and reviews of the field is that growth is difficult to be predicted (Coad, Frankish, et al., 2013b; Coad, 2007b; Storey, 2011). This fact is particularly true for young firms since they are affected not only by external factors but also by internal crises, setbacks and trial and error processes.

Nevertheless, the incapacity of the models to predict the future evolution of growth rates does not mean that growth is a close to random process, similar to a game of chance. What is needed is a conceptual framework that could embrace both directions of the correlation and making sense of previous empirical evidence, including the unpredictable nature of business growth. Recalling the second paper, neither randomness (alone) nor determinism (alone) would constitute suitable approximations to young firm growth. One intermediate position has been proposed by Derbyshire & Garnsey (2014) by considering firms as complex adaptive systems, whose performance is subjected to deterministic chaos. Adopting insights from Complexity science would help to recognize the limitations of anticipating the possible outcomes of the system, but at the same time, to acknowledge that there are certain variables and courses of actions (agency) that may influence the process by which the output is generated.

The latter does not imply to neglect or minimize the role played by randomness in several strategic and organizational phenomena, such as firm growth (Denrell et al., 2015). Neither does mean to consider randomness as a negative state of affairs that should be control for through more sophisticated econometric tools. As Denrell et al. (2015, p. 15) affirm *"… assuming randomness at the micro level to explain empirical regularities in organization theory or strategy does not deny that managers take deliberate intentional action. Neither is the role of management in chance explanations necessarily restricted to passive approaches such as "do nothing" or "do anything." Rather, recognizing the importance of randomness and luck can be a crucial first step in formulating useful prescriptions for managers…"*.

In the particular case of HGFs, this dissertation shows that most of them tend to exhibit high growth episodes early on their lives and only a limited number of them could sustain such pattern in successive years. Theoretically, it could be argued that this initial high growth period is more a consequence of the initial struggle to survive and overcome the cost disadvantages that firms face on their earlier years than a reflection of their competitive advantages. Hence, it would not be expected such behaviors to be repeated once survival has been somehow achieved.

Finally, a further question that deserves more debate refers to why the literature implicitly (or explicitly) expects that high growth rates *should* be persistent over time. It could be understand the relevance of persistence from the policy perspective, but at the firm level, it could be worth to ask whether managing and accommodating continuous high growth period is organizationally viable or, even more, desirable for entrepreneurs. Indeed, some previous studies successfully demonstrate that growth would not be always desirable because the organizational and personal consequences it may imply (Flamholtz & Randle, 1990; Wiklund et al., 2003).

5.2.2 Policy implications

For years, firm growth has attracted the attention of policy makers mainly as a mean to job creation. In particular, during the last few years young HGFs – often called as gazelles following Birch´s analogy – have dominated the entrepreneurship policy discourse. Their positive effects in terms of job creation, innovation and productive diversification are some of the main reasons why significant efforts and budgets are applied around the globe to promote and encourage the creation and development of these HGFs.

The results of this dissertation, in contrast, call for a more critical and less enthusiastic approach towards HGFs in the political discourse, as Nightingale & Coad (2013) advise. This dissertation does not deny the quantitative relevance that these kind of growing firms have mostly for job creation. Rather, it highlights that this high-growth episodes take place mostly at an earlier stage and only a small proportion of such HGFs are able to repeat this kind of high growth again in their lives. Thus, they are a sort of "one hit wonders" (Coad & Hölzl, 2009; S. O. Daunfeldt & Halvarsson, 2015).

In addition, a positive but weak association between high growth and profitability is found. Hence, the endogenous financial mechanism for newer expansions is restricted. Similarly, Daunfeldt et al. (2015) report that the financial 'health' of HGFs is not so vital before they display their high growth episodes, giving some explanation on why is so difficult to endogenously sustain such growth process. As Brush et al. (2009) illustrate, HGFs are *"cash hunger machines"*, so in the absence of internal turnover, they must rely on external sources of financing to continue growing.

The latter places an important policy implication. Facilitating the access to suitable source of finance such as working capital, seed capital, business angels and VC, should be at the top of the list of duties if a government wants to remove the obstacles that make difficult for entrepreneurs to sustain high growth periods.

Nevertheless, money is not the only constraint to be removed. Human and relational capital are just as relevant as financial capital for these HGFs and their entrepreneurs (Brush et al., 2009; Capelleras, Contin-Pilart & Larraza-Kintana, 2011). Therefore, mentorship and networking programs should be part of the agenda. The accelerator model (e.g. Y Combinator, 500 Start Up or Angel Pad) which now is widely disseminated offers interesting lessons of how to combine financial, relational and human capital to successfully start and scale up a HGFs. As well, some recent reviews highlight the difficulties that these firms experience in recruiting, hiring, training and retaining talented people (Wennberg, 2013). Therefore, an agenda of human resources management and organizational development should also be part of the policy menu for HGF.

Overall, these implications refer mostly to removing some barriers to sustain high growth periods. Nevertheless, in dynamic perspective, policies should have a focus on enlarging the future number of HGFs instead of merely assure the persistence of the current ones, which use to constitute a limited proportion of all firms. This brings the question of targeting. The results of this dissertation show that HGF constitute a "closed circle", meaning that transitions from other possible growth categories to this one is unlikely or at least limited. Therefore, it is key to identify and characterize potential high growth firms (N. Lee, 2014) or ´sleeping gazelles´ (Bornhäll et al., 2013) which constitute the most likely segments from where new HGFs could emerge.

Adopting a wider conception could be also advisable. Instead of focusing only on HGFs, policy makers should complement their focus with a wider look at other growth paths not as glamorous as the previous one but with the potential to display a more sustained yet low growth trajectory, with also relevant implications in terms of job creation or innovations. The fauna of growth prospectus is richer and wider than just gazelles, so why to lose them.

Finally, the results of this dissertation regarding the moderating role of firm age pose another implication. Firm age should be incorporated into the target function of policy makers, recognizing that the needs and demands of young firms are not the same across firms and throughout their initial years.

5.2.3 Practical implications

Finally, for entrepreneurs and young firms' managers, the results of this dissertation raised a few implications. First, we point to a positive impact of growth in young firms, which is, increasing profitability. Hence, no trade-off between profits and growth has been found in our sample. On the contrary, the existence of positive learning effects as the firm grows constitute a way in which by growing firms become more productive and hence, profitable.

However, this positive effect is only short-lived. Growth itself is not sufficient to secure profits. It should be accompanied by a suitable and flexible business model that allows entrepreneurs to capture the most profitable use of their own firm resources and capabilities and at the same time to capitalize from newer market opportunities. Moreover, the continuous development and renewal of such resources and capabilities is key to assure a translation of growth into successive profits.

Third, growth trajectories and their impact on firm profitability are highly affected by firm-specific heterogeneity. Consequently, there is no "one fits all" model or strategy to increase firm performance. The final result would depended on the initial resource base, the strategy adopted and the way in which the entrepreneur 'reads' the context and evaluates his own resources and capabilities to exploit new opportunities.

In particular, the results showed a slightly positive effect of high growth on subsequent performance, questioning to some extent the rewards that such accelerated growth processes might have at the firm level. It is likely that profit gains derived from high growth may be outweighed by the organizational challenges that managing a high growth firms encompasses, besides the increasing funding needs that such endeavour requires.

Finally, persistence in growth rates, especially at high growth rates, is mostly unlikely. Entrepreneurs should take into consideration that the most likely scenario after a high growth episode is not another one, but a stasis (or plateau) or declining stage. Moreover, there are strong reasons to justify these limits to grow. The first one is the exhaustion of firm resources and capabilities. Then, when introducing additional resources and capabilities, there are adjustment costs that have to be paid in order to accommodate these new resources or capabilities in the existing firm. Finally, there is also an internal limit for entrepreneurs to continuously identifying and exploiting new opportunities. These "entrepreneurial services" – in Penrose's terms could in fact be bought externally but again some adjustment costs and learning periods would inhibit the firm from experiencing a second continuous high growth period.

5.3 Limitations and future research agenda

Throughout this dissertation a number of limitations have been identified, which at the same time could open directions for future research and extensions. First, the period under analysis has been seriously affected by the general economic crisis whose impacts over the Spanish economy have been particularly sever since 2008. This particular situation makes it necessary to introduce the micro-macroeconomic interplay in our models, something that exceeds the inclusion of time dummies. In addition, comparing these results with other contexts and with less volatile environments would add robustness to the conclusions of this dissertation.

Secondly, in the three papers sales growth has been used as the growth measure both for theoretical and practical reasons. However, comparing these results with other growth measures based on employment could add robustness to the previous findings. In particular, both measures could be combined in a single composite indicator. As Wiklund et al. (2007) argue, multiple growth indicators give more information and hence are better than single ones. As well, employment growth is highly relevant from a policy point of view. Finally, including employment headcounts as an independent variable would allow analysing the join moderating role of size and age at the same time, advancing the understanding of the complexity and heterogeneous nature of the growth process, as it has been proposed in the second paper.

Another data limitation is related to the independent variables. In different parts of this dissertation, reference to firms' resources, routines and capabilities as key explanatory variables have been included. Nevertheless, the dataset based on SABI© lacks most of these variables. In addition, it does not have variables concerning firms' strategies that in fact may act as explanatory variables and focal moderator too. A logical extension of this dissertation would be to explore and incorporate other datasets like the Encuesta sobre Estrategias Empresariales – ESEE [Business Strategy Survey] developed by the Ministry of Industry, Tourism and Commerce and the SEPI Foundation or the Panel de Innovación Tecnologica – PITEC [Spanish Technological Innovation Panel] a join endeavor of the National Statistical Institute and the Spanish Foundation for Science and Technology.

Indeed, future studies might focus their attention not only on the presence of heterogeneity, but also on examining *what* specific firm-level variables may affect growth persistence and its relationship with profits and *how*. This dissertation provides some preliminary evidence on the extent to which heterogeneity may affect growth and its impact on profits. However, more insights are needed on the sources of such inter-firm heterogeneity within particular environments. Additionally, the identification of industry variables that may act as moderators also constitutes a promising line for future research (Delmar et al., 2013). Hence, it would be interesting to explore the moderating role of specific firm and industry variables both in the profits-growth relationship and on the persistence of (high) growth rates.

Particularly, there is still too much to contribute in explaining *why* young firms could not maintain such high growth trajectories. Thus far, Parker et al. (2010) emphasize the relevance of dynamic strategic management and others, point to the important difficulties that managing such high growth periods imply at the firm level (e.g. Blackburn & Brush, 2009; C. Brush et al., 2009; St-Jean et al., 2008; Wennberg, 2013). As well, there are other contingency factors such as size, initial resources and abilities that could also play a moderating role, constituting an interesting avenue for future research in order to have a deeper understanding of the underlying factors that moderate the relationship between high growth and profitability following Senderovitz et al. (2015).

In this vein, the adoption of more advanced econometric methods to account for this increased complexity is highly advisable. Multilevel mixed-effects models (e.g. Hox, 2010) that incorporate the nested nature of the firm-industry-context levels and allow to include such structure in the errors and estimated coefficients provide a very interesting avenue, still under-explored by the literature on firm growth. Additionally, new methods that take full advantage of the information of large panel datasets, considering the heterogeneity and dynamics of growth rates should be introduced. New developments in dynamic quantile regressions in panel data suggested by Capasso et al. (2014) could be a way of deal with that issues. Another improvement could be developing more cohort studies and Markov chain transitions analyses like Anyadike-Danes & Hart (2014) did. Nevertheless, more qualitative research is also needed to get a deeper understanding of the whole process of growth, including entrepreneurs' perspective and its implications. Particularly, these case studies should integrate new theoretical developments like the dynamic states approach (Levie & Lichtenstein, 2010) and focus on the specific case of growing and non-growing firms.

Nevertheless, the future research agenda is not only circumscribed to empirical or methodological issues. Most importantly, the field of business growth needs to be critically revised and updated to accommodate the bulk of new evidence that contrast most of the well-grounded theoretical contributions that we use to rely on. In particular, young business growth and high growth firms need a deeper and solid theoretical background upon which contrast the research hypotheses. Even more, as it has been demonstrated in the first paper, digging into the causal mechanisms between growth and profits involves much more complex approaches (Atukeren, 2008; Granger, 2003; Pearl, 2009).

One fruitful research opportunity is to introduce insights from the Complexity science paradigm into our field of study. Complexity science is an emerging post-positivistic and interdisciplinary field of research focused on the dynamical properties of open and complex adaptive systems. Complexity science offers an 'interpretivist lens' and an integrative framework on which different theoretical perspectives may converge in an effort to better understand and model the dynamical properties of firms as complex adaptive systems. Precisely, the notion of firms as complex adaptive systems is at the heart of Derbyshire & Garnsey (2014, 2015) critics on the Gambler´s Ruin approach (Coad, Frankish, et al., 2013a). Also it is at the grounds of Levie & Lichtenstein (2010) notion of 'dynamic states' which they propose as a step forward to avoid the criticisms of life-cycle models.

In particular, the distinction between indeterminism and complex adaptive systems becomes fundamental to explain the kind of evolution observed in young firms' growth paths. Ontologically, indeterminism implies an absence of cause, while the complex adaptive system´s view recognizes the existence of certain causes and initial conditions, whose interactions and feedbacks effects make the outcome to be unpredictable, giving the impression of a random process.

Including these insights of Complexity science into our theories and models might provide a suitable conceptual framework to understand the underlying complex dynamic properties of the phenomenon of firm growth processes. Moreover, it could help to distinguish which part of the explanation is ontologically random and which part seems to be random because it is unpredictable or inaccurately measured.

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STATISTICAL APPENDIX

PAPER 1

Comparison of the industry composition of the sample and the data of the National Institute of Statistics (INE in Spanish)

Industry sector	Sample (1997)		INE (1996)		Diff.
	N	%	N	%	
Food & Beverages	118	12.7%	27,177	17.0%	**-4.3%**
Tobacco products	0	0.0%	25	0.0%	0.0%
Textiles	34	3.7%	6,829	4.3%	-0.6%
Wearing apparel	27	2.9%	10,498	6.6%	**-3.7%**
Leather and related products	26	2.8%	6,744	4.2%	-1.4%
Wood and of products of wood and cork	61	6.6%	13,331	8.4%	-1.8%
Paper and paper products	15	1.6%	1,860	1.2%	0.5%
Printing and reproduction of recorded media	114	12.3%	13,264	8.3%	**4.0%**
Coke and refined petroleum products	0	0.0%	41	0.0%	0.0%
Chemicals and chemical products and pharmaceuticals	35	3.8%	3,545	2.2%	1.6%
Rubber and plastic products	38	4.1%	4,862	3.0%	1.1%
Other non-metallic mineral products	60	6.5%	9,608	6.0%	0.5%
Basic metals	16	1.7%	1,496	0.9%	0.8%
Fabricated metal products	154	16.6%	25,789	16.2%	0.5%
Computer, electronic and optical products	13	1.4%	2,755	1.7%	-0.3%
Electrical equipment	12	1.3%	3,665	2.3%	-1.0%
Manufacture & repair of machinery and equipment	101	10.9%	9,047	5.7%	**5.2%**
Motor vehicles, trailers and semi-trailers	12	1.3%	1,642	1.0%	0.3%
Other transport equipment	0	0.0%	1,260	0.8%	-0.8%
Furniture & other manufacturing	90	9.7%	16,081	10.1%	-0.4%
Total	**926**	**100.0%**	**159,519**	**100.0%**	

Comparison of the composition by AACC of the sample and the data of the National Institute of Statistics (INE in Spanish)

Autonomous Community (AACC)	Sample (1997)		INE (1999)		Diff.
	N	%	N	%	
Andalusia	**147**	**15.9%**	**28,011**	**12.1%**	**3.8%**
Aragon	41	4.4%	8,166	3.5%	0.9%
Asturias	11	1.2%	3,231	1.4%	-0.2%
Balearic Islands	15	1.6%	4,939	2.1%	-0.5%
Canary Islands	6	0.6%	5,551	2.4%	-1.7%
Cantabria	7	0.8%	2,286	1.0%	-0.2%
Castile and Leon	42	4.5%	12,139	5.2%	-0.7%
Castile - La Mancha	47	5.1%	12,053	5.2%	-0.1%
Catalonia	**182**	**19.7%**	**54,772**	**23.6%**	**-3.9%**
Valencian Community	127	13.7%	29,357	12.6%	1.1%
Extremadura	15	1.6%	3,945	1.7%	-0.1%
Galicia	58	6.3%	13,496	5.8%	0.5%
Madrid	100	10.8%	25,316	10.9%	-0.1%
Murcia	36	3.9%	6,703	2.9%	1.0%
Navarre	13	1.4%	3,875	1.7%	-0.3%
Basque Country	69	7.5%	15,508	6.7%	0.8%

La Rioja	8	0.9%	2,812	1.2%	-0.3%
Total	**924**	**100.0%**	**232,160**	**100.0%**	

Comparison of the industry composition of the sample and the data of the National Institute of Statistics (INE in Spanish)

Industry sector	Sample (2000)		DIRCE (2000)		Diff	Sample (2001)		DIRCE (2001)		Diff	Sample (2002)		DIRCE (2002)		Diff	Sample (2003)		DIRCE (2003)		Diff
	N	%	N	%		N	%	N	%		N	%	N	%		N	%	N	%	
Food & Beverages	55	6.3	1,030	3.0	3.3	71	6.9	968	2.6	4.3	64	4.1	888	2.5	1.6	69	4.6	806	2.2	2.4
Tobacco products	0	0.0	8	0.0	0.0	0	0.0	8	0.0	0.0	0	0.0	3	0.0	0.0	0	0.0	4	0.0	0.0
Textiles	14	1.6	412	1.2	0.4	22	2.1	427	1.1	1.0	30	1.9	416	1.2	0.8	17	1.1	354	1.0	0.2
Wearing apparel	22	2.5	712	2.1	0.5	20	1.9	614	1.6	0.3	16	1.0	554	1.6	-0.5	13	0.9	467	1.3	-0.4
Leather and related products	17	2.0	560	1.6	0.3	21	2.0	540	1.4	0.6	24	1.5	522	1.5	0.1	25	1.7	422	1.2	0.5
Wood and of products of wood and cork	28	3.2	444	1.3	1.9	21	2.0	509	1.4	0.7	48	3.1	424	1.2	1.9	24	1.6	417	1.1	0.4
Paper and paper products	6	0.7	108	0.3	0.4	3	0.3	88	0.2	0.1	5	0.3	118	0.3	0.0	10	0.7	72	0.2	0.5
Printing and reproduction of recorded media	51	5.9	1320	3.9	2.0	59	5.7	1,495	4.0	1.7	62	4.0	1,249	3.6	0.4	61	4.0	1,284	3.5	0.5
Coke and refined petroleum products	1	0.1	2	0.0	0.1	1	0.1	0	0.0	0.1	0	0.0	0	0.0	0.0	0	0.0	0	0.0	0.0
Chemicals and chemical products and pharmaceuticals	25	2.9	231	0.7	2.2	17	1.7	223	0.6	1.1	14	0.9	175	0.5	0.4	9	0.6	188	0.5	0.1
Rubber and plastic products	21	2.4	320	0.9	1.5	28	2.7	313	0.8	1.9	22	1.4	275	0.8	0.6	15	1.0	284	0.8	0.2
Other non-metallic mineral products	29	3.3	562	1.6	1.7	38	3.7	540	1.4	2.2	39	2.5	499	1.4	1.1	34	2.3	482	1.3	0.9
Basic metals	13	1.5	90	0.3	1.2	9	0.9	79	0.2	0.7	18	1.2	79	0.2	0.9	14	0.9	75	0.2	0.7
Fabricated metal products	102	11.8	1770	5.2	6.6	138	13.4	1,743	4.7	8.7	143	9.2	1,631	4.6	4.6	150	9.9	1,627	4.5	5.5
Computer, electronic and optical products	5	0.6	299	0.9	-0.3	2	0.2	330	0.9	-0,7	9	0.6	264	0.8	-0.2	9	0.6	268	0.7	-0.1
Electrical equipment	13	1.5	122	0.4	1.1	14	1.4	129	0.3	1,0	15	1.0	116	0.3	0,6	9	0.6	87	0.2	0.4
Manufacture & repair of machinery and equipment	40	4.6	595	1.7	2.9	40	3.9	641	1.7	2.2	37	2.4	623	1.8	0,6	34	2.3	553	1.5	0.7
Motor vehicles, trailers and semi-trailers	4	0.5	116	0.3	0.1	7	0.7	106	0.3	0.4	12	0.8	103	0.3	0,5	12	0.8	98	0.3	0.5

Other transport equipment	3	0.3	131	0.4	0.0	3	0.3	122	0.3	0.0	4	0.3	135	0.4	-0,1	2	0.1	112	0.3	-0.2
Furniture & other manufacturing	33	3.8	1,027	3.0	0.8	34	3.3	960	2.6	0.7	48	3.1	867	2.5	0.6	46	3.0	923	2.5	0.5
Land transport and transport via pipelines	78	9.0	2.395	7.0	2.0	76	7.4	2,072	5.5	1.8	119	7.7	1,811	5.2	2.5	112	7.4	1,826	5.0	2.4
Water transport	2	0.2	27	0.1	0.2	2	0.2	40	0.1	0.1	6	0.4	32	0.1	0.3	5	0.3	31	0.1	0.2
Air transport	0	0.0	14	0.0	0.0	1	0.1	11	0.0	0.1	2	0.1	9	0.0	0.1	3	0.2	12	0.0	0.2
Warehousing and support activities for transportation and Travel agencies	15	1.7	1.078	3.2	-1.4	22	2.1	1,233	3.3	-1.2	23	1.5	1,201	3.4	-1.9	27	1.8	1,165	3.2	-1.4
Postal and courier activities; Telecommunications	23	2.6	573	1.7	1.0	22	2.1	621	1.7	0.5	43	2.8	547	1.6	1.2	30	2.0	547	1.5	0.5
Accommodation and food service activities	57	6.6	6,787	19.9	-13.3	101	9.8	7,028	18.8	-9.0	203	13.1	6,901	19.6	-6.6	173	11.5	7,571	20.8	-9.3
Information and communication (except telecomm.)	42	4.8	1,454	4.3	0.6	64	6.2	2,324	6.2	0.0	110	7.1	2,243	6.4	0.7	105	7.0	2,157	5.9	1.0
Scientific research and development	2	0.2	85	0.2	0.0	4	0.4	111	0.3	0.1	4	0.3	96	0.3	0.0	3	0.2	127	0.3	-0.1
Other professional. scientific and technical activities	167	19.2	11.888	34.8	-15.6	189	18.4	14,074	37.7	-19.3	430	27.7	13,343	38.0	-10.2	499	33.0	14,483	39.7	-6.7

Note: Each column labeled as DIRCE corresponds to the industry composition of all the new firms created in each year according to the Directorio Central de Empresas (Central Directory of Business) from the national Statistical Institute.

Annual Sales. Summary Statistics by cohort and age

Cohort / Age		1	2	3	4	5	6	7	8	9	10
2000	Mean	865,616	1,031,826	1,154,022	1,289,155	1,406,912	1,541,856	1,671,573	1,675,494	1,405,673	1,430,867
	SD	2,503,927	2,626,441	2,457,320	2,596,674	2,465,479	2,382,905	2,464,562	2,530,676	2,238,523	2,272,912
	10%	103,173	127,713	167,159	179,364	187,858	203,439	219,696	195,637	148,131	144,435
	25%	199,793	249,252	313,018	350,922	372,195	394,787	427,225	415,650	321,300	301,929
	Median	399,077	528,444	616,550	695,178	780,317	873,852	961,838	933,753	744,731	714,908
	75%	853,007	1,107,829	1,237,798	1,419,436	1,594,777	1,940,461	2,084,931	2,110,344	1,685,684	1,749,715
	90%	1,657,088	2,084,383	2,329,353	2,522,405	3,056,329	3,375,815	3,686,125	4,009,960	3,253,124	3,381,002
	N	868	858	853	848	842	835	829	809	797	781
2001	Mean	710,051	897,899	1,062,084	1,209,259	1,382,500	1,537,341	1,501,773	1,172,749	1,192,987	1,258,406
	SD	1,281,211	1,579,417	2,187,846	2,537,179	2,892,915	3,306,534	2,992,602	2,080,899	2,180,407	2,485,861
	10%	85,446	107,389	111,932	134,723	149,970	156,636	138,519	110,975	93,156	87,398
	25%	175,879	225,653	245,242	272,521	303,034	324,040	309,669	259,215	239,242	215,462
	Median	364,917	475,392	566,187	609,626	683,886	769,427	738,587	598,745	577,706	565,348
	75%	766,401	981,636	1,133,793	1,272,155	1,458,000	1,568,871	1,572,760	1,323,157	1,384,092	1,362,918
	90%	1,500,660	1,793,410	2,191,450	2,630,101	2,801,173	3,132,052	3,149,652	2,554,425	2,673,010	2,819,792
	N	1,029	1,015	1,008	1,001	988	979	958	938	916	899
2002	Mean	573,127	745,874	890,796	1,023,266	1,119,631	1,120,962	974,926	1,037,351	1,004,756	960,222
	SD	1,134,895	1,524,576	1,884,057	2,058,325	2,042,639	2,300,609	2,367,296	2,810,312	2,204,959	2,046,690
	10%	49,370	68,242	80,863	94,695	101,631	93,464	80,174	73,343	68,658	58,298
	25%	114,107	150,757	176,637	206,760	231,672	214,289	176,191	170,692	154,658	128,525
	Median	281,510	361,594	434,924	494,685	551,409	540,867	454,122	453,815	437,652	387,567
	75%	637,457	821,659	1,001,650	1,199,387	1,322,873	1,324,469	1,076,407	1,101,385	1,096,959	1,044,799
	90%	1,305,619	1,632,715	1,908,630	2,273,289	2,405,171	2,392,750	2,142,304	2,209,556	2,261,083	2,172,991
	N	1,550	1,501	1,489	1,474	1,454	1,426	1,396	1,358	1,337	1,295
2003	Mean	603,974	775,972	960,974	1,109,921	1,136,750	885,227	952,740	1,006,928	973,891	1,112,397

	SD	1,228,344	1,850,395	3,289,125	4,137,418	4,828,527	1,749,117	1,921,307	2,350,837	3,109,089	4,084,999
	10%	53,084	73,750	84,429	93,179	86,607	68,050	65,109	56,181	41,000	43,567
	25%	114,967	150,620	178,721	193,428	184,675	151,164	152,931	134,188	118,666	117,643
	Median	281,575	354,770	421,717	459,815	467,869	385,380	398,063	379,553	324,209	342,156
	75%	633,822	842,328	1,009,435	1,206,329	1,153,310	1,031,800	1,078,309	1,107,176	993,149	1,054,566
	90%	1,301,544	1,665,954	2,028,086	2,271,005	2,317,062	2,042,714	2,225,506	2,333,368	2,134,651	2,507,777
	N	1,510	1,483	1,465	1,450	1,420	1,395	1,350	1,322	1,278	1,096

Annual Sales Growth. Summary Statistics by cohort and age

Cohort / Age		1	2	3	4	5	6	7	8	9	10
2000	Mean	0.509	0.092	0.076	0.040	0.043	0.041	0.032	-0.019	-0.089	-0.009
	SD	0.463	0.225	0.192	0.145	0.129	0.170	0.165	0.158	0.212	0.197
	10%	0.041	-0.074	-0.081	-0.093	-0.083	-0.082	-0.098	-0.160	-0.293	-0.173
	25%	0.206	0.007	-0.007	-0.016	-0.011	-0.013	-0.017	-0.083	-0.166	-0.065
	Median	0.425	0.080	0.052	0.037	0.042	0.046	0.036	-0.009	-0.071	0.003
	75%	0.716	0.183	0.132	0.106	0.108	0.104	0.096	0.050	0.006	0.070
	90%	1.102	0.313	0.240	0.184	0.178	0.174	0.153	0.128	0.085	0.147
	N	868	858	853	848	842	835	829	809	797	781
2001	Mean	0.455	0.102	0.049	0.047	0.057	0.037	-0.027	-0.087	-0.023	-0.016
	SD	0.445	0.202	0.208	0.179	0.179	0.155	0.161	0.176	0.217	0.197
	10%	0.028	-0.073	-0.097	-0.102	-0.082	-0.097	-0.174	-0.266	-0.198	-0.180
	25%	0.156	0.004	-0.015	-0.015	-0.009	-0.020	-0.087	-0.162	-0.075	-0.072
	Median	0.365	0.074	0.050	0.048	0.047	0.036	-0.014	-0.070	-0.005	-0.006
	75%	0.647	0.179	0.122	0.109	0.112	0.100	0.049	-0.008	0.059	0.060
	90%	1.048	0.305	0.233	0.195	0.212	0.175	0.116	0.068	0.143	0.132
	N	1,029	1,015	1,008	1,001	988	979	958	938	916	899
2002	Mean	0.462	0.105	0.075	0.059	0.044	-0.016	-0.085	-0.016	-0.026	-0.064

		1	2	3	4	5	6	7	8	9	10
	SD	0.423	0.212	0.195	0.180	0.170	0.175	0.209	0.202	0.191	0.219
	10%	0.037	-0.072	-0.077	-0.095	-0.099	-0.175	-0.289	-0.184	-0.201	-0.251
	25%	0.181	0.000	-0.005	-0.005	-0.020	-0.076	-0.162	-0.072	-0.086	-0.118
	Median	0.392	0.081	0.057	0.055	0.043	-0.007	-0.062	-0.005	-0.012	-0.038
	75%	0.665	0.187	0.139	0.124	0.114	0.062	0.010	0.061	0.049	0.021
	90%	1.007	0.319	0.262	0.222	0.220	0.134	0.087	0.155	0.126	0.096
	N	1,550	1,501	1,489	1,474	1,454	1,426	1,396	1,358	1,337	1,295

Cohort / Age		1	2	3	4	5	6	7	8	9	10
2003	Mean	0.478	0.100	0.071	0.054	-0.014	-0.090	-0.006	-0.028	-0.069	-0.042
	SD	0.428	0.238	0.200	0.221	0.188	0.239	0.211	0.211	0.234	0.238
	10%	0.039	-0.090	-0.098	-0.110	-0.209	-0.315	-0.191	-0.219	-0.303	-0.228
	25%	0.189	0.003	-0.004	-0.019	-0.082	-0.167	-0.079	-0.089	-0.137	-0.102
	Median	0.401	0.077	0.066	0.044	-0.001	-0.063	-0.001	-0.008	-0.035	-0.017
	75%	0.690	0.195	0.146	0.129	0.071	0.011	0.072	0.061	0.030	0.046
	90%	1.021	0.344	0.250	0.225	0.159	0.101	0.172	0.148	0.101	0.143
	N	1,510	1,483	1,465	1,450	1,420	1,395	1,350	1,322	1,278	1,096

Size bands (summary statistics)

Cohort	Size band	N	Freq.	Sales (mean)	Sales (median)
2000	Size band 1 (micro)	153	17.63	86,912	91,684
	Size band 2 (small)	218	25.12	216,166	208,425
	Size band 3 (medium)	243	28.00	455,248	452,507
	Size band 4 (large)	254	29.26	1,828,602	1,181,799
	Total	**868**	**100.00**		
2001	Size band 1 (micro)	212	20.60	83,713	85,400
	Size band 2 (small)	262	25.46	217,022	214,084
	Size band 3 (medium)	271	26.34	454,306	446,494
	Size band 4 (large)	284	27.60	1,739,070	1,052,097
	Total	**1,029**	**100.00**		
2002	Size band 1 (micro)	491	31.68	72,750	70,652
	Size band 2 (small)	379	24.45	215,117	212,068
	Size band 3 (medium)	334	21.55	435,678	414,842
	Size band 4 (large)	346	22.32	1,493,244	1,111,983
	Total	**1,550**	**100.00**		
2003	Size band 1 (micro)	475	31.46	75,699	74,933
	Size band 2 (small)	353	23.38	206,844	197,552
	Size band 3 (medium)	357	23.64	456,335	447,468
	Size band 4 (large)	325	21.52	1,657,076	1,129,303
	Total	**1,510**	**100.00**		

COHORT 2000. Complete description of the different growth paths during the five first years.

Path	N	%	Path	N	%	Path	N	%	Path	N	%
GGGGG	157	18.6%	DGGGG	6	0.7%	GSGSD	3	0.4%	DGGGD	1	0.1%
GGGSG	49	5.8%	GDDDD	6	0.7%	GSSSS	3	0.4%	DGGGS	1	0.1%
GGGDG	46	5.5%	GDGDD	6	0.7%	SSGGG	3	0.4%	DGSDD	1	0.1%
GGGGS	43	5.1%	GDSGG	6	0.7%	DDGGD	2	0.2%	DGSDG	1	0.1%
GGDGG	38	4.5%	GDGGS	5	0.6%	DDGGG	2	0.2%	DSDDD	1	0.1%
GGGGD	31	3.7%	GDSDG	5	0.6%	DGSGD	2	0.2%	DSGGD	1	0.1%
GDGGG	24	2.9%	GGDSS	5	0.6%	DSGGG	2	0.2%	DSGSG	1	0.1%
GGSGG	22	2.6%	GGSGS	5	0.6%	GDGDS	2	0.2%	DSSGS	1	0.1%
GDGDG	19	2.3%	GGSSG	5	0.6%	GDGSS	2	0.2%	GDDSG	1	0.1%
GGDDG	16	1.9%	GSDGG	5	0.6%	GDSGD	2	0.2%	GDDSS	1	0.1%
GSGGG	16	1.9%	GSSSD	5	0.6%	GSDDD	2	0.2%	GDSGS	1	0.1%
GGDGD	15	1.8%	SGGGG	5	0.6%	GSDDG	2	0.2%	GDSSG	1	0.1%
GGGSS	15	1.8%	GDDSD	4	0.5%	GSDDS	2	0.2%	GDSSS	1	0.1%
GDGGD	14	1.7%	GDGSD	4	0.5%	GSGDD	2	0.2%	GSDSS	1	0.1%
GGGDD	14	1.7%	GGSDD	4	0.5%	GSGDS	2	0.2%	GSSDG	1	0.1%
GGDDD	12	1.4%	GGSSD	4	0.5%	GSSGG	2	0.2%	SDDGS	1	0.1%
GGGDS	11	1.3%	GSGGD	4	0.5%	GSSSG	2	0.2%	SDSSG	1	0.1%
GGDGS	10	1.2%	GSSGS	4	0.5%	SDGSD	2	0.2%	SGDDG	1	0.1%
GGGSD	10	1.2%	DGGDG	3	0.4%	SGDSG	2	0.2%	SGDGG	1	0.1%

GGSGD	10	1.2%	DGGSS	3	0.4%	SGGGD	2	0.2%	SGGGS	1	0.1%
GDGSG	9	1.1%	GDDDG	3	0.4%	DDDDD	1	0.1%	SGSDD	1	0.1%
GDDGD	8	1.0%	GDDGS	3	0.4%	DDGDD	1	0.1%	SSDGG	1	0.1%
GDDGG	8	1.0%	GDSSD	3	0.4%	DDGDG	1	0.1%	SSDGS	1	0.1%
GGDSG	8	1.0%	GGDDS	3	0.4%	DDGDS	1	0.1%	SSDSG	1	0.1%
GGSSS	8	1.0%	GGDSD	3	0.4%	DDSDG	1	0.1%	SSGSG	1	0.1%
GSGDG	8	1.0%	GGSDS	3	0.4%	DGDDD	1	0.1%	SSSSS	1	0.1%
GSGSG	8	1.0%	GSDGD	3	0.4%	DGDDS	1	0.1%			
DGDGG	7	0.8%	GSDGS	3	0.4%	DGGDD	1	0.1%			
GGSDG	7	0.8%	GSGGS	3	0.4%	DGGDS	1	0.1%	**Total**	**842**	**100.0%**

Note: (G) Growth; (S) Stasis; (D) Decline

COHORT 2000. Complete description of the different growth paths from the 6th to the 10th year.

Path	N	%	Path	N	%	Path	N	%	Path	N	%
GGDDG	38	4,9%	SGDDD	5	0.6%	DDDGG	2	0.3%	GDGDS	1	0.1%
GGDDD	35	4.5%	SGGDD	5	0.6%	DDGDS	2	0.3%	GDGSD	1	0.1%
GGGDG	34	4.4%	DDGDG	4	0.5%	DGGGG	2	0.3%	GDSDS	1	0.1%
GGGDD	21	2.7%	DGDDS	4	0.5%	DGGGS	2	0.3%	GDSGD	1	0.1%
GGSDG	19	2.4%	DGDSD	4	0.5%	DGGSG	2	0.3%	GDSGG	1	0.1%
GGDDS	18	2.3%	DSDDG	4	0.5%	DGSDD	2	0.3%	GDSSS	1	0.1%
GDDDG	17	2.2%	GDDGG	4	0.5%	DGSSG	2	0.3%	GGSGD	1	0.1%
GGGDS	16	2.0%	GDDSG	4	0.5%	DSDGS	2	0.3%	GGSGS	1	0.1%
GGGGG	16	2.0%	GDGGG	4	0.5%	DSSSD	2	0.3%	GSGDS	1	0.1%
GGSDD	16	2.0%	GGDGG	4	0.5%	GDDSD	2	0.3%	GSGGS	1	0.1%
GDDDD	14	1.8%	GGDSD	4	0.5%	GDGGD	2	0.3%	GSSGD	1	0.1%
GDGDG	14	1.8%	GGDSS	4	0.5%	GDGGS	2	0.3%	GSSGG	1	0.1%
GSDDD	14	1.8%	GGGSG	4	0.5%	GGSSD	2	0.3%	GSSGS	1	0.1%
DDDDD	12	1.5%	GGSGG	4	0.5%	GGSSG	2	0.3%	GSSSG	1	0.1%
DGGDG	12	1.5%	GSDDS	4	0.5%	GSDGD	2	0.3%	GSSSS	1	0.1%
GGGGD	12	1.5%	GSGGD	4	0.5%	GSDGS	2	0.3%	SDDGD	1	0.1%
SGGDG	12	1.5%	GSSDS	4	0.5%	GSDSS	2	0.3%	SDDSG	1	0.1%
GSDDG	11	1.4%	SSGDG	4	0.5%	GSGSD	2	0.3%	SDGDS	1	0.1%
DGDDG	10	1.3%	SSSDD	4	0.5%	SDDDG	2	0.3%	SDGGG	1	0.1%
GDGDD	10	1.3%	DDDSD	3	0.4%	SDGDD	2	0.3%	SDGSD	1	0.1%
DGGDD	9	1.2%	DDGGD	3	0.4%	SGGDS	2	0.3%	SDGSG	1	0.1%
GDDGD	9	1.2%	DDGGG	3	0.4%	SGGGS	2	0.3%	SDSDD	1	0.1%
GGGSS	9	1.2%	DDSGG	3	0.4%	SGSGS	2	0.3%	SGDGG	1	0.1%
DGDDD	8	1.0%	DGGSS	3	0.4%	SGSSD	2	0.3%	SGDSG	1	0.1%
DGDGG	8	1.0%	DGSDG	3	0.4%	SSGGG	2	0.3%	SGDSS	1	0.1%

GDSDD	8	1.0%	DSDDS	3	0.4%	SSSDG	2	0.3%	SGGGD	1	0.1%
GGGGS	8	1.0%	DSDGD	3	0.4%	DDDDS	1	0.1%	SGGSD	1	0.1%
SGDDG	8	1.0%	DSGDD	3	0.4%	DDDGS	1	0.1%	SGGSS	1	0.1%
DDDDG	7	0.9%	DSGDG	3	0.4%	DDGSS	1	0.1%	SGSDD	1	0.1%
GGDGD	7	0.9%	DSSDD	3	0.4%	DDSDG	1	0.1%	SGSGD	1	0.1%
GGDSG	7	0.9%	GDDDS	3	0.4%	DDSDS	1	0.1%	SGSSG	1	0.1%
SGSDG	7	0.9%	GDGSS	3	0.4%	DDSGS	1	0.1%	SSDDS	1	0.1%
DDGDD	6	0.8%	GDSDG	3	0.4%	DGDSG	1	0.1%	SSDGD	1	0.1%
SGDDS	6	0.8%	GGSDS	3	0.4%	DGGDS	1	0.1%	SSDGG	1	0.1%
DGDGD	5	0.6%	GSGGG	3	0.4%	DGGSD	1	0.1%	SSGDD	1	0.1%
DGGGD	5	0.6%	GSGSG	3	0.4%	DGSGG	1	0.1%	SSGSD	1	0.1%
DSDDD	5	0.6%	SDSDG	3	0.4%	DGSSD	1	0.1%	SSGSG	1	0.1%
GGDGS	5	0.6%	SGDGD	3	0.4%	DSGDS	1	0.1%	SSGSS	1	0.1%
GGGSD	5	0.6%	SGGGG	3	0.4%	DSGGD	1	0.1%	SSSDS	1	0.1%
GGSSS	5	0.6%	SGGSG	3	0.4%	DSSDG	1	0.1%	SSSGS	1	0.1%
GSGDD	5	0.6%	SGSDS	3	0.4%	DSSGS	1	0.1%	SSSSG	1	0.1%
GSGDG	5	0.6%	SGSSS	3	0.4%	DSSSG	1	0.1%	SSSSS	1	0.1%
GSSDD	5	0.6%	SSDDD	3	0.4%	DSSSS	1	0.1%			
GSSDG	5	0.6%	SSDDG	3	0.4%	GDDGS	1	0.1%	**Total**	**781**	**100.0%**

Note: (G) Growth; (S) Stasis; (D) Decline

COHORT 2001. Complete description of the different growth paths during the five first years.

Path	N	%	Path	N	%	Path	N	%	Path	N	%
GGGGG	200	20.2%	GDSSG	6	0.6%	GSGSS	3	0.3%	DGDDS	1	0.1%
GGGDG	51	5.2%	GGDDS	6	0.6%	GSSDG	3	0.3%	DGDSD	1	0.1%
GGDGG	47	4.8%	GGSDD	6	0.6%	SDGGD	3	0.3%	DGDSG	1	0.1%
GGGGS	42	4.3%	GGSSG	6	0.6%	SGGGG	3	0.3%	DGGDD	1	0.1%
GGGSG	38	3.8%	GGSSS	6	0.6%	DDDDG	2	0.2%	DGGGD	1	0.1%
GGGGD	34	3.4%	GSGSG	6	0.6%	DDDGG	2	0.2%	DGGGS	1	0.1%
GGSGG	33	3.3%	GSSGG	6	0.6%	DDDGS	2	0.2%	DGGSS	1	0.1%
GDGGG	30	3.0%	GSSGS	6	0.6%	DDGGS	2	0.2%	DGSDG	1	0.1%
GGGDD	25	2.5%	DGDGG	5	0.5%	DDGSD	2	0.2%	DGSGD	1	0.1%
GGDDG	22	2.2%	DGGDG	5	0.5%	DDGSG	2	0.2%	DGSSS	1	0.1%
GDDGG	19	1.9%	GSDGG	5	0.5%	DGDDD	2	0.2%	DSGDD	1	0.1%
GGGSS	18	1.8%	GSDGS	5	0.5%	DGDDG	2	0.2%	DSSSG	1	0.1%
GSGGG	18	1,8%	GDDDD	4	0,4%	DGDGD	2	0,2%	GDDGS	1	0,1%
GDGDG	15	1,5%	GDDDS	4	0,4%	DGGSG	2	0,2%	GDDSD	1	0,1%
GGDGD	15	1,5%	GDGDS	4	0,4%	DGSDD	2	0,2%	GDSSD	1	0,1%
GGDGS	15	1,5%	GDGGS	4	0,4%	DGSGS	2	0,2%	GSDDS	1	0,1%

GDGGD	13	1,3%	GDSDG	4	0,4%	DSGGD	2	0,2%	GSGDD	1	0,1%
GSGGD	12	1,2%	GGDSD	4	0,4%	GDDSG	2	0,2%	GSSDS	1	0,1%
GGDDD	10	1,0%	GGSGD	4	0.4%	GDDSS	2	0.2%	SDDSG	1	0.1%
GGGDS	10	1.0%	GGSSD	4	0.4%	GDGSD	2	0.2%	SDGDG	1	0.1%
GGGSD	10	1.0%	GSDGD	4	0.4%	GDSGS	2	0.2%	SDGGG	1	0.1%
DGGGG	9	0.9%	GSGSD	4	0.4%	GGDSS	2	0.2%	SDGGS	1	0.1%
GGDSG	9	0.9%	GSSSD	4	0.4%	GGSDS	2	0.2%	SDGSG	1	0.1%
GGSDG	9	0.9%	GSSSS	4	0.4%	GSDDG	2	0.2%	SDSGG	1	0.1%
GDDDG	8	0.8%	SGDDD	4	0.4%	GSGDG	2	0.2%	SGDSG	1	0.1%
GSGGS	8	0.8%	DDGGG	3	0.3%	GSGDS	2	0.2%	SGGDG	1	0.1%
GDDGD	7	0.7%	DSGGG	3	0.3%	GSSDD	2	0.2%	SGGGS	1	0.1%
GDGSG	7	0.7%	GDGSS	3	0.3%	GSSSG	2	0.2%	SGGSG	1	0.1%
GDSGG	7	0.7%	GDSDD	3	0.3%	SGDGG	2	0.2%	SGSSG	1	0.1%
GGSGS	7	0.7%	GDSGD	3	0.3%	SGSGS	2	0.2%	SSGGS	1	0.1%
GDGDD	6	0.6%	GSDSG	3	0.3%	DDGGD	1	0.1%	SSSSS	1	0.1%
									Total	**988**	**100.0**

Note: (G) Growth; (S) Stasis; (D) Decline

COHORT 2001. Complete description of the different growth paths from the 6th to the 10th year.

Path	N	%	Path	N	%	Path	N	%	Path	N	%
GDDDD	45	5,0%	GGSSG	6	0,7%	SSDSD	3	0,3%	DDDSG	1	0,1%
GDDGD	34	3,8%	SGDGD	6	0,7%	SSDSS	3	0,3%	DDGDS	1	0,1%
GDDDG	30	3,3%	SGDGS	6	0,7%	DDDDS	2	0,2%	DDSDS	1	0,1%
GGDGG	26	2,9%	SGDSD	6	0,7%	DDGGD	2	0,2%	DDSGS	1	0,1%
GGDDD	22	2,4%	DDDGS	5	0,6%	DDGGS	2	0,2%	DDSSD	1	0,1%
GDDSD	18	2,0%	DSDSD	5	0,6%	DDGSG	2	0,2%	DDSSS	1	0,1%
DDDDD	17	1,9%	GDGGD	5	0,6%	DDSDG	2	0,2%	DGDDS	1	0,1%
GGDGD	17	1,9%	GDSDD	5	0,6%	DDSGG	2	0,2%	DGGDG	1	0,1%
GGGGG	17	1,9%	GDSGG	5	0,6%	DGDGS	2	0,2%	DGGDS	1	0,1%
GSDGG	16	1,8%	GGGDD	5	0,6%	DGDSS	2	0,2%	DGGGG	1	0,1%
SDDDD	16	1,8%	GSDDS	5	0,6%	DGGGS	2	0,2%	DGSDD	1	0,1%
GDDDS	14	1,6%	GSDGD	5	0,6%	DGGSG	2	0,2%	DGSGG	1	0,1%
GDDGG	14	1,6%	SGDSG	5	0,6%	DGSDS	2	0,2%	DGSGS	1	0,1%
DGDDD	13	1,4%	DDDSS	4	0,4%	DSDDG	2	0,2%	DSDGD	1	0,1%
GGDDG	13	1,4%	DGDSD	4	0,4%	DSDSG	2	0,2%	DSGDD	1	0,1%
DDDGD	12	1,3%	DGSSG	4	0,4%	DSGGD	2	0,2%	DSGSS	1	0,1%
DGDGD	12	1,3%	GDDSS	4	0,4%	DSGSG	2	0,2%	DSSDD	1	0,1%
DDDDG	11	1,2%	GGDSD	4	0,4%	GDGDS	2	0,2%	DSSGD	1	0,1%
GDGDD	11	1,2%	GGGGS	4	0,4%	GDSSD	2	0,2%	DSSSG	1	0,1%

GSDDG	11	1,2%	GGSGD	4	0,4%	GDSSS	2	0,2%	GDGSD	1	0,1%
DDDGG	10	1,1%	GSDGS	4	0,4%	GGGDS	2	0,2%	GDSDS	1	0,1%
GDDGS	10	1,1%	SDDDG	4	0,4%	GGSDS	2	0,2%	GDSGD	1	0,1%
GGDGS	10	1,1%	SDDGS	4	0,4%	GGSGS	2	0,2%	GGDSS	1	0,1%
GGDSG	10	1,1%	SDDSD	4	0,4%	GGSSS	2	0,2%	GSDSG	1	0,1%
GSDSD	10	1,1%	SGDDD	4	0,4%	GSSDD	2	0,2%	GSGDD	1	0,1%
DGDDG	9	1,0%	SSDDD	4	0,4%	GSSSD	2	0,2%	GSGDG	1	0,1%
GDDSG	9	1,0%	SSDGG	4	0,4%	SDDSS	2	0,2%	GSGDS	1	0,1%
GGDDS	9	1,0%	SSDGS	4	0,4%	SDGDD	2	0,2%	GSGGG	1	0,1%
GGSDD	9	1,0%	SSDSG	4	0,4%	SDSDS	2	0,2%	GSGSS	1	0,1%
GSDDD	9	1,0%	DDGGG	3	0,3%	SDSGG	2	0,2%	GSSDG	1	0,1%
DDGDG	8	0,9%	DDSGD	3	0,3%	SDSGS	2	0,2%	GSSGD	1	0,1%
GDGGG	8	0,9%	DGGGD	3	0,3%	SDSSG	2	0,2%	GSSGG	1	0,1%
SDDGD	8	0,9%	DSDDD	3	0,3%	SGDSS	2	0,2%	GSSSS	1	0,1%
SDDGG	8	0,9%	DSDDS	3	0,3%	SGGGD	2	0,2%	SDDSG	1	0,1%
SGDGG	8	0,9%	DSDGG	3	0,3%	SGSDD	2	0,2%	SDGDS	1	0,1%
DDDSD	7	0,8%	GDGGS	3	0,3%	SGSGG	2	0,2%	SDSDG	1	0,1%
DDGDD	7	0,8%	GDGSG	3	0,3%	SGSGS	2	0,2%	SDSSS	1	0,1%
DGDGG	7	0,8%	GDSDG	3	0,3%	SSDDG	2	0,2%	SGDDS	1	0,1%
DGGDD	7	0,8%	GDSSG	3	0,3%	SSDDS	2	0,2%	SGSGD	1	0,1%
GDGDG	7	0,8%	GGSDG	3	0,3%	SSGDG	2	0,2%	SSGDD	1	0,1%
GGGDG	7	0,8%	GGSSD	3	0,3%	SSGGD	2	0,2%	SSGGS	1	0,1%
GSDSS	7	0,8%	GSSGS	3	0,3%	SSSDG	2	0,2%	SSGSG	1	0,1%
SGDDG	7	0,8%	SDDDS	3	0,3%	SSSGD	2	0,2%	SSSDD	1	0,1%
GGGGD	6	0,7%	SDSDD	3	0,3%	SSSGG	2	0,2%	SSSDS	1	0,1%
GGGSG	6	0,7%	SGGDG	3	0,3%	SSSSS	2	0,2%	SSSSD	1	0,1%
									Total	**899**	**100,0%**

Note: (G) Growth; (S) Stasis; (D) Decline

COHORT 2002. Complete description of the different growth paths during the five first years.

Path	N	%	Path	N	%	Path	N	%	Path	N	%
GGGGG	298	20,5%	GSDGG	10	0,7%	GSSSS	4	0,3%	DGDSG	1	0,1%
GGGGD	79	5,4%	GSGGS	10	0,7%	DGDGG	3	0,2%	DGGGS	1	0,1%
GGGDG	73	5,0%	GDDGS	9	0,6%	GDDDD	3	0,2%	DGSGG	1	0,1%
GGGGS	64	4,4%	GGSDG	9	0,6%	GDDDS	3	0,2%	DGSSS	1	0,1%
GDGGG	55	3,8%	GGDSD	8	0,6%	GDGSS	3	0,2%	DSDGD	1	0,1%
GGDGG	55	3,8%	GSGSG	8	0,6%	GSGDS	3	0,2%	DSDSS	1	0,1%
GGSGG	40	2,8%	GSSGD	8	0,6%	GSGSD	3	0,2%	DSGDD	1	0,1%
GGGSG	36	2,5%	GDSGS	7	0,5%	SGGDG	3	0,2%	DSGGD	1	0,1%

GGDGD	34	2,3%	GGSSS	7	0,5%	SGGGS	3	0,2%	DSGGG	1	0,1%
GGGDD	30	2,1%	GSGSS	7	0,5%	SGGSG	3	0,2%	DSSGG	1	0,1%
GSGGG	28	1,9%	GSSDS	7	0,5%	SGSGG	3	0,2%	DSSSS	1	0,1%
GDGDG	26	1,8%	GDGSG	6	0,4%	SGSGS	3	0,2%	GDDSD	1	0,1%
GGDDG	26	1,8%	GDSDG	6	0,4%	SSGGG	3	0,2%	GDDSG	1	0,1%
GDDGG	24	1,7%	GGDSS	6	0,4%	DDDSG	2	0,1%	GDDSS	1	0,1%
GDGGD	24	1,7%	GGSDD	6	0,4%	DDGDD	2	0,1%	GDSDD	1	0,1%
GGSGD	21	1,4%	GSGDD	6	0,4%	DDGGD	2	0,1%	GDSDS	1	0,1%
GGGSS	20	1,4%	GSSDD	6	0,4%	DDGSG	2	0,1%	GDSSG	1	0,1%
DGGGG	18	1,2%	SGGGG	6	0,4%	GDGDS	2	0,1%	GSSDG	1	0,1%
GSSGG	18	1,2%	DGGDD	5	0,3%	GDSSD	2	0,1%	SDDDG	1	0,1%
GGGSD	17	1,2%	DGGDG	5	0,3%	GDSSS	2	0,1%	SDDGD	1	0,1%
GDDDG	14	1,0%	DGGSG	5	0,3%	GGDDS	2	0,1%	SDDGS	1	0,1%
GDGGS	14	1,0%	GDSGD	5	0,3%	GGSDS	2	0,1%	SDGGD	1	0,1%
GGGDS	14	1,0%	GSDDD	5	0,3%	GGSSD	2	0,1%	SDGGG	1	0,1%
GSGGD	14	1,0%	GSDGD	5	0,3%	GSSSD	2	0,1%	SGDGG	1	0,1%
GDDGD	13	0,9%	GSDSG	5	0,3%	SGDDG	2	0,1%	SGGSS	1	0,1%
GGSGS	13	0,9%	GSSGS	5	0,3%	SGDSG	2	0,1%	SGSDG	1	0,1%
GDGDD	12	0,8%	GSSSG	5	0,3%	SGGGD	2	0,1%	SGSSS	1	0,1%
GGDSG	12	0,8%	DDDGD	4	0,3%	DDDDD	1	0,1%	SSDGD	1	0,1%
GGSSG	12	0,8%	DDGGG	4	0,3%	DDDGG	1	0,1%	SSGSD	1	0,1%
GSGDG	12	0,8%	DGDGD	4	0,3%	DDDSS	1	0,1%	SSSGS	1	0,1%
GDSGG	11	0,8%	DGDGS	4	0,3%	DDSDD	1	0,1%	SSSSS	1	0,1%
GGDDD	11	0,8%	DGGGD	4	0,3%	DDSSG	1	0,1%			
GGDGS	10	0,7%	GDGSD	4	0,3%	DGDDG	1	0,1%	**Total**	**1454**	**100,0%**

Note: (G) Growth; (S) Stasis; (D) Decline

COHORT 2002. Complete description of the different growth paths from the 6th to the 10th year.

Path	N	%	Path	N	%	Path	N	%	Path	N	%
DDDDD	68	5,3%	GGDSD	7	0,5%	DGDSG	3	0,2%	SSDGG	2	0,2%
GDDDD	40	3,1%	GGGDS	7	0,5%	DSGGD	3	0,2%	SSDGS	2	0,2%
GDGDD	39	3,0%	GGGGS	7	0,5%	DSGSD	3	0,2%	SSGGD	2	0,2%
DDGDD	38	2,9%	SDGDD	7	0,5%	DSSDD	3	0,2%	SSGGS	2	0,2%
DDGGD	38	2,9%	DDDSG	6	0,5%	DSSDG	3	0,2%	SSGSD	2	0,2%
DDDGD	37	2,9%	DGGGD	6	0,5%	GDDSS	3	0,2%	SSGSS	2	0,2%
DDSDD	25	1,9%	DGGGG	6	0,5%	GDGDS	3	0,2%	SSSDG	2	0,2%
DDGDG	23	1,8%	DSDDD	6	0,5%	GDGSG	3	0,2%	SSSGD	2	0,2%
DGDDD	22	1,7%	DSDGD	6	0,5%	GDSSS	3	0,2%	DDDSS	1	0,1%
SDDDD	20	1,5%	GDSDS	6	0,5%	GGDGS	3	0,2%	DGDDS	1	0,1%

DDDSD	19	1,5%	GDSGG	6	0,5%	GGGSG	3	0,2%	DGGSD	1	0,1%
GGGGG	18	1,4%	GGDDS	6	0,5%	GGSGD	3	0,2%	DGGSG	1	0,1%
DDGGG	17	1,3%	GSDDS	6	0,5%	GGSGG	3	0,2%	DGGSS	1	0,1%
DGDGD	17	1,3%	SDDDG	6	0,5%	GGSGS	3	0,2%	DGSDG	1	0,1%
DDDDG	16	1,2%	SDDDS	6	0,5%	GSGDS	3	0,2%	DGSGG	1	0,1%
DDDGG	16	1,2%	SDGDG	6	0,5%	GSGGS	3	0,2%	DGSSD	1	0,1%
DDGSD	16	1,2%	SDGGD	6	0,5%	GSSDD	3	0,2%	DGSSS	1	0,1%
GDDGD	16	1,2%	SSSSS	6	0,5%	GSSGG	3	0,2%	DSDGG	1	0,1%
GDGGD	16	1,2%	DDSGS	5	0,4%	SDDGS	3	0,2%	DSDSD	1	0,1%
GDGDG	15	1,2%	DGSDD	5	0,4%	SDDSG	3	0,2%	DSDSG	1	0,1%
GDGGG	15	1,2%	DGSGD	5	0,4%	SDDSS	3	0,2%	DSDSS	1	0,1%
GDDDG	14	1,1%	GDDGS	5	0,4%	SDGDS	3	0,2%	DSGDG	1	0,1%
GDDGG	14	1,1%	GGDSS	5	0,4%	SDGGS	3	0,2%	DSGDS	1	0,1%
SDDSD	14	1,1%	GGGDG	5	0,4%	SDGSS	3	0,2%	DSGSG	1	0,1%
DDGGS	13	1,0%	GGSSS	5	0,4%	SDSDS	3	0,2%	DSSGD	1	0,1%
GDSDD	13	1,0%	GSDDD	5	0,4%	SDSGS	3	0,2%	DSSGS	1	0,1%
SDDGD	13	1,0%	GSGSD	5	0,4%	SSSDD	3	0,2%	GDSSG	1	0,1%
GGDGD	12	0,9%	GSSSS	5	0,4%	DDDGS	2	0,2%	GGGSD	1	0,1%
GDSSD	11	0,8%	SDGSD	5	0,4%	DDGSS	2	0,2%	GGSSG	1	0,1%
GGDDD	11	0,8%	SDSSD	5	0,4%	DGDGG	2	0,2%	GSDSD	1	0,1%
DGGDD	10	0,8%	SDSSS	5	0,4%	DGDGS	2	0,2%	GSDSG	1	0,1%
GGGDD	10	0,8%	SGDGD	5	0,4%	DGGDS	2	0,2%	GSGSG	1	0,1%
GGSDD	10	0,8%	SSDGD	5	0,4%	DGSDS	2	0,2%	GSGSS	1	0,1%
DGGDG	9	0,7%	SSSSD	5	0,4%	DSDDS	2	0,2%	GSSDG	1	0,1%
GDDDS	9	0,7%	DDGSG	4	0,3%	DSGGG	2	0,2%	GSSDS	1	0,1%
GDDSD	9	0,7%	DDSDS	4	0,3%	DSSGG	2	0,2%	SDSDG	1	0,1%
GDGSD	9	0,7%	DDSGG	4	0,3%	DSSSD	2	0,2%	SGDDG	1	0,1%
GDSGD	9	0,7%	DDSSG	4	0,3%	DSSSS	2	0,2%	SGDGS	1	0,1%
GSDGD	9	0,7%	DSDDG	4	0,3%	GDDSG	2	0,2%	SGGDD	1	0,1%
SDGGG	9	0,7%	DSGDD	4	0,3%	GGDGG	2	0,2%	SGGGD	1	0,1%
SGDDD	9	0,7%	GGDDG	4	0,3%	GGSDS	2	0,2%	SGGSD	1	0,1%
DDSSD	8	0,6%	GGGSS	4	0,3%	GSDGG	2	0,2%	SGGSS	1	0,1%
GDGSS	8	0,6%	GGSDG	4	0,3%	GSDGS	2	0,2%	SGSDD	1	0,1%
GGGGD	8	0,6%	GGSSD	4	0,3%	GSGGD	2	0,2%	SGSDS	1	0,1%
SDSDD	8	0,6%	GSGDD	4	0,3%	GSSGS	2	0,2%	SGSGG	1	0,1%
DDDDS	7	0,5%	GSGDG	4	0,3%	SDGSG	2	0,2%	SGSGS	1	0,1%
DDGDS	7	0,5%	GSGGG	4	0,3%	SDSGG	2	0,2%	SGSSG	1	0,1%
DDSDG	7	0,5%	SDDGG	4	0,3%	SGDSD	2	0,2%	SSDSD	1	0,1%
DDSGD	7	0,5%	SDSGD	4	0,3%	SGGGG	2	0,2%	SSGDD	1	0,1%

DGGGS	7	0,5%	SSGDG	4	0,3%	SGSGD	2	0,2%	SSGSG	1	0,1%
GDGGS	7	0,5%	SSGGG	4	0,3%	SSDDD	2	0,2%	SSSDS	1	0,1%
GDSDG	7	0,5%	DGDDG	3	0,2%	SSDDG	2	0,2%	SSSSG	1	0,1%
GDSGS	7	0,5%	DGDSD	3	0,2%	SSDDS	2	0,2%	**Total**	**1295**	**100,0%**

Note: (G) Growth; (S) Stasis; (D) Decline

COHORT 2003. Complete description of the different growth paths during the five first years.

Path	N	%	Path	N	%	Path	N	%	Path	N	%
GGGGG	192	13,5%	GGSSG	9	0,6%	DDDGD	3	0,2%	DGDSG	1	0,1%
GGGGD	168	11,8%	GSDGG	9	0,6%	DDDGG	3	0,2%	DGSDG	1	0,1%
GGGGS	63	4,4%	GSGDD	9	0,6%	DDGDD	3	0,2%	DGSGS	1	0,1%
GGGDD	60	4,2%	GGSGS	8	0,6%	DDGGG	3	0,2%	DSGDG	1	0,1%
GGGDG	55	3,9%	GSDGD	8	0,6%	DGDGD	3	0,2%	DSGGG	1	0,1%
GGDGG	47	3,3%	DGGDG	7	0,5%	DGDGS	3	0,2%	DSGSS	1	0,1%
GDGGD	39	2,7%	GGDSS	7	0,5%	GDDSD	3	0,2%	GDDDS	1	0,1%
GGDGD	36	2,5%	DGGGG	6	0,4%	GDSDS	3	0,2%	GDSSG	1	0,1%
GDGGG	33	2,3%	DGGSD	6	0,4%	GDSGS	3	0,2%	GSDDS	1	0,1%
GGSGG	33	2,3%	GDGSG	6	0,4%	GGSDS	3	0,2%	GSDSD	1	0,1%
GDGDD	32	2,3%	GDSGD	6	0,4%	GGSSS	3	0,2%	GSDSG	1	0,1%
GGGSG	32	2,3%	GGDDS	6	0,4%	GSDGS	3	0,2%	GSSDG	1	0,1%
GGGSS	27	1,9%	GGSSD	6	0,4%	GSSGD	3	0,2%	GSSDS	1	0,1%
GGGSD	26	1,8%	GSDDD	6	0,4%	SDGSD	3	0,2%	GSSSG	1	0,1%
GGDDD	22	1,5%	GSGSG	6	0,4%	SGGGD	3	0,2%	SDDGD	1	0,1%
GSGGG	21	1,5%	GDGSS	5	0,4%	DDGGD	2	0,1%	SDDSS	1	0,1%
GGSGD	19	1,3%	GDSDD	5	0,4%	DGDDD	2	0,1%	SDGGG	1	0,1%
GGGDS	18	1,3%	GDSGG	5	0,4%	DGGGS	2	0,1%	SDSGS	1	0,1%
GDDGD	17	1,2%	GSGSS	5	0,4%	DGSDD	2	0,1%	SGDDD	1	0,1%
GSGGD	17	1,2%	GSSGG	5	0,4%	DGSGG	2	0,1%	SGDDG	1	0,1%
GDGDG	15	1,1%	GSSGS	5	0,4%	DSDGD	2	0,1%	SGDGD	1	0,1%
GDGGS	15	1,1%	DGDDG	4	0,3%	GDDSS	2	0,1%	SGDSS	1	0,1%
GDDGG	14	1,0%	DGDGG	4	0,3%	GSDSS	2	0,1%	SGGSD	1	0,1%
GGDSG	14	1,0%	DGGDD	4	0,3%	GSSSS	2	0,1%	SGGSG	1	0,1%
GDGSD	13	0,9%	GDDDG	4	0,3%	SGGDD	2	0,1%	SGGSS	1	0,1%
GGSDG	13	0,9%	GDDGS	4	0,3%	SGGDG	2	0,1%	SGSDG	1	0,1%
GGDSD	12	0,8%	GDDSG	4	0,3%	SGGDS	2	0,1%	SGSGD	1	0,1%
GGSDD	12	0,8%	GDGDS	4	0,3%	SSGGG	2	0,1%	SSDGS	1	0,1%
GSGSD	11	0,8%	GDSDG	4	0,3%	DDDGS	1	0,1%	SSGDD	1	0,1%
GGDDG	10	0,7%	GSGDG	4	0,3%	DDGSD	1	0,1%	SSGGD	1	0,1%
GSGGS	10	0,7%	GSGDS	4	0,3%	DDSGD	1	0,1%	SSGSS	1	0,1%

DGGGD	9	0,6%	GSSDD	4	0,3%	DDSGG	1	0,1%	SSSDS	1	0,1%
GDDDD	9	0,6%	GSSSD	4	0,3%	DDSSD	1	0,1%	SSSSS	1	0,1%
GGDGS	9	0,6%	SGGGG	4	0,3%	DGDDS	1	0,1%	**Total**	**1420**	**100,0%**

Note: (G) Growth; (S) Stasis; (D) Decline

COHORT 2003. Complete description of the different growth paths from the 6th to the 10th year.

Path	N	%	Path	N	%	Path	N	%	Path	N	%
DDDDD	46	4,2%	GGGGD	6	0,5%	SGDGG	3	0,3%	DDSDS	1	0,1%
DGDDD	42	3,8%	GSDDD	6	0,5%	SGGGD	3	0,3%	DDSGG	1	0,1%
DDGDD	39	3,6%	SGDDD	6	0,5%	SSDDG	3	0,3%	DGDSG	1	0,1%
DDDDG	27	2,5%	SGDDG	6	0,5%	SSGSG	3	0,3%	DSDGS	1	0,1%
DDGDG	26	2,4%	DDDSS	5	0,5%	SSSGS	3	0,3%	DSGGG	1	0,1%
DGDGD	25	2,3%	DGDGS	5	0,5%	DDSGS	2	0,2%	DSSGD	1	0,1%
DGGDD	24	2,2%	DSDGD	5	0,5%	DGGSS	2	0,2%	DSSGG	1	0,1%
DDDGD	23	2,1%	DSGSD	5	0,5%	DGSGS	2	0,2%	GDDGS	1	0,1%
DGDDG	23	2,1%	DSSDS	5	0,5%	DSDDS	2	0,2%	GDDSG	1	0,1%
DGGDG	23	2,1%	GDDGG	5	0,5%	DSDGG	2	0,2%	GDDSS	1	0,1%
DGGGD	18	1,6%	SDGSD	5	0,5%	DSDSD	2	0,2%	GDGGS	1	0,1%
GGGGG	17	1,6%	SGGGG	5	0,5%	DSGSS	2	0,2%	GDSDG	1	0,1%
DDDGG	16	1,5%	SSGDD	5	0,5%	DSSDD	2	0,2%	GGDGS	1	0,1%
DDSDD	15	1,4%	DDDSG	4	0,4%	GDDSD	2	0,2%	GGDSD	1	0,1%
DGGDS	15	1,4%	DDSDG	4	0,4%	GDGSD	2	0,2%	GGSDG	1	0,1%
DGGGG	15	1,4%	DGDSS	4	0,4%	GDGSS	2	0,2%	GGSDS	1	0,1%
GGDDD	14	1,3%	DGGSD	4	0,4%	GDSGG	2	0,2%	GGSGS	1	0,1%
DDDDS	13	1,2%	DGSGD	4	0,4%	GDSSG	2	0,2%	GGSSS	1	0,1%
DDDSD	13	1,2%	DGSSD	4	0,4%	GGGDS	2	0,2%	GSDDS	1	0,1%
DGGGS	13	1,2%	DSGGD	4	0,4%	GGGSG	2	0,2%	GSDGD	1	0,1%
DGSDD	13	1,2%	DSSSD	4	0,4%	GGSGD	2	0,2%	GSDSS	1	0,1%
DDGGD	11	1,0%	DSSSS	4	0,4%	GGSSG	2	0,2%	GSGDG	1	0,1%
DGDGG	11	1,0%	GDDDS	4	0,4%	GSGGG	2	0,2%	GSGGD	1	0,1%
DSGDD	11	1,0%	GDGGG	4	0,4%	GSGGS	2	0,2%	GSSDD	1	0,1%
GDDDG	11	1,0%	GDSDD	4	0,4%	GSGSD	2	0,2%	GSSGD	1	0,1%
GGDGG	11	1,0%	GGGSD	4	0,4%	GSSDS	2	0,2%	SDGDG	1	0,1%
SDDDD	11	1,0%	GGGSS	4	0,4%	GSSGG	2	0,2%	SDGGS	1	0,1%
DDGDS	10	0,9%	GGSSD	4	0,4%	SDDDS	2	0,2%	SDGSS	1	0,1%
DGDDS	10	0,9%	GSGDD	4	0,4%	SDDGD	2	0,2%	SDSGD	1	0,1%
DSDDD	10	0,9%	GSGDS	4	0,4%	SDDGG	2	0,2%	SDSGS	1	0,1%
GDDDD	10	0,9%	GSGSG	4	0,4%	SDDSD	2	0,2%	SGDGS	1	0,1%
GGGDD	10	0,9%	SDDDG	4	0,4%	SDDSG	2	0,2%	SGDSD	1	0,1%

GGSDD	9	0,8%	SDSDG	4	0,4%	SDGDD	2	0,2%	SGDSG	1	0,1%
DDGGG	8	0,7%	SSSSS	4	0,4%	SDGDS	2	0,2%	SGDSS	1	0,1%
DDGSS	8	0,7%	DDSSD	3	0,3%	SDGGD	2	0,2%	SGGDS	1	0,1%
DGGSG	8	0,7%	DDSSS	3	0,3%	SDGGG	2	0,2%	SGGGS	1	0,1%
DGSSG	8	0,7%	DGSDS	3	0,3%	SDSDS	2	0,2%	SGGSD	1	0,1%
GDGDD	8	0,7%	DGSGG	3	0,3%	SGDDS	2	0,2%	SGSDD	1	0,1%
GDGGD	8	0,7%	DSDSS	3	0,3%	SGDGD	2	0,2%	SGSGG	1	0,1%
SSDDD	8	0,7%	DSGGS	3	0,3%	SGGDD	2	0,2%	SGSGS	1	0,1%
DDGSD	7	0,6%	DSGSG	3	0,3%	SGGDG	2	0,2%	SGSSD	1	0,1%
DDSGD	7	0,6%	DSSDG	3	0,3%	SGGSG	2	0,2%	SSDGD	1	0,1%
DSDDG	7	0,6%	GDGDS	3	0,3%	SGGSS	2	0,2%	SSDSD	1	0,1%
GDDGD	7	0,6%	GDSSD	3	0,3%	SGSDG	2	0,2%	SSGDS	1	0,1%
GGDDG	7	0,6%	GGDDS	3	0,3%	SGSDS	2	0,2%	SSGGD	1	0,1%
GSDDG	7	0,6%	GGDGD	3	0,3%	SGSGD	2	0,2%	SSGGG	1	0,1%
SSSDD	7	0,6%	GGDSG	3	0,3%	SGSSG	2	0,2%	SSGGS	1	0,1%
DDGGS	6	0,5%	GGGGS	3	0,3%	SGSSS	2	0,2%	SSSDG	1	0,1%
DGDSD	6	0,5%	GGSGG	3	0,3%	SSGDG	2	0,2%	SSSDS	1	0,1%
DGSDG	6	0,5%	GSGSS	3	0,3%	SSSSD	2	0,2%	SSSGD	1	0,1%
DSGDG	6	0,5%	GSSSG	3	0,3%	SSSSG	2	0,2%	SSSGG	1	0,1%
GDGDG	6	0,5%	GSSSS	3	0,3%	DDDGS	1	0,1%			
GGGDG	6	0,5%	SDSDD	3	0,3%	DDGSG	1	0,1%	**Total**	**1096**	**100,0%**

Note: (G) Growth; (S) Stasis; (D) Decline

Basic Model – Complete regressions' outputs by cohort

Dependent variable: Growth$_{i,\,t}$	Cohort 2000	Cohort 2001	Cohort 2002	Cohort 2003
Growth $_{i,\,t-1}$	0.0419***	0.0702***	0.0595***	0.0521***
Age $_{i,\,t-1}$	-0.0078***	-0.0070***	-0.0124***	-0.0095***
Growth$_{i,t-1}$ x age$_{i,\,t-1}$	-0.0073***	-0.0100***	-0.0049***	-0.0049***
year2003	-0.0063			
year2004	-0.0102*	0.0022		
year2005	0.0006	0.0107**	0.0057	
year2006	0.0121**	0.0183***	0.0180***	0.0147***
year2007	0.0113**	0.0148***	0.0180***	0.0035
year2008	-0.0263***	-0.0296***	-0.0172***	-0.0322***
year2009	-0.0827***	-0.0766***	-0.0575***	-0.0842***
year2010		-0.0055	0.0123***	-0.0108**
year2011			0.0150***	-0.0100**
year2012				-0.0283***
sector11	0.0117	0.0153	-0.0263	-0.0117
sector13	-0.0109	-0.0255**	-0.0212**	-0.0224*
sector14	-0.0215**	-0.0220**	-0.0576***	-0.0175
sector15	-0.0227**	-0.0133	-0.0315***	0.0045
sector16	-0.0194**	-0.0112	-0.0394***	-0.0135
sector17	-0.0456***	0.0390*	-0.0096	-0.0210
sector18	-0.0054	-0.0044	-0.0313***	-0.0319***
sector19	0.0078	0.0045		

sector20	0.0117	0.0055	-0.0101	-0.0185
sector21	-0.0140	0.0356	-0.0114	0.0358
sector22	-0.0093	-0.0102	-0.0119	-0.0075
sector23	-0.0226**	-0.0109	-0.0274***	-0.0502***
sector24	-0.0188*	0.0064	-0.0276**	-0.0433***
sector25	-0.0051	-0.0023	-0.0326***	-0.0313***
sector26	0.0034	0.0047	-0.0202	-0.0689***
sector27	-0.0101	-0.0079	-0.0147	-0.0220
sector28	-0.0101	-0.0046	-0.0166*	-0.0116
sector29	-0.0539***	-0.0160	-0.0114	-0.0396***
sector30	0.0020	0.0608***	-0.0726***	-0.0234
sector31	-0.0166*	-0.0359***	-0.0314***	-0.0444***
sector32	-0.0307*	-0.0208	-0.0248**	-0.0379**
sector49	0.0046	0.0093	-0.0121	-0.0229***
sector50	-0.0312	-0.0069	-0.0029	-0.0196
sector51		0.0155	0.0447	0.0224
sector53	0.0001		-0.0357*	0.0083
sector55	-0.0209*	-0.0158	-0.0192*	-0.0263**
sector56	-0.0113	-0.0138**	-0.0294***	-0.0288***
sector58	0.0169	0.0018	-0.0309**	-0.0348***
sector59	-0.0224	-0.0231	-0.0250**	-0.0146
sector60		-0.0129	-0.0174	-0.0992***
sector61	-0.0081	0.0082	-0.0119	0.0078
sector62	-0.0086	0.0129*	-0.0022	-0.0014
sector63	0.0469*	0.0224	-0.0034	-0.0204
sector69	-0.0110	0.0001	-0.0072	-0.0203***
sector70	0.0036	-0.0031	-0.0147*	-0.0132
sector71	-0.0002	-0.0018	-0.0224***	-0.0529***
sector72	0.0268	-0.0148	0.0372	0.0778***
sector73	-0.0146*	-0.0055	-0.0281***	-0.0393***
sector74	0.0029	-0.0081	-0.0123	-0.0280***
sector75	0.0246	-0.0363	0.0049	-0.0192
sector79	-0.0090	0.0209**	-0.0169	-0.0087
constant term	0.0789***	0.0604***	0.0906***	0.0920***
N	7,452	8,702	12,730	12,259
Pseudo R^2	0.0592	0.0696	0.0705	0.0609

Legend: * p<.1; ** p<.05; *** p<.01

Spline regressions models – Complete regressions' outputs by cohort

Dependent variable: $Growth_{i,t}$	Cohort 2000	Cohort 2001	Cohort 2002	Cohort 2003
Growth t-1	0.0096	0.0707***	0.0868***	0.0338***
Lag_age1 [1.5]	-0.0076***	-0.0032**	-0.0152***	-0.0097***
Lag_age2 [6.10]	-0.0107***	-0.0108***	-0.0083***	-0.0110***
Lag_age1 x Growth t-1	0.0098*	-0.0107**	-0.0195***	0.0014
Lag_age2 x Growth t-1	-0.0345***	-0.0081	0.0159***	-0.0098**
year2003	-0.0138**			
year2004	-0.0203***	-0.0015		
year2005	-0.0089*	0.0033	0.0139***	
year2006		0.0068	0.0296***	
year2007	0.0040		0.0332***	
year2008	-0.0286***	-0.0412***		-0.0391***
year2009	-0.0822***	-0.0844***	-0.0463***	-0.0902***
year2010		-0.0091*	0.0205***	-0.0153**
year2011			0.0189***	-0.0131**
year2012				-0.0304***
sector11	0.0107	0.0157	-0.0281	-0.0127
sector13	-0.0101	-0.0250**	-0.0213**	-0.0239**
sector14	-0.0202*	-0.0218**	-0.0578***	-0.0208

sector15	-0.0226*	-0.0128	-0.0262**	0.0022
sector16	-0.0195**	-0.0100	-0.0388***	-0.0151
sector17	-0.0486***	0.0389*	-0.0088	-0.0184
sector18	-0.0067	-0.0041	-0.0328***	-0.0335***
sector19	0.0071	0.0047		
sector20	0.0100	0.0055	-0.0124	-0.0233
sector21	-0.0113	0.0363	-0.0218	0.0335
sector22	-0.0094	-0.0097	-0.0108	-0.0126
sector23	-0.0198**	-0.0106	-0.0303***	-0.0516***
sector24	-0.0190	0.0069	-0.0273**	-0.0440***
sector25	-0.0064	-0.0017	-0.0314***	-0.0321***
sector26	-0.0000	0.0050	-0.0117	-0.0685***
sector27	-0.0112	-0.0075	-0.0156	-0.0225
sector28	-0.0122	-0.0044	-0.0153	-0.0123
sector29	-0.0521**	-0.0155	-0.0137	-0.0424***
sector30	0.0021	0.0606***	-0.0720***	-0.0253
sector31	-0.0163*	-0.0354***	-0.0315***	-0.0467***
sector32	-0.0261	-0.0225*	-0.0222*	-0.0405***
sector49	0.0045	0.0099	-0.0120	-0.0241***
sector50	-0.0306	-0.0069	-0.0029	-0.0214
sector51		0.0156	0.0451	0.0202
sector53	0.0009	-0.0154	-0.0359*	0.0063
sector55	-0.0187		-0.0191*	-0.0284**
sector56	-0.0110	-0.0136**	-0.0287***	-0.0310***
sector58	0.0160	0.0019	-0.0297**	-0.0381***
sector59	-0.0217	-0.0226	-0.0263**	-0.0081
sector60		-0.0127	0.0057	-0.1016***
sector61	-0.0102	0.0084	-0.0132	0.0066
sector62	-0.0088	0.0134*	-0.0024	-0.0041
sector63	0.0481*	0.0229	-0.0034	-0.0143
sector69	-0.0128	0.0003	-0.0056	-0.0224***
sector70	-0.0037	-0.0153	-0.0143*	-0.0154*
sector71	-0.0016	-0.0011	-0.0220***	-0.0559***
sector72	0.0299	-0.0147	0.0380	0.0751***
sector73	-0.0164*	-0.0056	-0.0288***	-0.0395***
sector74	0.0039	-0.0087	-0.0115	-0.0286***
sector75	0.0193	-0.0372	0.0062	-0.0145
sector79	-0.0129	0.0213**	-0.0198*	-0.0106
constant	0.0862***	0.0565***	0.0883***	0.1016***
N	7.452	8.702	12.730	12.259
Pseudo R^2	0.0598	0.0696	0.0708	0.0605

Legend: * p<.1; ** p<.05; *** p<.01

Basic model including the quadratic term – Complete regressions' outputs by cohort

Dependent variable: $Growth_{i,t}$	Cohort 2000	Cohort 2001	Cohort 2002	Cohort 2003
Growth $_{i,t-1}$	-0.0081	0.0718***	0.1096***	0.0473***
Age $_{i,t-1}$	-0.0038	0.0023	-0.0194***	-0.0622***
Age2 $_{i,t-1}$	-0.0005	-0.0009***	0.0008**	0.0053***
$Growth_{i,t-1}$ x $age_{i,t-1}$	0.0313***	-0.0121	-0.0426***	-0.0020
$Growth_{i,t-1}$ x age2 $_{i,t-1}$	-0.0044***	0.0003	0.0041***	-0.0003
year2003	-0.0163***			
year2004	-0.0245***	-0.0043		
year2005	-0.0121*	-0.0004	0.0179***	
year2006		0.0040	0.0340***	0.0509***
year2007	0.0009		0.0362***	0.0659***
year2008	-0.0324***	-0.0440***		0.0461***
year2009	-0.0845***	-0.0881***	-0.0440***	
year2010		-0.0119**	0.0230***	0.0682***
year2011			0.0217***	0.0535***
year2012				0.0084*
sector11	0.0109	0.0159	-0.0316*	-0.0116
sector13	-0.0100	-0.0251**	-0.0219**	-0.0217*
sector14	-0.0223**	-0.0218**	-0.0577***	-0.0179
sector15	-0.0221*	-0.0129	-0.0224*	0.0042
sector16	-0.0202*	-0.0100	-0.0375***	-0.0134
sector17	-0.0483**	0.0389*	-0.0085	-0.0210
sector18	-0.0063	-0.0041	-0.0320***	-0.0318***
sector19	0.0068	0.0046		
sector20	0.0099	0.0055	-0.0130	-0.0192
sector21	-0.0110	0.0363	-0.0232	0.0351
sector22	-0.0090	-0.0097	-0.0088	-0.0111
sector23	-0.0196*	-0.0107	-0.0292***	-0.0512***
sector24	-0.0190	0.0069	-0.0270**	-0.0432***
sector25	-0.0063	-0.0017	-0.0315***	-0.0313***
sector26	0.0011	0.0049	-0.0119	-0.0685***
sector27	-0.0107	-0.0075	-0.0157	-0.0220
sector28	-0.0125	-0.0044	-0.0152	-0.0113
sector29	-0.0512***	-0.0155	-0.0143	-0.0397***
sector30	0.0013	0.0606***	-0.0684***	-0.0233
sector31	-0.0160	-0.0355***	-0.0324***	-0.0445***
sector32	-0.0283	-0.0205	-0.0205	-0.0383**
sector49	0.0047	0.0097	-0.0117	-0.0228***
sector50	-0.0305	-0.0069	-0.0052	-0.0196
sector51		0.0156	0.0499	0.0218
sector53	0.0010		-0.0363*	0.0084
sector55	-0.0176	-0.0154	-0.0187	-0.0262**
sector56	-0.0110	-0.0137**	-0.0293***	-0.0288***
sector58	0.0162	0.0018	-0.0299**	-0.0342***
sector59	-0.0243	-0.0230	-0.0263**	-0.0146
sector60		-0.0128	-0.0236	-0.0991***
sector61	-0.0099	0.0084	-0.0135	0.0076
sector62	-0.0075	0.0134*	-0.0028	-0.0013
sector63	0.0494	0.0230	-0.0036	-0.0204
sector69	-0.0122	0.0004	-0.0060	-0.0207***
sector70	-0.0039	-0.0153	-0.0146*	-0.0138
sector71	-0.0014	-0.0014	-0.0220***	-0.0536***
sector72	0.0280	-0.0148	0.0378	0.0773***
sector73	-0.0154	-0.0055	-0.0288***	-0.0387***
sector74	0.0046	-0.0085	-0.0117	-0.0282***
sector75	0.0192	-0.0362	0.0064	-0.0178
sector79	-0.0179	0.0213**	-0.0199*	-0.0090
constant	0.0833***	0.0519***	0.0901***	0.1402***

COHORT 2000 Regression results according to size bands. Basic Model

Variable	Size			
	1° quartile	2° quartile	3° quartile	4° quartile
Growth (t-1)	0.0291	0.0194	0.1038***	0.0260
Age (t-1)	-0.0102***	-0.0106***	-0.0060***	-0.0064***
Growth x Age (t-1)	-0.0068	-0.0054	-0.0154***	-0.0108**
year03	0.0363*	0.0040	-0.0090	-0.0187
year04	-0.0031	-0.0146	-0.0106	-0.0066
year05	-0.0048	0.0036	0.0106	0.0002
year06	0.0094	0.0074	0.0290***	0.0013
year07	0.0266	0.0181*	0.0143	0.0068
year08	-0.0079	-0.0226**	-0.0310***	-0.0170
year09	-0.0643***	-0.0654***	-0.0845***	-0.0958***
sector11	0.0034	0.0126	-0.0775	
sector13	0.0697	-0.0574**	0.0175	-0.0247
sector14	0.0010	-0.0195	-0.0345*	-0.0134
sector15	-0.0161	-0.0444*	-0.0322	-0.0340
sector16	-0.0016	-0.0129	-0.0212	-0.0246
sector17	-0.0703	-0.0566**	-0.0224	-0.0573
sector18	-0.0161	0.0094	-0.0164	-0.0102
sector19	0.0324			
sector20	0.0129	0.0282	-0.0205	0.0129
sector21	0.0373	-0.0096		
sector22	0.0370*	-0.0252	0.0147	
sector23	-0.0166	-0.0034	-0.0240	-0.0205
sector24	0.0045	-0.0258	-0.0270	0.0051
sector25	-0.0093	-0.0016	-0.0199	-0.0038
sector26	0.0011	0.0548	-0.0224	
sector27	0.0194	-0.0177	-0.0177	0.0167
sector28	0.0051	-0.0117	-0.0090	-0.0158
sector29	0.0372	-0.0379	-0.1169***	
sector30	0.0460	0.0149		
sector31	-0.0428	-0.0182	-0.0260	-0.0084
sector32	-0.0168	-0.0250	-0.0505	
sector49	-0.0183	0.0154	-0.0066	0.0124
sector50	0.0767	-0.0710		
sector53	0.0811**	-0.0116	0.0079	
sector55	-0.0208	-0.0132	-0.0581**	-0.0123
sector56	-0.0233	-0.0106	-0.0193	-0.0151
sector58	0.0483	0.0080	-0.0497	-0.0151
sector59	-0.0020	-0.0303	-0.0590**	-0.0346
sector61	0.0908	0.0460	-0.0370	0.0035
sector62	-0.0346	-0.0171	-0.0143	-0.0003
sector63	0.0688*	0.0256		
sector69	-0.0023	-0.0343**	-0.0236	-0.0268
sector70	0.0670	0.0299	-0.0226	-0.0177
sector72	0.0492	-0.0190		

sector71	-0.0098	0.0107	-0.0195	0.0274
sector73	0.0035	-0.0180	-0.0343*	-0.0199
sector74	-0.0317	-0.0026	0.0037	0.0439*
sector75	0.0077			
sector79	-0.0327	0.0312	-0.0497	0.0180
constant	0.1002***	0.0953***	0.0721***	0.0659***

COHORT 2001 Regression results according to size bands. Basic Model

Variable	Size			
	1° quartile	2° quartile	3° quartile	4° quartile
Growth (t-1)	0.0061	0.0804***	0.0843***	0.0429***
Age (t-1)	-0.0108***	-0.0104***	-0.0062***	-0.0068***
Growth x Age (t-1)	-0.0068	-0.0175***	-0.0103**	-0.0041
year04	0.0078	-0.0017	-0.0010	-0.0058
year05	0.0063	0.0114	0.0097	-0.0014
year06	0.0211	0.0213*	0.0107	0.0092
year07	0.0293**	0.0044	0.0141	0.0096
year08	-0.0279**	-0.0253**	-0.0271***	-0.0338***
year09	-0.0452***	-0.0760***	-0.0882***	-0.0842***
year10	-0.0120	-0.0072	-0.0112	-0.0047
sector11	0.0172	-0.0077	-0.0006	
sector13	-0.1021***	-0.0359	-0.0071	-0.0454**
sector14	-0.1219**	-0.0266	-0.0221	-0.0218
sector15	-0.0360	-0.0027	-0.0322*	-0.0102
sector16	-0.0957***	0.0043	-0.0237	-0.0124
sector17	-0.0448	0.0801*	0.0583*	
sector18	-0.0320	-0.0159	-0.0136	0.0112
sector19	0.0009			
sector20	0.0198	-0.0318	0.0087	0.0205
sector21	0.0376			
sector22	0.0114	-0.0362	-0.0028	-0.0076
sector23	-0.0087	-0.0106	-0.0096	-0.0160
sector24	-0.0550	0.0344	-0.0242	-0.0120
sector25	-0.0380*	-0.0044	0.0019	-0.0079
sector26	0.0410	0.0007		
sector27	-0.0678*	0.0037	-0.0067	-0.0335*
sector28	-0.0146	-0.0274	-0.0043	-0.0165
sector29	-0.0366	-0.0552**	-0.0073	
sector30	-0.0601	0.0704	0.0788**	
sector31	-0.0631**	-0.0339	-0.0430**	-0.0314**
sector32	-0.0650	-0.0254	-0.0124	
sector49	0.0135	0.0140	0.0111	0.0049
sector50	0.0070	-0.0431		
sector51	0.0146			
sector55	-0.0939***	-0.0213	-0.0299	-0.0074
sector56	-0.0258	-0.0209	-0.0131	-0.0141
sector58	-0.0441	0.0253	0.0014	-0.0382
sector59	-0.0762	0.0220	-0.0779**	0.0200
sector60	-0.0134			

sector61	-0.1023**	0.0055	0.0421	0.0063
sector62	-0.0192	-0.0118	0.0197	-0.0073
sector63	-0.0117	0.0507	-0.0591	
sector69	-0.0315	-0.0103	0.0129	0.0009
sector70	-0.0661***	-0.0169	-0.0127	0.0101
sector71	-0.0475**	0.0222	0.0010	-0.0283
sector72	-0.0529	-0.0772*		
sector73	-0.0378*	-0.0155	0.0036	0.0044
sector74	-0.0573**	0.0139	0.0027	-0.0147
sector75	-0.0744	-0.0327		
sector79	-0.0154	0.0628*	0.0143	-0.0212
constant	0.1160***	0.0847***	0.0611***	0.0600***

COHORT 2002 Regression results according to size bands. Basic Model

Variable	Size			
	1° quartile	2° quartile	3° quartile	4° quartile
Growth (t-1)	0.0550***	0.0359*	0.0603***	0.1075***
Age (t-1)	-0.0152***	-0.0127***	-0.0113***	-0.0096***
Growth x Age (t-1)	-0.0131***	-0.0002	-0.0053	-0.0052
year05	0.0082	0.0127	0.0032	0.0078
year06	0.0171**	0.0192*	0.0113	0.0329***
year07	0.0220***	0.0240**	0.0175*	0.0206***
year08	-0.0104	-0.0140	-0.0264***	-0.0192**
year09	-0.0363***	-0.0443***	-0.0827***	-0.0700***
year10	0.0047	0.0088	-0.0010	0.0346***
year11	0.0134	0.0181*	-0.0006	0.0312***
sector11	-0.0711***	-0.0096		
sector13	-0.0414*	0.0222	-0.0358*	-0.0225
sector14	-0.0538**	-0.1141***	0.0079	-0.0504**
sector15	-0.0405	-0.0128	-0.0380*	-0.0167
sector16	0.0018	-0.0569***	-0.0135	-0.0422***
sector17	-0.0157	0.0112	0.0330	
sector18	-0.0368**	-0.0309	-0.0796***	-0.0425***
sector20	0.0376	-0.0336	-0.0272	-0.0194
sector21	-0.0446			
sector22	-0.0231	0.0177	0.0084	-0.0313**
sector23	-0.0104	-0.0275	-0.0194	-0.0373***
sector24	-0.0396	0.0045	-0.0251	-0.0193
sector25	-0.0319**	-0.0326**	-0.0239	-0.0357***
sector26	-0.1106***	0.0342	0.0341	-0.0005
sector27	-0.0740**	-0.0015	0.0148	-0.0412**
sector28	-0.0226	-0.0245	0.0034	-0.0170
sector29	-0.0479*	0.0170	-0.0205	
sector30	-0.0579**	-0.0687**		
sector31	-0.0606***	-0.0361	-0.0335	-0.0190
sector32	-0.0542**	0.0701**	-0.0095	-0.0207
sector49	-0.0381**	-0.0065	-0.0003	-0.0132
sector50	0.0171	-0.0131	-0.0048	
sector51	0.0350	0.1874***		

sector53	-0.0262	-0.0218	-0.0411	
sector55	-0.0404**	-0.0255	0.0104	-0.0209
sector56	-0.0403***	-0.0332**	-0.0239	-0.0222**
sector58	-0.0452	-0.0351	-0.0291	-0.0160
sector59	-0.0398*	-0.0069	-0.0196	-0.0073
sector60	-0.0149	-0.0216		
sector61	0.0256	-0.0034	-0.0430	-0.0144
sector62	-0.0166	0.0058	-0.0018	0.0047
sector63	-0.0241	-0.0576*	0.0592*	
sector69	-0.0211	-0.0100	-0.0110	-0.0105
sector70	-0.0268*	-0.0270	-0.0304	-0.0030
sector71	-0.0230*	-0.0064	-0.0699***	-0.0446***
sector72	0.0747***	0.0195		
sector73	-0.0161	-0.0468***	-0.0395**	-0.0316***
sector74	-0.0178	-0.0186	-0.0046	-0.0263*
sector75	-0.0079	-0.0004	0.0125	
sector79	-0.0289	-0.0257	-0.0384	-0.0144
constant	0.1206***	0.0893***	0.0868***	0.0669***

COHORT 2003 Regression results according to size bands. Basic Model

Variable	Size			
	1° quartile	2° quartile	3° quartile	4° quartile
Growth (t-1)	0.0826***	0.0325**	0.0649***	0.0343**
Age (t-1)	-0.0111***	-0.0098***	-0.0102***	-0.0078***
Growth x Age (t-1)	-0.0257***	-0.0024	-0.0042	0.0072**
year06	0.0283***	0.0107	0.0098	0.0063
year07	0.0228***	-0.0026	-0.0053	-0.0008
year08	-0.0114	-0.0337***	-0.0368***	-0.0413***
year09	-0.0682***	-0.0973***	-0.0835***	-0.0985***
year10	0.0018	-0.0201**	-0.0120	-0.0124
year11	0.0017	-0.0119	-0.0117	-0.0130
year12	-0.0253***	-0.0312***	-0.0352***	-0.0224***
sector11	-0.0502	-0.0269	0.0016	0.0231
sector13	-0.1111**	-0.0098	-0.0364*	0.0159
sector14	-0.0125	-0.0189	-0.0351	-0.0143
sector15	-0.0715**	0.0087	-0.0220	0.0315**
sector16	-0.0540**	0.0198	-0.0164	0.0008
sector17	-0.0491	-0.0129	-0.0631***	0.0051
sector18	-0.0557***	-0.0222	-0.0064	-0.0514***
sector20	-0.0680**	-0.0075	-0.0144	-0.0046
sector21	0.0549			
sector22	-0.0538	0.0057	-0.0104	-0.0166
sector23	-0.0821***	-0.0323	-0.0460***	-0.0517***
sector24	0.0917**	-0.0462**	-0.0857***	-0.0122
sector25	-0.0623***	-0.0361**	-0.0297***	-0.0156
sector26	0.0005	-0.0754*	-0.0905**	-0.0639***
sector27	0.1473***	-0.0188	-0.0039	
sector28	-0.0348	-0.0147	-0.0226	0.0122
sector29	-0.0522	-0.0416*	0.0054	-0.0419**

sector30	-0.0090			
sector31	-0.0692***	-0.0415**	-0.0409**	-0.0531***
sector32	-0.0953***	0.0032	-0.0299	-0.0856**
sector49	-0.0540***	-0.0158	-0.0317***	-0.0009
sector50	-0.0245	-0.0366	-0.0142	
sector51	0.0366	0.0188		
sector53	-0.0216	0.0480		
sector55	-0.0645**	-0.0350	-0.0385*	-0.0079
sector56	-0.0466***	-0.0479***	-0.0317***	-0.0029
sector58	-0.0420**	-0.0501**	-0.0702***	-0.0392*
sector59	-0.0038	-0.0753***	-0.1487***	0.0135
sector60	-0.3229***	-0.0501		
sector61	-0.0598	-0.0608**	0.1026***	
sector62	-0.0301**	-0.0026	-0.0078	0.0395***
sector63	-0.0154	-0.0312	-0.0476**	
sector69	-0.0430***	-0.0299*	-0.0385***	0.0071
sector70	-0.0555***	-0.0023	0.0090	0.0035
sector71	-0.0807***	-0.0783***	-0.0513***	-0.0228**
sector72	0.0539	0.1031**	0.0562	
sector73	-0.0675***	-0.0423**	-0.0534***	-0.0167
sector74	-0.0482***	-0.0456***	-0.0310**	-0.0315
sector75	-0.0296	-0.0253	-0.0374	
sector79	-0.0764***	0.0163	0.0092	0.0352**
constant	0.1179***	0.1025***	0.1009***	0.0705***

COHORT 2000 Regression results according to size bands. Spline Regressions

Variable	Size			
	1° quartile	2° quartile	3° quartile	4° quartile
Growth (t-1)	-0.0287	0.0018	0.0639***	0.0209
Age1 (t-1)	-0.0119*	-0.0105**	-0.0016	-0.0054
Age2 (t-1)	-0.0119**	-0.0126***	-0.0130***	-0.0071**
Growth x Age1	0.0145	0.0097	0.0018	-0.0041
Growth x Age2	-0.0282	-0.0342**	-0.0316**	-0.0203*
year03	0.0275	0.0002	-0.0199**	-0.0179
year04	-0.0114	-0.0206	-0.0302***	-0.0070
year05	-0.0137	-0.0014	-0.0135	-0.0009
year07	0.0218	0.0149	-0.0065	0.0052
year08	-0.0115	-0.0198	-0.0457***	-0.0165*
year09	-0.0627***	-0.0644***	-0.0926***	-0.0942***
sector11	0.0037	0.0203	-0.0717*	
sector13	0.0629	-0.0563*	0.0193	-0.0231
sector14	0.0004	-0.0226	-0.0345*	-0.0133
sector15	-0.0151	-0.0358	-0.0311	-0.0290
sector16	0.0061	-0.0140	-0.0219	-0.0240
sector17	-0.0686	-0.0526	-0.0178	-0.0567
sector18	-0.0151	0.0026	-0.0166	-0.0102

sector19	0.0334			
sector20	0.0112	0.0282	-0.0233	0.0112
sector21	0.0311	-0.0111		
sector22	0.0431	-0.0284*	0.0164	
sector23	-0.0221	-0.0023	-0.0229	-0.0189
sector24	0.0050	-0.0274	-0.0265	-0.0020
sector25	-0.0119	-0.0026	-0.0204	-0.0021
sector26	-0.0001	0.0528	-0.0215	
sector27	0.0177	-0.0175	-0.0158	0.0169
sector28	0.0068	-0.0105	-0.0062	-0.0120
sector29	0.0326	-0.0373	-0.1165***	
sector30	0.0443	0.0171		
sector31	-0.0367	-0.0136	-0.0283*	-0.0101
sector32	-0.0168	-0.0229	-0.0502	
sector49	-0.0174	0.0165	-0.0052	0.0139
sector50	0.0770	-0.0691*		
sector53	0.0802*	-0.0093	0.0096	
sector55	-0.0185	-0.0092	-0.0562**	-0.0121
sector56	-0.0222	-0.0104	-0.0184	-0.0137
sector58	0.0463	0.0051	-0.0455	-0.0138
sector59	-0.0050	-0.0319	-0.0592**	-0.0317
sector61	0.0848	0.0438	-0.0380*	0.0049
sector62	-0.0292	-0.0245	-0.0131	0.0017
sector63	0.0639	0.0264		
sector69	-0.0037	-0.0333	-0.0244	-0.0247
sector70	0.0656	0.0165	-0.0213	-0.0161
sector71	-0.0133	0.0048	-0.0187	0.0253
sector72	0.0503	-0.0187		
sector73	0.0050	-0.0177	-0.0333*	-0.0284*
sector74	-0.0296	-0.0041	0.0029	0.0445**
sector75	0.0006			
sector79	-0.0300	-0.0006	-0.0514	0.0204
constant	0.1149***	0.0980***	0.0771***	0.0613***

COHORT 2001 Regression results according to size bands. Spline Regressions

Variable	Size			
	1° quartile	2° quartile	3° quartile	4° quartile
Growth (t-1)	-0.0220	0.0955***	0.0912***	0.0565***
Age1 (t-1)	-0.0064*	-0.0086**	-0.0022	-0.0044*
Age2 (t-1)	-0.0173***	-0.0126***	-0.0104***	-0.0091***
Growth x Age1	0.0090	-0.0266**	-0.0172	-0.0132**
Growth x Age2	-0.0264**	-0.0038	0.0014	0.0085
year04	-0.0066	-0.0020	-0.0027	-0.0051
year05	-0.0132	0.0075	0.0021	-0.0050
year06	-0.0011	0.0149	-0.0000	0.0057
year08	-0.0505***	-0.0318**	-0.0396***	-0.0410***
year09	-0.0568***	-0.0793***	-0.0950***	-0.0904***
year10	-0.0193*	-0.0064	-0.0153	-0.0072
sector11	0.0182	-0.0084	-0.0006	

sector13	-0.1120***	-0.0333	-0.0066	-0.0487**
sector14	-0.1297***	-0.0271	-0.0223	-0.0208
sector15	-0.0310	-0.0006	-0.0345	-0.0118
sector16	-0.1060***	0.0059	-0.0239	-0.0116
sector17	-0.0461	0.0795*	0.0558*	
sector18	-0.0310*	-0.0158	-0.0159	0.0109
sector19	0.0007			
sector20	0.0170	-0.0332	0.0102	0.0215
sector21	0.0406			
sector22	0.0085	-0.0336	-0.0049	-0.0077
sector23	-0.0096	-0.0087	-0.0072	-0.0161
sector24	-0.0630	0.0348	-0.0239	-0.0155
sector25	-0.0377**	-0.0057	0.0014	-0.0092
sector26	0.0408	0.0021		
sector27	-0.0661**	0.0024	-0.0088	-0.0358*
sector28	-0.0133	-0.0261	-0.0016	-0.0195
sector29	-0.0327	-0.0541*	-0.0094	
sector30	-0.0529	0.0672	0.0779**	
sector31	-0.0644***	-0.0318	-0.0320	-0.0316**
sector32	-0.0554	-0.0225	-0.0173	
sector49	0.0095	0.0171	0.0114	0.0057
sector50	0.0088	-0.0432		
sector51	0.0149			
sector55	-0.0945***	-0.0226	-0.0313	-0.0076
sector56	-0.0274	-0.0213	-0.0120	-0.0137
sector58	-0.0432*	0.0272	-0.0012	-0.0366
sector59	-0.0799**	0.0225	-0.0759**	0.0175
sector60	-0.0129			
sector61	-0.1031***	0.0058	0.0409	0.0047
sector62	-0.0191	-0.0094	0.0178	-0.0075
sector63	-0.0117	0.0501	-0.0590	
sector69	-0.0324*	-0.0118	0.0132	0.0014
sector70	-0.0634***	-0.0158	-0.0103	0.0098
sector71	-0.0435**	0.0219	-0.0026	-0.0296
sector72	-0.0516*	-0.0728		
sector73	-0.0372**	-0.0189	0.0044	0.0023
sector74	-0.0583***	0.0270	0.0011	-0.0141
sector75	-0.0749*	-0.0337		
sector79	-0.0122	0.0655*	0.0122	-0.0190
constant	0.1205***	0.0826***	0.0572***	0.0573***

COHORT 2002 Regression results according to size bands. Spline Regressions

Variable	Size			
	1° quartile	2° quartile	3° quartile	4° quartile
Growth (t-1)	0.0325	0.0699***	0.1121***	0.1305***
Age1 (t-1)	-0.0190***	-0.0142***	-0.0160***	-0.0122***
Age2 (t-1)	-0.0126***	-0.0091***	-0.0059**	-0.0058**
Growth x Age1	-0.0044	-0.0181**	-0.0408***	-0.0257***
Growth x Age2	-0.0235**	0.0286**	0.0457***	0.0273**

year05	0.0078	0.0190*	0.0147	0.0151*
year06	0.0192**	0.0307***	0.0288***	0.0414***
year07	0.0276***	0.0377***	0.0433***	0.0370***
year09	-0.0291***	-0.0356***	-0.0666***	-0.0583***
year10	0.0124	0.0146	0.0116	0.0395***
year11	0.0169*	0.0191**	0.0084	0.0329***
sector11	-0.0707***	-0.0111		
sector13	-0.0403	0.0250	-0.0389**	-0.0163
sector14	-0.0511	-0.1135***	-0.0019	-0.0596***
sector15	-0.0370	0.0093	-0.0480**	-0.0169
sector16	-0.0011	-0.0533***	-0.0166	-0.0415***
sector17	-0.0134	0.0006	0.0343	
sector18	-0.0353*	-0.0284	-0.0877***	-0.0423***
sector20	0.0395	-0.0318	-0.0261	-0.0181
sector21	-0.0378			
sector22	-0.0057	0.0185	0.0060	-0.0317**
sector23	-0.0066	-0.0267	-0.0212	-0.0346***
sector24	-0.0365	0.0048	-0.0341*	-0.0237
sector25	-0.0291*	-0.0339**	-0.0259*	-0.0304***
sector26	-0.1131***	0.0230	0.0071	-0.0013
sector27	-0.0713**	-0.0019	0.0043	-0.0396**
sector28	-0.0211	-0.0234	-0.0023	-0.0159
sector29	-0.0489*	0.0089	-0.0178	
sector30	-0.0679**	-0.0714*		
sector31	-0.0551**	-0.0379	-0.0307	-0.0140
sector32	-0.0521**	0.0651*	-0.0039	-0.0161
sector49	-0.0363**	-0.0071	-0.0032	-0.0096
sector50	0.0151	-0.0133	-0.0118	
sector51	0.0345	0.1937***		
sector53	-0.0269	-0.0166	-0.0389	
sector55	-0.0404*	-0.0247	0.0082	-0.0223
sector56	-0.0374**	-0.0335**	-0.0259*	-0.0227**
sector58	-0.0441	-0.0352*	-0.0254	-0.0142
sector59	-0.0371	-0.0048	-0.0111	-0.0093
sector60	0.0564	-0.0206		
sector61	0.0274	-0.0037	-0.0475*	-0.0233
sector62	-0.0151	0.0071	-0.0030	0.0071
sector63	-0.0218	-0.0607**	0.0571*	
sector69	-0.0186	-0.0097	-0.0124	-0.0109
sector70	-0.0294*	-0.0276	-0.0200	-0.0035
sector71	-0.0205	-0.0039	-0.0699***	-0.0401***
sector72	0.0738**	0.0183		
sector73	-0.0141	-0.0450***	-0.0315*	-0.0294**
sector74	-0.0151	-0.0180	-0.0044	-0.0244
sector75	-0.0042	-0.0008	0.0145	
sector79	-0.0313	-0.0407	-0.0444*	-0.0177
constant	0.1268***	0.0842***	0.0876***	0.0645***

COHORT 2003 Regression results according to size bands. Spline Regressions

Variable	Size			
	1° quartile	2° quartile	3° quartile	4° quartile
Growth (t-1)	0.0806***	0.0328**	0.0671***	0.0269*
Age1 (t-1)	-0.0287***	-0.0340***	-0.0309***	-0.0324***
Age2 (t-1)	0.0062**	0.0145***	0.0107***	0.0170***
Growth x Age1	-0.0240***	-0.0025	-0.0052	0.0107*
Growth x Age2	-0.0299***	0.0002	-0.0031	0.0013
year06	0.0455***	0.0350***	0.0309***	0.0308***
year07	0.0574***	0.0459***	0.0365***	0.0492***
year08	0.0404***	0.0393***	0.0264***	0.0324***
year10	0.0548***	0.0533***	0.0506***	0.0614***
year11	0.0370***	0.0363***	0.0301***	0.0356***
year12	-0.0081	-0.0073	-0.0142	0.0017
sector11	-0.0500	-0.0267	0.0003	0.0219
sector13	-0.1114**	-0.0099	-0.0373*	0.0169
sector14	-0.0126	-0.0201	-0.0361	-0.0137
sector15	-0.0720**	0.0087	-0.0231	0.0322**
sector16	-0.0541**	0.0200	-0.0175	-0.0054
sector17	-0.0499	-0.0129	-0.0649**	0.0022
sector18	-0.0560***	-0.0228	-0.0075	-0.0511***
sector20	-0.0684*	-0.0073	-0.0154	-0.0049
sector21	0.0544*			
sector22	-0.0532	0.0058	-0.0115	-0.0175
sector23	-0.0824***	-0.0324	-0.0473***	-0.0511***
sector24	0.0911*	-0.0464***	-0.0868***	-0.0118
sector25	-0.0628***	-0.0361***	-0.0310***	-0.0149*
sector26	0.0027	-0.0753**	-0.0918**	-0.0644***
sector27	0.1458***	-0.0202	-0.0034	
sector28	-0.0357	-0.0140	-0.0237	0.0073
sector29	-0.0523	-0.0416**	0.0046	-0.0415**
sector30	-0.0100			
sector31	-0.0679***	-0.0381**	-0.0423**	-0.0528***
sector32	-0.0951***	-0.0203	-0.0308	-0.0881***
sector49	-0.0544***	-0.0153	-0.0326***	-0.0013
sector50	-0.0233	-0.0366	-0.0141	
sector51	0.0365	0.0177		
sector53	-0.0227	0.0486		
sector55	-0.0640*	-0.0351*	-0.0400*	-0.0083
sector56	-0.0469***	-0.0477***	-0.0329***	-0.0024
sector58	-0.0427**	-0.0523***	-0.0713***	-0.0318
sector59	-0.0045	-0.0752***	-0.1499***	0.0140
sector60	-0.3237***	-0.0495*		
sector61	-0.0601	-0.0613***	0.1016***	
sector62	-0.0304*	-0.0025	-0.0087	0.0384***
sector63	-0.0159	-0.0312	-0.0495**	
sector69	-0.0432***	-0.0288**	-0.0394***	0.0075

sector70	-0.0562***	-0.0028	0.0077	-0.0022
sector71	-0.0798***	-0.0782***	-0.0525***	-0.0222**
sector72	0.0537	0.1033***	0.0546	
sector73	-0.0680***	-0.0422***	-0.0546***	-0.0182*
sector74	-0.0485***	-0.0459***	-0.0320**	-0.0324*
sector75	-0.0295	-0.0251	-0.0386	
sector79	-0.0766***	0.0162	0.0081	0.0356***
constant	0.1360***	0.1266***	0.1224***	0.0949***

Comparison of the industry composition of the sample and the data of the National Institute of Statistics (INE in Spanish)

Industry sector	Sample (1997)		DIRCE (1999)		Diff
	N	%	N	%	
Food & Beverages	87	6.7	1,121	3.2	3.5
Tobacco products	0	0.0	4	0.0	0.0
Textiles	41	3.2	484	1.4	1.8
Wearing apparel	27	2.1	738	2.1	0.0
Leather and related products	95	7.3	642	1.8	5.5
Wood and of products of wood and cork	42	3.2	576	1.6	1.6
Paper and paper products	12	0.9	125	0.4	0.6
Printing and reproduction of recorded media	100	7.7	1,404	4.0	3.7
Coke and refined petroleum products	0	0.0	1	0.0	0.0
Chemicals and chemical products and pharmaceuticals	30	2.3	249	0.7	1.6
Rubber and plastic products	40	3.1	363	1.0	2.1
Other non-metallic mineral products	58	4.5	616	1.8	2.7
Basic metals	14	1.1	100	0.3	0.8
Fabricated metal products	160	12.3	1,726	4.9	7.4
Computer, electronic and optical products	59	4.5	652	1.9	2.7
Electrical equipment	16	1.2	350	1.0	0.2
Manufacture & repair of machinery and equipment	16	1.2	140	0.4	0.8
Motor vehicles, trailers and semi-trailers	6	0.5	127	0.4	0.1
Other transport equipment	2	0.2	129	0.4	-0.2
Furniture & other manufacturing	74	5.7	1,100	3.1	2.6
	25	1.9		0.0	1.9
Land transport and transport via pipelines	102	7.9	6,852	19.5	-11.6
Water transport	101	7.8	2,654	7.5	0.2
Air transport	2	0.2	35	0.1	0.1
Warehousing and support activities for transportation and Travel agencies	1	0.1	15	0.0	0.0
Postal and courier activities; Telecommunications	68	5.2	1,141	3.2	2.0
Accommodation and food service activities	24	1.8	472	1.3	0.5
Information and communication (except telecomm.)	42	3.2	1,387	3.9	-0.7
Scientific research and development	2	0.2	81	0.2	-0.1
Other professional. scientific and technical activities	52	4.0	11,909	33.8	-29.8
Total	1,298	100.0	35,193	100.0	

Note: DIRCE corresponds to the industry composition of all the new firms created in 1999 according to the Directorio Central de Empresas (Central Directory of Business) from the national Statistical Institute.

Complete description of the different growth paths over the studied period (four consecutive 3-years periods)

Path	N	%	Path	N	%	Path	N	%	Path	N	%
4999	73	5,7%	4240	3	0,2%	1402	2	0,2%	2430	1	0,1%
0999	49	3,8%	4231	3	0,2%	1401	2	0,2%	2424	1	0,1%
4099	32	2,5%	4230	3	0,2%	1399	2	0,2%	2422	1	0,1%
3999	32	2,5%	4222	3	0,2%	1320	2	0,2%	2421	1	0,1%
1999	29	2,3%	4212	3	0,2%	1311	2	0,2%	2420	1	0,1%
4110	21	1,6%	4201	3	0,2%	1299	2	0,2%	2410	1	0,1%
4199	20	1,6%	4140	3	0,2%	1231	2	0,2%	2341	1	0,1%
3099	13	1,0%	4131	3	0,2%	1210	2	0,2%	2340	1	0,1%
4410	12	0,9%	4041	3	0,2%	1200	2	0,2%	2339	1	0,1%

4399	12	0,9%	4040	3	0,2%	1131	2	0,2%	2333	1	0,1%
4111	12	0,9%	4030	3	0,2%	1129	2	0,2%	2332	1	0,1%
4100	12	0,9%	4014	3	0,2%	1120	2	0,2%	2324	1	0,1%
4009	12	0,9%	3430	3	0,2%	1010	2	0,2%	2322	1	0,1%
2999	12	0,9%	3410	3	0,2%	1009	2	0,2%	2311	1	0,1%
4499	11	0,9%	3400	3	0,2%	1001	2	0,2%	2303	1	0,1%
4311	11	0,9%	3322	3	0,2%	0414	2	0,2%	2240	1	0,1%
4010	11	0,9%	3321	3	0,2%	0330	2	0,2%	2233	1	0,1%
3199	11	0,9%	3311	3	0,2%	0231	2	0,2%	2230	1	0,1%
3109	11	0,9%	3299	3	0,2%	0214	2	0,2%	2224	1	0,1%
3100	11	0,9%	3230	3	0,2%	0209	2	0,2%	2220	1	0,1%
4210	10	0,8%	3220	3	0,2%	0140	2	0,2%	2219	1	0,1%
3310	9	0,7%	3200	3	0,2%	0119	2	0,2%	2211	1	0,1%
1111	9	0,7%	3113	3	0,2%	0100	2	0,2%	2209	1	0,1%
1099	9	0,7%	3031	3	0,2%	4449	1	0,1%	2201	1	0,1%
4330	8	0,6%	3001	3	0,2%	4441	1	0,1%	2149	1	0,1%
4309	8	0,6%	3000	3	0,2%	4439	1	0,1%	2123	1	0,1%
4300	8	0,6%	2419	3	0,2%	4432	1	0,1%	2112	1	0,1%
4130	8	0,6%	2330	3	0,2%	4421	1	0,1%	2104	1	0,1%
4000	8	0,6%	2300	3	0,2%	4419	1	0,1%	2101	1	0,1%
2210	8	0,6%	2299	3	0,2%	4411	1	0,1%	2043	1	0,1%
1110	8	0,6%	2130	3	0,2%	4402	1	0,1%	2040	1	0,1%
1109	8	0,6%	2114	3	0,2%	4349	1	0,1%	2039	1	0,1%
4310	7	0,5%	2109	3	0,2%	4332	1	0,1%	2029	1	0,1%
4301	7	0,5%	1499	3	0,2%	4329	1	0,1%	2023	1	0,1%
4299	7	0,5%	1310	3	0,2%	4324	1	0,1%	2014	1	0,1%
4109	7	0,5%	1219	3	0,2%	4314	1	0,1%	2013	1	0,1%
4101	7	0,5%	1000	3	0,2%	4303	1	0,1%	2001	1	0,1%
3399	7	0,5%	0210	3	0,2%	4302	1	0,1%	1441	1	0,1%
3211	7	0,5%	4442	2	0,2%	4239	1	0,1%	1440	1	0,1%
3111	7	0,5%	4429	2	0,2%	4233	1	0,1%	1430	1	0,1%
3010	7	0,5%	4403	2	0,2%	4232	1	0,1%	1421	1	0,1%
1199	7	0,5%	4401	2	0,2%	4223	1	0,1%	1420	1	0,1%
4431	6	0,5%	4339	2	0,2%	4214	1	0,1%	1419	1	0,1%
4420	6	0,5%	4333	2	0,2%	4203	1	0,1%	1412	1	0,1%
4400	6	0,5%	4321	2	0,2%	4202	1	0,1%	1404	1	0,1%
4219	6	0,5%	4320	2	0,2%	4149	1	0,1%	1403	1	0,1%
4211	6	0,5%	4312	2	0,2%	4142	1	0,1%	1400	1	0,1%
4129	6	0,5%	4241	2	0,2%	4133	1	0,1%	1349	1	0,1%

4020	6	0,5%	4229	2	0,2%	4132	1	0,1%	1342	1	0,1%
3131	6	0,5%	4221	2	0,2%	4124	1	0,1%	1340	1	0,1%
3119	6	0,5%	4220	2	0,2%	4102	1	0,1%	1321	1	0,1%
2111	6	0,5%	4204	2	0,2%	4033	1	0,1%	1319	1	0,1%
2099	6	0,5%	4143	2	0,2%	4031	1	0,1%	1312	1	0,1%
4209	5	0,4%	4139	2	0,2%	4013	1	0,1%	1300	1	0,1%
4200	5	0,4%	4134	2	0,2%	4001	1	0,1%	1233	1	0,1%
4121	5	0,4%	4123	2	0,2%	3442	1	0,1%	1232	1	0,1%
4119	5	0,4%	4122	2	0,2%	3440	1	0,1%	1221	1	0,1%
4021	5	0,4%	4120	2	0,2%	3433	1	0,1%	1211	1	0,1%
4011	5	0,4%	4113	2	0,2%	3424	1	0,1%	1149	1	0,1%
4004	5	0,4%	4104	2	0,2%	3423	1	0,1%	1144	1	0,1%
3210	5	0,4%	4103	2	0,2%	3419	1	0,1%	1143	1	0,1%
3139	5	0,4%	4049	2	0,2%	3409	1	0,1%	1139	1	0,1%
3120	5	0,4%	4044	2	0,2%	3404	1	0,1%	1124	1	0,1%
3009	5	0,4%	4029	2	0,2%	3401	1	0,1%	1122	1	0,1%
1121	5	0,4%	4023	2	0,2%	3342	1	0,1%	1119	1	0,1%
0199	5	0,4%	4012	2	0,2%	3333	1	0,1%	1102	1	0,1%
0099	5	0,4%	4003	2	0,2%	3330	1	0,1%	1049	1	0,1%
4440	4	0,3%	3441	2	0,2%	3323	1	0,1%	1039	1	0,1%
4340	4	0,3%	3431	2	0,2%	3302	1	0,1%	1033	1	0,1%
4319	4	0,3%	3411	2	0,2%	3301	1	0,1%	1032	1	0,1%
4313	4	0,3%	3332	2	0,2%	3241	1	0,1%	1029	1	0,1%
4213	4	0,3%	3320	2	0,2%	3239	1	0,1%	1020	1	0,1%
4141	4	0,3%	3313	2	0,2%	3222	1	0,1%	1019	1	0,1%
4112	4	0,3%	3309	2	0,2%	3212	1	0,1%	1013	1	0,1%
4019	4	0,3%	3231	2	0,2%	3204	1	0,1%	0449	1	0,1%
3499	4	0,3%	3221	2	0,2%	3203	1	0,1%	0441	1	0,1%
3420	4	0,3%	3213	2	0,2%	3141	1	0,1%	0440	1	0,1%
3300	4	0,3%	3209	2	0,2%	3140	1	0,1%	0431	1	0,1%
3219	4	0,3%	3201	2	0,2%	3134	1	0,1%	0410	1	0,1%
3130	4	0,3%	3142	2	0,2%	3132	1	0,1%	0409	1	0,1%
3110	4	0,3%	3104	2	0,2%	3129	1	0,1%	0402	1	0,1%
3011	4	0,3%	3102	2	0,2%	3121	1	0,1%	0399	1	0,1%
2310	4	0,3%	3033	2	0,2%	3103	1	0,1%	0300	1	0,1%
2131	4	0,3%	3014	2	0,2%	3101	1	0,1%	0213	1	0,1%
2110	4	0,3%	2401	2	0,2%	3044	1	0,1%	0131	1	0,1%
1301	4	0,3%	2320	2	0,2%	3042	1	0,1%	0129	1	0,1%
1112	4	0,3%	2301	2	0,2%	3040	1	0,1%	0120	1	0,1%

1101	4	0,3%	2120	2	0,2%	3034	1	0,1%	0113	1	0,1%
1100	4	0,3%	2119	2	0,2%	3030	1	0,1%	0110	1	0,1%
0430	4	0,3%	2113	2	0,2%	3029	1	0,1%	0101	1	0,1%
4430	3	0,2%	2100	2	0,2%	3022	1	0,1%	0041	1	0,1%
4409	3	0,2%	2011	2	0,2%	3020	1	0,1%	0040	1	0,1%
4343	3	0,2%	2009	2	0,2%	3019	1	0,1%	0019	1	0,1%
4341	3	0,2%	2004	2	0,2%	3012	1	0,1%	0010	1	0,1%
4331	3	0,2%	2000	2	0,2%	3004	1	0,1%	0009	1	0,1%
4323	3	0,2%	1410	2	0,2%	2499	1	0,1%	0000	1	0,1%
4322	3	0,2%	1409	2	0,2%	2439	1	0,1%	**Total**	**1275**	**100,0%**

Note. Growth status is labeled as (0) decline, (1) stasis, (2) low growth, (3) moderate growth, (4) high growth and (9) exit.

Complete Regression Output – OLS & Fixed-Effects estimations

Dependent variable: Profit margin	OLS estimations			Fixed-Effects estimations		
	(1)	(2)	(3)	(1)	(2)	(3)
Profit margin (t-1)	0.4312***	0.4269***	0.4266***	0.2160**	0.3351**	0.3345**
Age (t-1)	-0.0058**	-0.0038*	-0.0045*	-0.0047	-0.0083***	-0.0093***
Size (t-1)	0.0431***	0.0460***	0.0463***	0.0851***	0.1148**	0.1106**
High growth (t-1)		0.0192***	-0.0085		0.0129	-0.0290
High growth x Age (t-1)			0.0037*			0.0055*
year2000				0.0048		
year2001	-0.0174			-0.0154		
year2002	-0.0261	-0.0077	-0.0102	-0.0313	-0.0133	-0.0171
year2003	-0.0260	-0.0076	-0.0112	-0.0396	-0.0173	-0.0227
year2004	0.0107	0.0277*	0.0241*	-0.0092	0.0126	0.0071
year2005	-0.0061	0.0093	0.0058	-0.0258	-0.0020	-0.0072
year2006	0.0165	0.0301*	0.0268*	-0.0103	0.0191	0.0143
year2007	0.0088	0.0204	0.0173	-0.0180	0.0135	0.0091
year2008	-0.0103	-0.0010	-0.0041	-0.0417	-0.0068	-0.0111
year2009	-0.0058	0.0024	0.0003	-0.0393	-0.0032	-0.0061
year2010	0.0109	0.0179	0.0173	-0.0298	0.0147	0.0138
year2011	-0.0010	0.0043	0.0045	-0.0441	0.0050	0.0052

year2012	-0.0301	-0.0270	-0.0263	-0.0810	-0.0263	-0.0252
year2013				-0.0599		
sector11	-0.0151	-0.0159	-0.0159			
sector13	0.0055	0.0047	0.0052			
sector14	-0.0052	-0.0036	-0.0029			
sector15	0.0063	0.0078	0.0073			
sector16	0.0003	0.0007	0.0008			
sector17	0.0375	0.0391	0.0398			
sector18	0.0235	0.0248	0.0253			
sector20	0.0413	0.0419	0.0422			
sector21	-0.1062	-0.1184	-0.1207			
sector22	0.0385	0.0415	0.0416			
sector23	-0.0687	-0.0779	-0.0775			
sector24	0.0168	0.0168	0.0175			
sector25	-0.0003	-0.0027	-0.0025			
sector26	0.0260	0.0222	0.0219			
sector27	0.0131	0.0182	0.0187			
sector28	0.0130	0.0102	0.0105			
sector29	-0.0089	-0.0115	-0.0112			
sector30	0.0251	0.0204	0.0169			
sector31	-0.0186	-0.0212	-0.0211			
sector32	0.0236	0.0285	0.0290			
sector33	0.0272	0.0274	0.0276			
sector49	-0.0155	-0.0160	-0.0158			
sector50	0.0158	0.0331	0.0329			
sector51	0.0853***	0.0848***	0.0860***			
sector52	0.0300	0.0296	0.0294			
sector53	0.0108	0.0142	0.0152			
sector55	-0.0024	-0.0011	-0.0011			
sector56	-0.0075	-0.0096	-0.0096			

sector58	0.0264	0.0258	0.0265			
sector59	-0.0236	-0.0315	-0.0318			
sector60	-0.2621***	-0.2885***	-0.2895***			
sector61	0.0275	0.0276	0.0266			
sector62	0.0245	0.0231	0.0239			
sector71	0.0050	-0.0024	-0.0028			
sector72	-0.1202***	-0.1288**	-0.1266**			
sector73	0.0225	0.0194	0.0198			
sector79	0.0909	0.0353	0.0359			
constant term	-0.0023	-0.0369	-0.0286	-0.0218	-0.0441	-0.0270
N	13,752	12,477	12,477	16,336	12,477	12,477
Groups	1,275	1,213	1,213	1,296	1,213	1,213
R^2	0.1083	0.1263	0.1264	0.0453	0.0836	0.0838

Legend: * p<.10; ** p<.05; *** p<.01