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*Published in:*  
Journal of Evolutionary Economics

*DOI (link to publication from Publisher):*  
[10.1007/s00191-017-0532-6](https://doi.org/10.1007/s00191-017-0532-6)

*Publication date:*  
2018

*Document Version*  
Accepted author manuscript, peer reviewed version

[Link to publication from Aalborg University](#)

*Citation for published version (APA):*  
Coad, A., Holm, J. R., Krafft, J., & Quatraro, F. (2018). Firm age and performance. *Journal of Evolutionary Economics*, 28(1), 1-11. <https://doi.org/10.1007/s00191-017-0532-6>

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## Firm Age and Performance

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This version: 04 July 2017

### **Abstract:**

Amid increasing interest in firm age and its effects on firm performance, this special issue offers an exhaustive review of the literature and a novel collection of evidence on the effects of firm age on performance, including a special focus of interest on innovation performance, financial performance, exports, survival and growth. This editorial positions the theme in the extant literature, and provides key definitions and challenges ahead in the field of evolutionary economics. It introduces the collection of articles composing the special issue. The papers offer a diversity of country contexts, as well as analytical approaches and methods. They include an exhaustive review of the literature on age and firms’ performance, and present original empirical studies focusing on the effects of age on firms’ economic outcomes on the one hand, and on innovation outcomes on the other hand. While most of the papers use econometric analysis, the level of analysis ranges from firm to individual.

**JEL codes:** L10; L20

**Keywords:** Firm Age, Firm Performance, Survival, Cohort, Evolutionary Economics, Liability of Newness

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## 1. Introduction

Firm age appears as a prolific field of research today, gaining momentum and visibility both in top academic journals in economics and management (Journal of Political Economy, Quarterly Journal of Economics, Strategic Management Journal, Academy of Management Journal, Administrative Science Quarterly) as well as in top field journals (Small Business Economics, Journal of Business Venturing, Journal of Evolutionary Economics, Industrial and Corporate Change, etc).

The recent decades are marked by an explosion in the number of journal articles. As an illustration, the journal platform JSTOR identifies more than 3000 contributions containing the exact phrase 'firm age', with 214 references in the 1980s, 531 in the 1990s, 1136 in the 2000s and 1237 for the period 2010-2017. Relatedly, Figure 1 shows how interest in "firm age" has increased in the last few decades, according to the Google Ngrams tool (Ophir, 2016). The most frequently-used terms associated with firm age are "firm age and size" and "firm age and firm size".<sup>2</sup>

Though very dynamic, the field is undeniably still far from reaching a maturity phase. Theoretical concepts related to age are still being refined. Regarding organizational rigidity, for example, Loderer et al. (2017) present theory and evidence that the decline in growth opportunities (proxied by Tobin's q) that occurs as firms age is due to the organizational rigidity that occurs from a continual focus on improving the management of assets in place. Yang and Aldrich (2017) revisit the concept of liability of newness and distinguish between resources at birth and resources collected immediately after entry.

The growing interest of scholars in the domain of firm age and performance also echoes a gradual change in focus over time. While at the origin firm age is predominantly analysed in relation to the industry structure, more ambitious questions have been raised in the 2000s such as the link with firm performance, the rise of entrepreneurship, and the types of innovation at work. These new research questions peak at the turn of the millennium, when there is a consensus that the internet revolution could hardly emerge if the old, incumbent companies were not contested by young, new firms, like Google, Facebook, etc.

This Schumpeterian vision that economic development at all times is essentially nurtured by the emergence of new industries created by new firms is still present in the literature today, especially in the industry life cycle literature (Klepper, 1997). However, recent contributions in the field are also prone to follow a pragmatic view, by questioning the link between the emergence of industries and the young age of firms composing the industry, or alternatively the correspondence between mature industries and incumbent aging firms.

The research programme is then motivated by the investigation of whether young firms are really 'fast and furious' compared to old firms, and conversely whether old firms are more 'slow and

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<sup>2</sup> According to Ophir's (2016) "wild card" Ngram search technique, starting with search terms "firm growth \*" and then "firm growth and \*" [analysis performed on 15 June 2017].

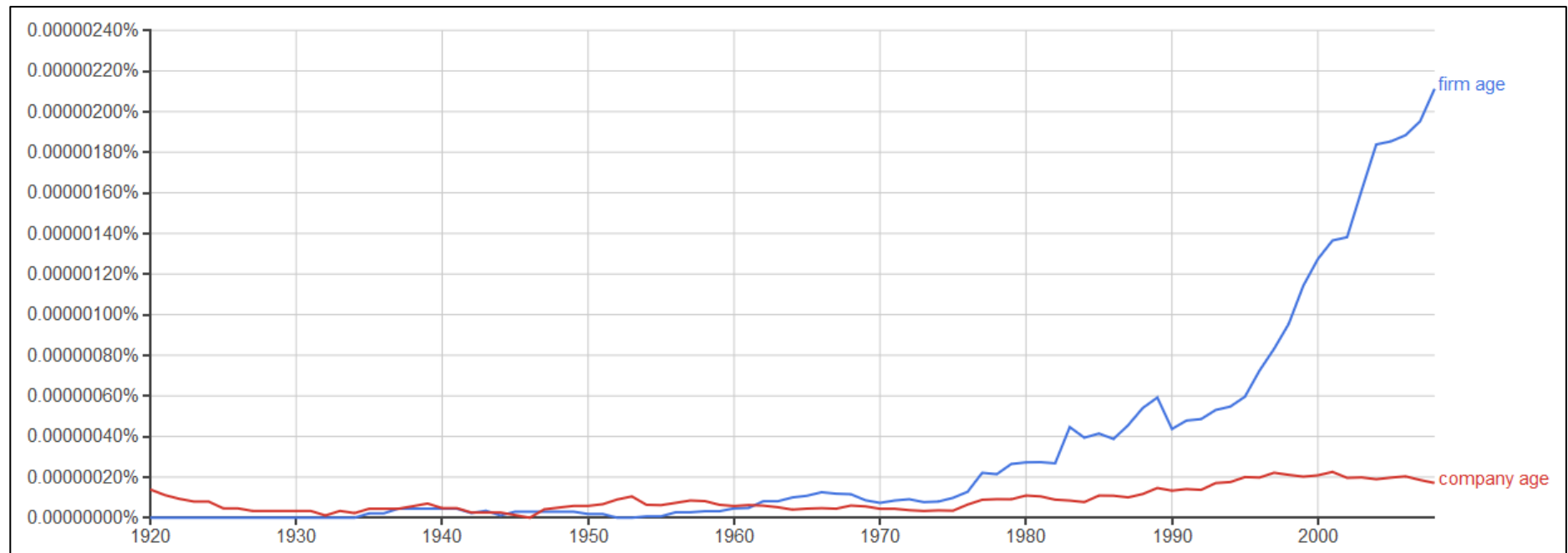
cautious' than their younger counterparts (Krafft, Lechevalier, Quatraro, Storz, 2014; Colombelli, Krafft, Vivarelli, 2016; Colombelli, Krafft, Quatraro, 2014).

In sum, the dominant vision today is that each type of firm co-exists and contributes to economic growth in a different way, through product and/or process innovation, different paths in terms of exports or distinct sorts of occupations and job requirements. In this new perspective, firm age is more than a control variable, and the opposition between young and old firms in itself deserves reconsideration as age is continuous and not a discrete variable. In a significant number of cases, firm survival is observed only because these firms were born one year before or after a certain event that produced massive exits in an industry, and this requires more than a distinction between young and old, but rather how the grouping of firms into younger/older cohorts can affect the evolution of an industry. This is particularly true in the field of eco-innovation, in which it pays to be green only if you are born green, i.e. born within the green revolution (Leoncini et al., 2017).

Age is deemed to open new windows of research opportunity in the field of diversification, and especially in well-known topics like integration/specialization in horizontally- or vertically-related industries, as being new in a given industry can also be moderated with age. For instance, in some cases, going green by diversification could in the end be on a par with born-to-be-green, provided that age can help catching up (Leoncini et al., 2017).

Just as firm size generated a sharp increase in focus over the last years, research on firm age is now booming and producing new results in firm-level and industrial dynamics.

Figure 1: Google ngrams plot of appearances of the term “firm age”



Source:

[https://books.google.com/ngrams/graph?content=firm+age%2C+company+age&year\\_start=1920&year\\_end=2008&corpus=15&smoothing=3&share=&direct\\_url=t1%3B%2Cfirm%20age%3B%2Cc0%3B.t1%3B%2Ccompany%20age%3B%2Cc0](https://books.google.com/ngrams/graph?content=firm+age%2C+company+age&year_start=1920&year_end=2008&corpus=15&smoothing=3&share=&direct_url=t1%3B%2Cfirm%20age%3B%2Cc0%3B.t1%3B%2Ccompany%20age%3B%2Cc0)

last accessed 15 June 2017.

## 2. Epistemological considerations

The concept of “age” when pertaining to social constructs, such as firms, may seem as odd as asking “how tall is the firm”. It is an example of what Coad (2017) refers to as an anthropomorphic analogy, and as with Darwinian evolution it may be discussed at length how apt the analogy is for economics (Schubert, 2014; Pelikan, 2011 Aldrich et al., 2008). There are both practical and philosophical reasons why the analogy is not useful, and “age” should instead be understood as meaning something quite different in relation to a firm than in biology, just as “size” means something very different too.<sup>3</sup> However the effect of age is much less, and much less systematically, studied than the effect of size. This is presumably because of a lack of data on firm age in previous work. This Special Issue on “Firm Age and Performance” seeks to collect evidence on the effect of firm age on performance and make it available collectively. The special issue starts with a review of the literature (Coad, 2017) which is then followed by six empirical studies on the relationship between firm age and innovation (Pellegrino, 2017; Cucculelli, 2017), financial performance (Van Stel et al., 2017), exporting (Grazzi and Moschella, 2017), survival (Anyadike-Danes and Hart, 2017) and growth (Cowling et al., 2017). The empirical studies and the review reveals that studying the effect of firm age generally means studying the uniqueness of entrepreneurial upstarts, comparing new and old firms or comparing entrants and incumbents. This leads to the question of what is actually captured by measuring the age of a firm, which will be discussed in the following section.

## 3. Age as a variable

The special issue papers identify a number of salient features of firm age as a variable.

First, there are considerations of causality. It is clear that firm performance does not influence age, because age cannot be influenced. A firm can do nothing to turn back the clock. Age influences performance, probably through intermediating mechanisms such as routinization, accumulated reputation and organizational rigidity. The causal arrow runs from age to performance. There is no spurious correlation when it comes to age and performance, because the only interpretation of a correlation between age and performance is that age causes performance.<sup>4</sup>

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<sup>3</sup> Faced with the question “how big is Mrs Smith” most persons would reply in terms of weight or height, whereas an alien having learned about the concept “size” from an economist would reply in terms of Mrs Smith’s income, number of working hours, or perhaps volume of inputs (food and drink).

<sup>4</sup> Some scholars, such as Loderer et al (2017, p. 2), suggest that there may be “reverse causality” between firm age and performance in the form of a selection bias that may arise from unsuccessful young firms being more likely to be selected out of the population. However, we do not agree that this can be called “reverse causality”, because a firm’s performance cannot influence a firm’s age. Firm performance may have a causal influence on survival (i.e. whether age will subsequently be observed or not), and hence the age distribution of the population, but not firm age itself. If we focus on an unbalanced panel, aggregate performance may evolve with the shifting population of survivors, but performance can never slow down or accelerate a firm’s age. In a balanced panel of firms that we know will survive until the end of the sample, all selection effects will have

Second, many of the observed relationships between age and performance are U-shaped or non-linear. For example, at the level of a solo entrepreneurs, there is a U-shape as performance initially suffers from a liability of newness, before increasing due to maturity and learning effects, and then ultimately decreasing due to liabilities of old age. Non-linear effects arise for a number of phenomena where the initial liability of newness fades, and performance improves, until a plateau is reached.

Third, building on the ubiquity of non-linear relationships of age and performance, a common theme of the papers is the use of graphical methods. All of the papers in this special issue use graphs to present their results. Graphs and plots are a natural way of presenting evolutions and trends in variables over time, where time is plotted on the horizontal axis. Alongside the disappointment with fishing for significant p-values, also known as p-hacking or asterisk-hunting (Bettis, 2012; Bettis et al., 2014; Wasserstein and Lazar, 2016) and problems with regression estimation of U-shapes (Haans et al., 2016), graphical approaches give a richer description of the underlying age-related relationships, as well as showing the economic significance of the magnitudes of the effects.

A simple yet powerful graphical tool is when there is age on the horizontal axis, and behaviour or performance on the vertical axis. Several papers in this special issue present the data in this way. Given that age causes performance, and not vice versa, this graphical representation should be read as what performance is observed when age takes a certain value, without concerns about spurious correlation. (Note that there is no need to “hold other factors constant”, because often the “other factors” lie on the causal path from age to performance, and hence they need not be controlled for).

The papers in the special issue also highlight the importance for future research to analyse datasets that have comprehensive coverage of the population of young firms, in order to avoid the selection bias that arises when small, short-lived young firms are excluded from databases.

## 4. Overview of the papers

The Special Issue brings together seven papers, which provide a rich theoretical and empirical account of the interplay of age and firm-level traditional variables in explaining firms’ heterogeneous performance. The papers differ in several respects, as summarized in Table 1.

The special section begins with a broad-based review of the empirical and theoretical literature on firm age (Coad, 2017), which serves as an introduction to the topic. The paper questions the usefulness of anthropomorphic analogies for understanding firms’ age and provide a framework to explain direct and indirect effects of age.

There are in general two different approaches to form hypotheses about the effects of firm age on performance. One may be labelled the Ecology approach in reference to Hannan and Freeman

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been removed, allowing the researcher to focus exclusively on internal developmental effects of age on performance.

(1984). The alternative can be labelled Evolutionary in reference to Jovanovic (1982), although its principles also adhere closely to Nelson and Winter (1982).

In the ecology approach, the focus is on the maturation of the firm, how its routines mature and how the firm changes, or fails to change, alongside changes in its environment. A range of different liabilities are used to conceptualise the dangers that arise throughout an organisation's life: the liabilities of newness, adolescence, age, senescence and obsolescence (see Coad, 2017, for details). Unlike the ecology approach, the evolutionary approach puts more emphasis on learning and selection. It is complementary to the ecology approach rather than a substitute for it, as it emphasises population dynamics over internal changes. In concise form, it has been summarised recently as "up or out" dynamics (Haltiwanger et al. 2013): firms must either learn or exit. In this direction, Bianchini et al. (2017) propose an analysis of the differential effects of corporate governance on firms' innovation across the firm age distribution. They find that the expected negative impact is stronger for younger than for older firms. Their results suggest that young firms tend to privilege short-termism and value preservation rather than long-term risky innovation strategies.

Following Coad's literature review are six empirical papers. These are organized according to the two themes of entrepreneurship and innovation. Entrepreneurship is a key area for age research. Some scholars even define entrepreneurship in terms of age limits, (e.g. Van Praag and Versloot 2007 define entrepreneurial firms as those aged less than seven years). Anyadike-Danes and Hart (2017) provide a large-sample representative picture of how a cohort of firms changes with age. Grazzi and Moschella (2017) focus on a specific breed of entrepreneurial firm – young exporters. Cowling et al. (2017) address the liabilities of young entrepreneurial firms by investigating how UK young firms fared during the recent financial crisis. Van Stel et al. (2017) focus on how firm owners' individual characteristics (in particular their start-up motive) and firm age influence earnings.

The second main organizing theme is innovation. Regarding innovation, theoretical work has put forward that young firms are more likely to perform radical innovation (Acemoglu and Cao, 2015). However, how can young firms be expected to be more innovative when they have to start from scratch, and lack capabilities, experience and routines? Empirical work has therefore found mixed results for whether younger firms are more innovative than older firms. How does the nature of innovation change with age? Cucculelli (2017) investigates how several indicators of innovation change with firm age. Pellegrino (2017) looks at how barriers to innovation change with firm age.

[TABLE 1 ABOUT HERE]

Table 1 suggests that the special issue papers can be classified according to the performance indicator used as a dependent variable, the type of dataset and the country to which firms belong. For what concerns the performance indicators, two main groups can be identified, i.e. economic and innovation outcomes.



Within the group focused on economic performance, Anyadike-Danes and Hart (2017) provide a detailed picture of survival rates, growth trajectories and net job creation by 239 thousand UK private sector firms born in 1998, over their first 15 years of life. They show that age matters critically for both survival and growth. Two thirds of firms die within the first five years after birth, and although survival chances improve after age 5, only 10 percent of the cohort survive to age 15. Equally, most firms which grow, grow in the first five years, and the fastest rates of growth are recorded up to age 5 too. After age 5 the average growth paths of surviving firms are pretty much flat. The authors also analyse the size-dependence of survival and growth conditional on age. The finding on survival is that (given age) larger firms have a better chance of survival but, extending this conventional result, they also show that when small firms grow, their survival chances improve. The results on growth can be summarised quite simply: most firms in the cohort are born small – 85 percent with less than 5 jobs – and of those that survive age 15 most are still small – 60 percent with less than 5 jobs. As far as most of the cohort survivors are concerned, firm performance is better characterised as ‘neither-up-nor-out dynamics’, rather than the conventional formulation of ‘up-or-out dynamics’. They find that job growth is concentrated at both ends of the size distribution. The contributions to employment change are almost equally divided between a very small number of very small firms (5 percent of the survivors born with less than five jobs) which grow extremely rapidly, and a similar number of larger firms which grow relatively slowly.

Cowling et al. (2017) also focus on UK firms, by gathering data from the Small Business Survey. They take sales and employment growth as performance indicators and apply an approach that fits within the ecology frame described above. After observing that older firms were hit harder by the 2008 financial crisis, Cowling and colleagues investigate to what extent age and entrepreneurs’ experience interact in shaping the way SMEs coped with the effects of the crisis. Their results suggest that entrepreneur experience had little fortifying effect in that specific macroeconomic context, as owners’ commitment and involvement decreases as the firm ages, leading to a liability of age where the firm relies too much on rigid routines and can less easily adapt to the crisis.

Van Stel et al. (2017) explicitly apply an evolutionary approach of learning and selection in their focus on learning among surviving firms. The study focusses on whether start-up motives are associated to differential entrepreneurs’ earnings, and to what extent the relationship between entrepreneurs’ tenure and earnings is related to start-up motives. They use a large sample of European entrepreneurs drawn from the European Community Household Panel (ECHP) covering the period 1994-2001. Van Stel and colleagues investigate the effect of learning by the entrepreneur. The longer a firm has survived, the more learning has arguably taken place, and this is reflected in the entrepreneur’s earnings. In addition, they find that earnings of necessity entrepreneurs are significantly lower than those of opportunity entrepreneurs, irrespective of the type of necessity motive. Moreover, these differences remain rather stable over the course of the entrepreneur’s business tenure, i.e., these differences are of a permanent nature.

Grazzi and Moschella (2017) investigate whether the export status of firms affects the patterns of employment growth of firms across different age classes. They gather together a unique dataset combining the universe of Italian firms and detailed information on export transactions. Their results provide evidence on differences in how exchange rates affect young and experienced exporters. In particular, early exporters appear to be better equipped than established firms to face exchange rate

variations, as their exports decrease less following a currency appreciation. The paper by Grazzi and Moschella (2017) illustrates the complementarity of the ecology and evolutionary approaches: The ability to engage in competition in foreign markets is a signal of high performance, and indeed exporting firms grow more than other firms. However, Grazzi and Moschella also find that the effect is stronger among young firms, suggesting that the selection process is working particularly intensively among young firms. That the exports of young firms are less sensitive to exchange rate fluctuations suggests that they rely less on price and more on other factors for their competitiveness. This means that young firms are innovative, in a broad sense, while older firms are comparatively rigid, as the ecology approach predicts.

Cucculelli (2017) also focuses on the Italian evidence, but by looking at innovation as a performance indicator. The analysis is based on an ad-hoc survey compiled through a questionnaire-based interview, and financial data drawn from the Bureau van Dijk AIDA Database. Cucculelli finds that the probability to introduce product innovations is affected by CEOs' tenure and the degree of maturity of the last product launched in the market. The mechanism is especially relevant for new entrants vis-à-vis mature firms. In this sense, Cucculelli focuses on learning within firms, and finds that aging implies building up resources and capabilities despite the fact that the simple correlation between the incidence of product innovation and age are negative. After controlling for time since last product innovation and tenure of the CEO, however, the correlation becomes positive. Cucculelli's analysis thus also demonstrates the complementarity between the ecology and evolutionary approaches, as it is arguably the inertia created by a long tenured CEO and a long time-span since previous innovations that decrease the firm's tendency for product innovation.

Finally, Pellegrino (2017) also focuses on innovation as a performance indicator, and specifically on firms' perceived barriers to innovation. The study is based on the data from the Spanish Innovation Survey (PITEC) for the period 2004-2011 and, as with the study by Cowling and colleagues, Pellegrino's analysis is particularly illuminating from an ecology approach. Pellegrino finds that young firms seem to be more affected than mature ones by the internal and external shortages of financial resources. This demonstrates the liability of newness as it suggests that a lack of legitimacy and reputation entail that young firms struggle to access finance. Even more interestingly, Pellegrino's results document the maturation within firms as the data allow a distinction between perceived and revealed obstacles, showing that a lack of skilled employees is a revealed obstacle for firms in general, while only older firms actually perceive this. Finally, Pellegrino's results demonstrate the liability of obsolescence in that older firms tend to face obstacles related to demand and market conditions, which indicates that they have not been able to keep up with the evolution of the environment.

Overall, the Special Issue papers confirm that firm age is a relevant variable deserving appropriate consideration in theoretical and empirical studies enquiring into the determinants of firms' performance. Moreover, provided the observed concentration of positive performance in the early years, the need for extensive and comprehensive datasets emerges, with an appropriate coverage of young firms. Such datasets need to include detailed information on the members of organisations, such as matched employer-employee datasets. This allows for further elaboration of the opposing effects that age increases experience but also rigidity. Both mechanisms are established in the papers in this Special Issue and their combined effects on performance in general is not certain.

The gathered evidence also bears policy implications. At a general level, it is clear that one-size-fits-all policies supporting firms' performances are not likely to be effective. Industrial policies should be designed by considering firms' and product life courses, sectors of activity, ownership structure, and type of performance indicator that is targeted.

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Table 1: overview of the special issue papers

Authors	Country	Data	Performance indicator	Main findings
<b>Coad</b>	-	Literature review	-	Questions biological analogies. Aging occurs at different levels: individuals, products, routines, firms, cohorts, industries. Most interesting age effects happen within the first 5-7 years.
<b>Anyadike-Danes and Hart</b>	UK	UK Business register	Growth, survival	Firm growth and firm death concentrated up to age 5. Given age, survival and growth depend significantly on size with job creation shared equally between a small number of rapidly growing firms born very small, and larger firms growing relatively slowly.
<b>Grazzi and Moschella</b>	Italy	ISTAT ASIA Database	Employment growth	Young firms are more adaptable (less affected by currency fluctuations) and are subject to stronger selection (export performance has a greater impact on growth)
<b>Cowling, Liu and Zhang</b>	UK	Small Business Survey	Employment/sales growth	Ageing leads to decreasing commitment from owner; not just experience
<b>Van Stel, Millán, Millán, and Román</b>	EU-15 countries	ECHP	Entrepreneurs' earnings	Entrepreneurs' earnings increase with experience, and are higher for opportunity entrepreneurs than for necessity entrepreneurs
<b>Cucculelli</b>	Italy	Ad hoc suvey + AIDA	Product innovation	Aging at different levels: CEO tenure age, product age, and firm age Age builds up resources for innovation, but long timespan since previous innovation builds inertia and hinders future innovation
<b>Pellegrino</b>	Spain	PITEC (Spanish	Perceived barriers to	Firms' perception of barriers change as firms

Innovation Survey)	innovation	mature and build legitimacy
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