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Abstract

We examine the relation between CEO age and firm organic growth in a large sample of mostly privately held European manufacturing firms of all size classes. Firms managed by a young CEO grow faster in terms of both sales and assets. Results are robust to the inclusion of a large vector of firm and CEO characteristics and to controls for time horizon, endogeneity and survival bias. We hypothesize that this relation is explained by an incentive of young CEOs to boost firm growth both to signal their talent in the market for managers and to get a longer stream of future compensation benefits. This may create an agency problem, due to a divergence of this corporate strategy from shareholders' targets. In line with this hypothesis, a larger blockholder ownership, allowing for a more effective monitoring, moderates the relation between CEO age and firm growth.

Keywords: Chief Executive Officer; CEO age; organic growth; agency theory; blockholder ownership; European manufacturing firms

JEL classification: G32; G34; L11; L25; L60

Declarations of interest: none

Introduction

What does determine firm growth? This question has been approached from different angles in the Industrial Organization (IO) field of research (Geroski, 1999). Stochastic models date back to the seminal work of Gibrat (1931) and have attracted attention up to recent times (see Hart and Oulton, 1996; Bottazzi and Secchi, 2006; Arata, 2019; among others), because of the consistent properties of the growth rates distribution across countries, industries and over time. Dynamic competitive equilibrium models (Jovanovic, 1982; Ericson and Pakes, 1995; Cabral and Mata, 2003; Cooley and Quadrini, 2004) explain businesses' growth with structural characteristics of the firms –such as younger age and smaller size--, a higher level of efficiency and investments and a more effective access to financial resources.¹ Evolutionary models (Nelson and Winter, 1982; Dosi et al. 1995), which are grounded in the Schumpeterian idea of “creative destruction”, have paid attention to the role of innovation in firm dynamics.²

While all these strands of the literature have focused on the role of firms' characteristics in explaining their episodes of size expansion, with few exceptions – such as the literature on the characteristics of the founders for the growth of new firms (e.g. Colombo and Grilli, 2005) - the role exerted by managers' targets and characteristics in firm growth has been much less explored. This is unfortunate, being the top executives the main responsible for corporate strategies (Hambrick and Mason, 1984; Bertrand and Schoar, 2003; Foss and Pedersen, 2016).

The principal-agent (P-A) framework, which is traditionally adopted in IO to model the relationship between shareholders' and managers' interests within the firm, does shed light on how firm growth may depend on executives' choices. Indeed, while the owners of the firm (principals) are interested in the expected present value of the firm's economic profits, managers (agents) aim at maximizing their utility, which is more related to firm size than to profit (see Baumol, 1959; Marris, 1964; Williamson, 1964; among others). This is because of the positive relationship between managers' compensation and firm size (Jensen, 1986),³ which has been empirically confirmed in several works (see Cosh and Hughes, 1997; Kato, 1997; Brunello et al., 2001; Gabaix et al. 2013; among others). Based on this P-A framework, managers are expected to push firm size (through

¹ Inspired by this theoretical framework, a large body of empirical research has investigated the role of these firm characteristics in growth (see Hall, 1987; Das, 1995; Bloningen and Tomlin, 2001; Lotti et al. 2009; Haltiwanger et al. 2013; Barba Navaretti et al. 2014; Geurts and Van Biesebebroeck, 2016; among others).

² Although through a complex relationship, innovation and technological change have been found to determine firm growth in several empirical papers (see Bottazzi et al., 2001; Coad and Rao, 2008; Harrison et al. 2014; among others).

³ Managers may be interested in expanding firm size also because of the desire of controlling more resources and staff (“empire building”) and the increase in their job security via a higher survival rate for larger firms (Donaldson and Lorsch, 1983).

growth) beyond the “optimal” one for shareholders, thus possibly deviating from profit maximization and creating a conflict of interests within the firm.

This paper adopts the P-A framework to show how managers’ targets and characteristics contribute to explain that part of the growth rates variability among firms, which is not ascribed to the stochastic, structural, financial and technological characteristics of the firm. In particular, we investigate whether the higher propensity towards firms’ growth, may be due to the specific incentives of young Chief Executive Officers (CEOs). We hypothesize that the aim of signaling their talent in the market for managers and the possibility of getting a longer stream of future compensation benefits lead younger CEO to seek higher firm growth with respect to their older counterparts. This may well create a divergence of interests with shareholders. Consistently with this framework, we expect the incentives of younger CEOs for firm growth to be hindered in firms with larger blockholder ownership, where shareholders monitoring is more stringent (Shleifer and Vishny, 1986; Chaigneau and Sahuguet, 2018).

This paper focuses on a specific type of firm growth, i.e. organic growth, which is usually proxied by the rate of growth of sales or assets. Even if firms may grow also through Mergers & Acquisitions (M&As), the interest in organic growth is grounded, from our point of view, in three facts. First, the vast majority of actual growth episodes are due to an internal expansion of the firm in terms of its capacity and output. Second, M&As are usually considered as “risky” strategies⁴: these may be preferred by young CEOs simply because of their lower risk aversion due to their youth (Falk et al., 2018). In this work, while we include a proxy for CEOs’ risk tolerance, we attempt to estimate the role of young CEOs incentives and targets in firm growth, “net of” their attitude towards risk.⁵ Third, similar to M&As, economic theory has shown that organic growth can generate significant agency problems.⁶

We analyze the role of CEO age in organic growth in a large sample of manufacturing firms from seven European countries (Austria, France, Germany, Hungary, Italy, Spain and the United Kingdom) in the period 2009-2014. The database we employ for the empirical analysis results from merging Bureau Van Dijk (BvD)’s Amadeus database with the European Firms in a Global Economy (EFIGE)

⁴ While high-profile M&As may ideally boost both revenues and earnings per share (Ahuja et al., 2017), the evidence of a positive effect of M&As on the shareholders’ value of the acquiring firms is mixed (see Andrade et al. 2001; Kräkel and Müller, 2015; among others).

⁵ Past studies have attributed younger CEOs’ engagement in “risky” strategies such as Mergers & Acquisitions (M&As) (Yim, 2013; Li et al., 2017), investments in Research and Development (R&D) (Serfling, 2014) and internationalization (Serra et al., 2012) to their superior risk-taking behavior.

⁶ Indeed, managers may over-invest, to signal that their firm’s present value is high, when markets are imperfectly informed about the firm’s long-run projects and executives are concerned with short-run evaluations (Bebchuck and Stole, 1993). Moreover, when the stock market is imperfectly informed about managerial ability, strategies aimed at pumping current figures up may be adopted by the managers, such as devoting effort in raising current sales volumes at the expenses of improving profit margins (Aghion and Stein, 2008).

survey. The EFIGE survey has several unique features. First, it is a sample built to represent the manufacturing sectors of the countries covered. In particular, the sampling design follows a stratification by industry, region and firm size. A relevant implication of this design for the purpose of the present work, is that we are able to consider a large number of mostly privately held firms (only about 2% of firms in the sample are listed) of different size classes, i.e. small, medium and large enterprises. This allows us to highlight that agency problems in the relationship between shareholders and managers is not an exclusive feature of large and widely held firms. Indeed, while a firm in which the same person holds the ownership and the management can be considered the base case of zero-agency costs (Jensen and Meckling, 1976), the initial separation between ownership and control takes place precisely when a firm is small (Danielson and Scott, 2007). Second, data from EFIGE are fully comparable across countries, since they are derived from responses to the same questionnaire, administered over the same time span (January to May 2010). Third, EFIGE includes a wide range of questions that allow us to control for a rich set of important firm and CEO characteristics, which is key in order to limit omitted variable bias issues. Our final sample includes about 7,200 manufacturing firms, across twenty-four 2-digits industries.

Our econometric analysis shows three relevant results. First, firms managed by CEOs younger than 45 show higher median sales and total assets growth over the period 2009-2014, once controlled for industry-country unobserved heterogeneity and a relevant set of firm and CEO characteristics. By means of quantile regressions, we also show that the effect is asymmetric along the distribution of firm growth rates: firms managed by younger CEOs do grow more than their counterparts managed by older CEOs, and this difference is stronger in the highest (75th and 90th) conditional percentiles. This result is consistent across the different countries considered. Second, our results show no significant statistical relationship between growth in operating profits and CEO age. We consider this second result as the evidence of a divergence of interests between CEOs and shareholders. Third, and consistently with agency theory, we find that in firms characterized by a more effective monitoring of managers' decisions (proxied by a larger blockholder ownership), the relationship between CEO age and firm organic growth is much weaker.

Being EFIGE a cross-sectional survey, we cannot employ an identification strategy based on changes in the longitudinal dimension of the CEO age variable. Nonetheless, we control for different time horizons over which growth rates are calculated, in order to minimize the risk of getting biased results due to the (unobserved) turnover of the CEO. Moreover, we take the likely endogeneity issue stemming from selection of the CEOs based on firms' growth trajectory and other characteristics into account, by employing a propensity score matched (PSM) sample analysis. We also control for the survival bias, due to the likely disappearance from the database of shrinking firms as time passes.

Finally, we conduct several robustness checks on the linearity of the CEO age effect, on the role of CEO tenure and the correlation between firm and CEO age and on the existence of country specificities in the relationship between CEO age and firm organic growth. The main results are robust to all these checks.

Our study contributes to the modern literature on industrial dynamics, by offering some interesting insights on the role played by a relevant characteristic of the managers, i.e. their age, in firm growth. While the growth effect of firm characteristics such as age, size, efficiency, innovative activities and also the one associated with demand factors (Foster et al. 2016; Pozzi and Schivardi, 2016) have been deeply studied, less evidence has been provided regarding the role played by the characteristics of the individuals who lead the firm.

This paper also relates to the literature which inquires into the role of managerial characteristics in firms' strategies (see Malmendier and Tate, 2005, 2008; Cronqvist et al. 2012; Faccio et al., 2016; among others). In this perspective, our paper is related to Li et al. (2017) which provided evidence that careers concerns explain why younger CEO take investment decisions that boost firm growth and Belenzon et al. (2019), who inquire into the relationship between firm growth and CEO age in a sample of European companies from BvD's Amadeus. However, two major novelties are provided by this work. First, unlike Li et al. (2017) who rely on a sample of only large US firms (with an average size of plant of about 300 employees), our analysis covers a set of diverse EU countries and includes small, medium and large firms (with 87 employees per firm on average, and a median size of 26 employees). This is key to highlight that agency problems are also at work in firms of smaller sizes. Second, while Belenzon et al. (2019) only focus on owner-managed firms to "[...] eliminate the potential agency problems [...], which could affect managerial actions and hence firm growth [...]" (p. 924), we precisely focus on this agency problem by comparing the relationship between CEO age and firm growth in firms with different degrees of blockholder ownership. Indeed, our empirical design delivers enough variability in governance structures, which allows testing for the role of blockholder ownership as a monitoring device that can align CEOs' strategies with shareholders' interests.

The rest of this paper is structured as follows. Section 2 draws the theoretical underpinnings of the relationship between CEO age and firm growth. Section 3 describes the data. Section 4 presents the econometric results and the robustness checks. Section 5 concludes.

2. Literature review and hypotheses development

2.1 CEO age, risk aversion and corporate strategies

Younger CEOs may be more risk-tolerant, thus pursuing riskier and incidentally size-enhancing strategies (like M&As, R&D investments and internationalization). Indeed, a positive relationship between risk aversion and individual age has been shown by Falk et al. (2018) in a representative sample of 80,000 individuals from 76 countries. Existing empirical studies largely support a negative relationship between CEO age and managerial risk-taking. Serfling (2014) finds a negative relationship between CEO age and firms' risky strategies, i.e. R&D investments, un-diversified acquisitions and operations, higher operating leverage. Yim (2013) empirically confirms the greater probability of firms managed by younger CEOs to pursue M&As in the period 1992-2007. Li et al. (2017) find that firms managed by younger CEOs are more likely to both significantly invest and divest than firms managed by older CEOs.

However, not all episodes of firm growth are the result of risky strategies: for example, managers may devote effort towards organic growth, via a boost in sales volumes and an increase in its market share, possibly at the expense of profitability (Aghion and Stein, 2008).

This boils down to the question: why would younger CEOs have a preferences for boosting organic firms' growth, other than their inherently lower risk aversion?

2.2 Signaling, compensation and career concerns

First, there may be a *managerial signaling* factor (Prendergast and Stole, 1996). A young CEO may prefer a rapid expansion of firm size to the optimal (for shareholders) size level in order to signal their talent to the market for managers. Conversely, older CEOs may be more reluctant to change their investment behavior frequently because this may be a signal of previous unsuccessful decisions (conservatism). Second, a *compensation incentive* factor may be also at work. To the extent that firm size is a primary determinant of the CEO's remuneration (see Cosh and Hughes, 1997; Kato, 1997; Brunello et al., 2001; Gabaix et al. 2013; among others) and an optimal contracting scheme cannot be signed,⁷ CEOs may be incentivized to pursue size expansion early in their career to get access to longer streams of future compensation benefits (Yim, 2013). Third, the *upper echelons theory* (Hambrick and Mason, 1984) would also predict that older CEOs attach more value to career and financial security and have greater commitment to the status quo of the firm. Indeed, old CEOs may

⁷ If an optimal contracting scheme may be signed between shareholders and managers, a higher compensation in larger firms may simply remunerate the higher effort and abilities needed to manage those firms with respect to their smaller counterparts

see the time of retirement as a moment of imminent assessment of their job and may prefer legacy conservation and wealth preservation.

While the factors discussed above predict a negative relationship between CEO age and firm growth, *career concerns* may work in the opposite direction. Indeed, younger CEOs may face higher probability of being fired due to a not yet established reputation⁸ and suffer greater market's scrutiny (Scharfstein and Stein, 1990; Holmstrom, 1999). If that is the case, young CEOs may pursue less size-enhancing investments with respect to their older counterparts, especially if these are also risky strategies (Hong et al., 2000). However, career concerns should be less relevant in the context of the present work, given that organic growth may well be pursued via non-risky strategies, such as a reduction in the price-cost margin.

A firm may devote effort toward growth and the expansion of its market share by lowering the price-cost margin, and this may create a divergence in interests between firm growth (managers) and profit maximization (shareholders). Among a variety of solutions proposed to reconcile this divergence, monitoring of executives by large blockholder owners is certainly one of the most common (Shleifer and Vishny, 1986; Chaigneau and Sahuguet, 2018). This is due to several reasons (Shleifer and Vishny, 1997). First, large blockholder owners have the incentives, given the magnitude of their ownership stake, to collect information on executives' actions. Second, they have a high voting power to put pressure on the managers, possibly to threaten to take them out (e.g. via a takeover). Third, when large shareholders own more than half of the firm's equity shares, they have full control over the firm and its management.

The role of ownership concentration seems relevant in the context of our empirical analysis on European firms, as the evidence suggests that in continental Europe a high reliance is posed on large investors and their monitoring effectiveness (with respect to alternative mechanisms, such as superior legal protection of investors or incentive contracts) in aligning the interests of the owners with respect to those of the managers (La Porta et al. 1998). The empirical evidence has shown that ownership concentration can be an effective tool in aligning shareholders' interests with executives' utility.⁹

⁸ Again, this would be the case of a not perfectly informed market for managers, which is learning about the ability of the manager, based on previous performance. Conversely, in a perfectly informed market for managers, compensation setting would not create incentives for CEOs to deviate from the optimal (for the shareholder) growth rate.

⁹ Thomsen and Pedersen (2000) find a positive effect of ownership concentration on the market-to-book value of equity and profitability in a sample of about 450 very large European companies observed during the first half of the 1990s. Bruton et al. (2009) have found support for concentrated ownership improving initial public offering (IPO) performance over the period 1996-2002 in a sample of both UK and French companies. Evidence has been also provided on the role that concentrated ownership plays in lowering the probability of value-reducing acquisitions (see Amihud and Lev, 1981; Denis et al. 1998).

To the extent that the relation between CEO age and firm organic growth is due to divergent interests between shareholder (more interested in profit growth) and CEOs (more interested in firm growth), one could expect this relation to be weaker when agency problems are reduced via a more effective monitoring, which may be achieved via a more a larger blockholder ownership. The discussion above lead us to hypothesize that:

H1. *Firms with younger CEOs show higher rates of organic growth, even conditional on risk-taking.*

H2. *The negative relation between CEO age and firm organic growth is weaker in firms with larger blockholder ownership.*

3. Data and descriptive analysis

In this paper we rely on a unique source of data which results from merging Bureau Van Dijk (BvD)'s Amadeus with the EU-EFIGE/Bruegel-UniCredit dataset (in short, EFIGE). Amadeus is a well-known and widely used source of economic and financial information on European companies. For the purpose of this paper we were able to gather data on the period that goes from 2001 to 2014. EFIGE is the result of a survey administered within the project *European Firms in a Global Economy: internal policies for external competitiveness*, which was supported by the Directorate General Research of the European Commission through its Seventh Framework Programme¹⁰. EFIGE, for the first time in Europe, combines measures of firms' international activities (e.g. exports, imports) with quantitative and qualitative information on about 150 items ranging from R&D and innovation, labor organization, financing and organizational activities. Data consist of a representative sample (at the country level for the manufacturing industry) of almost 15,000 surveyed firms (above 10 employees) in seven European economies (Germany, France, Italy, Spain, United Kingdom, Austria, and Hungary). Data were collected in 2010, and most questions refer to the year of activity 2008. In some cases, respondents (i.e. individuals who were occupying a leading position in their firms) were asked about the activities of their firms during the years from 2007 to 2009. Considering that the information on the age of the CEO is available for the year 2009, we will use the average firm growth in the period 2009-2014 as our dependent variable. Starting from the information available in Amadeus, we calculate the growth rate per unit of time:

$$\overline{gr}_{i,2009-2014} = \frac{\ln(SIZE_{i,2014}) - \ln(SIZE_{i,2008})}{6} \quad (1)$$

¹⁰ More information on the EFIGE project and survey are available at <http://bruegel.org/publications/datasets/efige/> and in Altomonte et al. (2012).

where $SIZE_{i,t}$ is equal to the operating revenues (sales) of the firm i at the end of year t .¹¹ This approach is better suited to analyze medium-run growth profiles of firms, which are more likely to be the results of CEOs' strategies and less affected by noise and measurement errors, which instead can be more severe if one considers yearly growth rates (Pieri, 2018). However, growth rates over longer periods, such as our 6-year period, may be more prone to the fallacy of not capturing a change (turnover) in CEO, which we cannot directly control in our data. To partially cope with this issue, we will replicate our analysis over shorter periods of time (see Section 4.2.1 and Table 6 for a discussion about this issue). It is worth mentioning that the information on sales growth derives from unconsolidated accounts, which excludes growth through M&As, hence accurately reflecting organic growth. Since not all data are available over the 2009-2014 period, our sample is effectively reduced to about 7,200 firms.¹²

The EFIGE survey provides the information on the age of the CEO into a categorical variable with seven items (< 25 years old; 25-34; 35-44; 45-54; 55-64; 65-74; >= 75). The frequency distribution of our sample firms across these CEO age bins is shown in Figure 1.

[Insert Figure 1 about here]

The histogram shows that the modal value of CEO age corresponds to the category 45-54 years old. While it is impossible to have a precise figure for the median and mean age of CEOs in our sample, an inspection of Figure 1 suggests that it could be slightly above 50, which is in line with the evidence provided by other academic works and scientific reports¹³. For example, Faccio et al. (2016) report a mean (median) age of 50.3 (51) for the CEOs of the firms included in their analysis, while in the sample of firms used in Li et al. (2017) the mean age of CEOs is at 53.6 and in Belenzon et al. (2019) is 50.6.

In order to clearly separate young from old CEOs, and in line with previous works on the role of CEO for firms' strategies, we group the seven categories into two macro-categories: CEOs younger

¹¹ We re-run the main empirical model by using the value of total assets at the end of the year as proxy for firm size and the main results are confirmed. We cross-referred the reader to Table 16.

¹² The reader is cross-referred to Tables A.1 and A.2. Admittedly, while a change in the sample composition takes place with respect to the countries considered (by moving from the Amadeus/EFIGE sample, i.e. the starting-point, to the one used in Table 1 and col.1 of Table 3), the same seems not to hold with respect industry composition and CEO age composition, being the last characteristic the most relevant to our analysis.

¹³ The average age of the CEOs of S&P 500 companies in 2016 was 58, but the age heterogeneity in the sample was staggering. While the CEOs of some successful companies, such as Facebook, Electronic Arts and Yahoo were about 40 years old or younger, others were well in their 70s, such as the CEOs of M&T Bank, Ralph Lauren Corp and FedEx Corp (World Economic Forum, 2016; Schloetzer et al., 2017). This heterogeneity is not just common among large enterprises, but it is a feature also of smaller, often unlisted companies that are active across different industries and countries.

than 45 versus the rest.¹⁴ While about 76% of our sample firms are managed by CEOs who are 45 or older, the share of CEOs younger than 45 is not negligible (24%).¹⁵

The EFIGE survey allows us to control for a number of firm and CEO characteristics that could confound the relationship between firm growth and CEO age, thus limiting the omitted variable bias issue. In particular, we have information on firm age (based on the year of establishment), which is typically associated with firm growth (Barba Navaretti et al., 2014). We also control for the propensity to innovate (Geroski, 1999) and the degree of internationalization (Serra et al., 2012), which are typically associated with risk-taking, hence they could result in higher firm growth. Moreover, we can take into account if the firm has gone through any form of quality certification and if it has widened its product range, as strategies for building a customer base (Foster et al. 2016). We also control for several proxies of economic and financial characteristics of the firm, such as such as firm size (Hall et al., 1987; Lotti et al. 2009), profitability (Coad, 2007), debt to assets ratio and past sales growth rate, all calculated from BvD's Amadeus over the period 2001-2008. As for CEOs, we can control for a number of characteristics associated with their risk-tolerance (including their gender and international experience) and over-confidence. In fact, young CEOs may be more over-confident than their older counterparts (Citci and Inci, 2016): overconfident CEOs systematically overestimate their ability to create value and, in case of abundant internal financing, tend to overinvest (Malmendier and Tate, 2005; 2008).¹⁶ A detailed description of the variables used in the empirical model is contained in Table 2.

Table 1 provides some summary statistics on the sales growth rates in the period 2009-2014.¹⁷

[Insert Table 1 about here]

Keeping in mind that the period from 2009 to 2014 embraces the years of Great Recession, which hit the European economies hard, it is not surprising that, as shown in Panel A, both the average and the

¹⁴ However, we will relax this assumption to allow for a different threshold and for possible non-linear effect of CEO age on firm growth as a robustness check. The reader is cross-referred to section 4.2.4 and Table 12.

¹⁵ Significant cross-country heterogeneity is found in the distribution of CEOs by age class. We cross-refer the reader to Section 4.2.7, Table 15 and Table A.2 in the online Appendix, for more information on this evidence.

¹⁶ Younger CEOs may be characterized by more stamina, better cognitive abilities, such as efficiency and effectiveness of information processing (i.e. speed, reasoning and memory), which may well be related to both the ability of the CEO to capture growth opportunities and (inversely) their age (Child, 1974). Due to the nature of our data, we are not able to control for some age-related CEO characteristics such as stamina and cognitive abilities. Nonetheless, we submit that if the association between CEO age and firm growth was driven by these peculiar individual characteristics of younger CEOs - instead of a specific set of incentives - there would be no obvious reason as to why it should be moderated by the effectiveness of large shareholders' monitoring.

¹⁷ We acknowledge a significant drop in the number of firms with respect to those in Figure 1. This is due the lower number of firms for which information on operating revenues (sales) are available in the BvD's Amadeus-EFIGE database with respect to the starting-point sample. As anticipated in footnote 10, changes in sample composition are mainly related to countries coverage, and not to industries coverage, nor to CEO age categories composition. See Table A.1 and A.2 in the on-line Appendix.

median sales growth rate have been negative (about -3.1% and -0.8%, respectively). In line with our expectations, the average and median firm managed by a CEO younger than 45 has experienced negative growth rate, but lower (in absolute value) than the average and median firm managed by an older CEO. In order to take possible differences across industries and countries into account, we also have computed the average growth rates adjusted by industry (2-digit NACE rev.2), country and year¹⁸: these are shown in Panel B of Table 1. The median growth rate of the group of firms managed by CEO younger than 45 is around 0.7 percentage point higher than the median growth rate of the group of firms managed by CEOs who are 45 or older. This difference is statistically significant as shown in the bottom panel of Table 1 (as per the p-value associated with the Wilcoxon; Mann-Whitney test). Moreover, the lower (in absolute value) skewness of the growth rates distribution for the firms managed by CEO younger than 45 points at fewer episodes of heavy size contraction for this group of firms in the period 2009-2014. Figure 2 confirms these results.

[Insert Figure 2 about here]

The distribution of sales growth rates for the firms managed by younger CEOs (grey line) shows not only a higher median but also a higher number of episodes of positive and fast growth and fewer episodes of heavy and negative growth (contraction) than the distribution of growth rates of firms managed by CEOs who are 45 or older. It is relevant to underline that the distribution of growth rates is not normal, while better approximated by a Laplace (symmetric exponential) distribution (Bottazzi et al. 2001; Bottazzi and Secchi, 2006). The characteristic tent-shape of these distribution points out the existence of “fat tails”, i.e. the higher incidence of episodes of fast growth and heavy contraction with respect to what a Gaussian (normal) distribution would predict.¹⁹ The presence of “fat tails” justifies two choices made in the econometric analysis. First, the adoption of *least absolute deviations* (LAD) estimator instead of the more common *ordinary least squares* (OLS) to get insights into the central tendency growth rate of firms managed by CEOs of different ages. Indeed, the first estimator is more robust in the case of non-Gaussian distribution of the dependent variable (Wooldridge, 2010), like the one of sales growth rate. Second, the attention paid to differences in growth between firms managed by CEOs of different ages, which may especially be located in the tails of the distribution: to uncover them we will use a generalization of LAD estimator, i.e. quantile regressions.

¹⁸ Adjusting growth rates by industry, country and year is a standard practice also to remove common trends, such as inflation and business cycles effects (see Bianchini et al. 2017, among others) which may vary across countries and industries. In practice, we subtract the average value of sales by country, industry and year to firm sales and then compute growth rates on these adjusted values.

¹⁹ The reader is cross-referred to the on-line Appendix A.1 for a graphical analysis of the distribution of growth rates of the European manufacturing firms in the sample.

Table 2 shows some descriptive statistics regarding firms' and CEOs' characteristics of the European manufacturing firms contained in the Amadeus-EFIGE database.

[Insert Table 2 about here]

Firms managed by younger and older CEOs are different in several dimensions and the last column of Table 2 confirms that these differences are, most of the times, statistically significant. The median firm managed by a young CEO in our sample is smaller, younger, more profitable and indebted than its counterpart run by an older CEO, and it was more likely to have introduced process innovations, while being less internationalized (in terms of number of market served via exports). Moreover, a higher share of females is observed among younger CEOs, who are also found to be more overconfident. Finally, firms managed by young CEOs grew more than their counterparts did in the period 2001-2008. Being the two groups of firms different in several dimensions we will conduct a multivariate analysis, controlling for firms' and CEOs' characteristics which may be well correlated with both CEO age and firm organic growth.²⁰

²⁰ To avoid that linear controls used throughout the empirical models do not adequately account for differences between firms with young and old CEOs, we also have performed a propensity score matched (PSM) sample analysis: the reader is cross-referred to Section 4.2.2 and Tables 7, 8 and 9 for further details and results of the PSM analysis.

4. Econometric analysis

4.1 Baseline estimates

Our baseline empirical model is a cross-sectional regression model of firm growth rates calculated over a 6-year period of time as a function of CEO's and firm's characteristics at the beginning of the period, and it may be written as:

$$\bar{g}r_{i,2009-2014} = \alpha_\theta + \beta_\theta CEO (< 45 \text{ y.o.})_{i,2009} + \gamma'_{1\theta} \bar{Z}_{i,2001-2008} + \gamma'_{2\theta} W_{i,2008} + \mu_{\theta j} \cdot \tau_{\theta c} + \varepsilon_{\theta i,2009-2014} \quad (2)$$

$\bar{g}r_{i,2009-2014}$ is the average growth rate of the firm i in the period 2009-2014, $CEO (< 45 \text{ y.o.})_{i,2009}$ is a dummy variable taking value 1 if the CEO is younger than 45 years old and 0 otherwise. The vector $\bar{Z}_{i,2001-2008}$ contains proxies (calculated as averages of the period 2001-2008) for relevant characteristics of firm i , which may well be related to both CEO age and firm growth, i.e., firm size, firm age, firm profitability, debt to assets ratio.²¹ The vector $W_{i,2008}$ contains proxies of both firm and CEO/executives characteristics obtained from the EFIGE survey, which mostly refers to 2008. Variables included in the $\bar{Z}_{i,2001-2008}$ and $W_{i,2008}$ vectors have been described in Section 3. In all the specifications, we include a vector of country-industry (indicated by the subscripts c and j , respectively) fixed effects, where manufacturing industries are defined at the 2-digit NACE rev.2 level of classification²² in order to control for systematic differences in firm growth and CEO age across countries and industries. We also report the heteroskedastic robust standard errors (as suggested by Machado et al. 2011) in parentheses²³.

As motivated in Section 3.1, we employ the quantile regression estimator (Koenker and Bassett, 1978), which is the vector of parameters δ that solves the following operation:²⁴

$$\min_{\delta} \frac{1}{n} \left\{ \sum_{i: \bar{g}r_{i,2009-2014} \geq \delta' X_i} \theta |\bar{g}r_{i,2009-2014} - \delta' X_i| + \sum_{i: \bar{g}r_{i,2009-2014} < \delta' X_i} (1 - \theta) |\bar{g}r_{i,2009-2014} - \delta' X_i| \right\}, \quad (3)$$

where, for notational simplicity, we denote the vector of “right-hand-side” variables in Eq.2 as X_i and the respective vector of parameters to be estimated as δ . For the time being, we will focus on $\theta=0.5$, i.e. the conditional median, or what is also referred to as LAD estimator, but slope parameters

²¹ While the dependent variable has been calculated by means of the growth rate per unit of time over the period 2009-2014 (as shown in Eq. 1), all control variables built from BvD's Amadeus have been calculated as averages of available yearly information during the period 2001-2008, in order to minimize the impact of yearly missing information.

²² We cross-refer the reader to Table A.1 in the on-line Appendix, for the taxonomy of manufacturing industries considered in the empirical analysis.

²³ Quantile regressions with heteroskedastic-robust standard errors have been estimated by using the Stata package `qreg2` written by J. A. F. Machado, P. M. D. C Parente and J. M. C. Santos Silva.

²⁴ Eq.3 is the objective function and is an asymmetric linear loss function. θ is the quantile defined as $Q_\theta(\bar{g}r_{i,2009-2014}|X_i) \equiv \inf\{\bar{g}r_{i,2009-2014} : F(\bar{g}r_{i,2009-2014}|X_i) \geq \theta\}$, in which $0 < \theta < 1$ and $\bar{g}r_{i,2009-2014}$ is a sample from a random variable with a conditional distribution function $F(\cdot | X_i)$.

may vary at different quantiles of the conditional growth rate distribution. This is particularly relevant for us, given the interest in assessing the role of CEO age in organic growth across the entire spectrum of growth rates, and because, as Figure 2 shows, there could be differences in growth rates among firms managed by CEOs of different ages in the tails of the distribution.

Table 3 shows the estimates for Eq.2 by means of LAD. In col. (1), we introduce only our main explanatory variable together with the vector country-industry dummies. From col. (2) to col. (8), we add the other firm characteristics in a “hierarchical” fashion, being the specification contained in col. (8) the most complete one. Once controlled for a large set of firm characteristics, the median growth rate of firms managed by a CEO younger than 45 is around 0.7 percentage point higher than the median growth rate of firms managed by an older CEO, on average in the period 2009-2014. The magnitude of this coefficient is stable across specifications.

[Insert Table 3 about here]

As for the coefficients associated with the control variables, it is worth mentioning that firm size and firm age show the expected negative sign, i.e. younger and smaller firms have grown more than their older and larger counterparts in the period 2009-2014 (see Haltiwanger et al. 2013; Barba Navaretti et al. 2014; among others). Most notably, since smaller and younger firms are more likely to appoint younger CEOs, in column (2) we notice that when controlling for firm size and age, the coefficient on CEO age drops slightly. However, our results show that if we compare two firms of the same size and age, the firm with a CEO younger than 45 will have 0.59 percentage point higher sales growth. While debt to assets ratio is never significant in explaining the growth of the median firm in the sample, more profitable firms (higher ROE) show higher median growth rates. This result may be concurrently explained by models that analyze the role of financing constraint for firms’ investment (Fazzari et al. 1988), and by the evolutionary models of “growth of the fitter” (Coad, 2007). *Ceteris paribus*, more innovative (especially in terms of process innovation) and internationalized firms (in terms of both the number of countries to which a firm exports and the status of importer) have grown faster in the period 2009-2014 (see Coad and Rao, 2008; Grazzi and Moschella, 2018; among others). Finally, while the share of graduate workers is not associated with higher average growth, both quality certification and product range widening strategies actually are.

As discussed in Section 2, CEO age may be picking up other characteristics of the top executive, which may be associated with higher firm growth. Thus, to limit any omitted variable bias problem, we enrich our baseline empirical model with a vector of CEO characteristics observed at the beginning of the period. In particular, we include the information on CEO gender and proxies of risk-tolerance, over-confidence, and international experience. Table 4 shows that while over-confidence

is positively correlated with average firm growth, risk-tolerance and CEO gender are not, and the international experience of the executives is only marginally significant. At the same time, while a small decrease in the CEO age coefficient is appreciable, still the median growth rate of firms managed by a CEO younger than 45 is around 0.66 percentage point higher than the median growth rate of firms managed by an older CEO.

[Insert Table 4 about here]

These results support the view that organic growth is the outcome of investing in high-growth segments of activity, creating new products, services and business models (Ahuja et al., 2017). These results are also consistent with the idea that younger CEOs may not necessarily boost organic growth because of their higher risk-tolerance. Indeed, the propensity not to hedge against exchange rate risk, which is our proxy for CEOs' risk-tolerance is not significantly associated with firm growth, and the same holds for variables that are traditionally associated with more risk-taking, such as CEO gender (male) and the international experience of the executives. Among the CEO characteristics, our proxy for over-confidence is the only one that is significantly associated with higher firm growth. However, overconfidence is not necessarily associated to higher risk-taking (Malmendier and Tate, 2005; 2008).

Overall, from these first set of econometric results, we have evidence that CEO age is negatively correlated with organic growth in the period 2009-2014. In line with Hp. 1, we submit that younger CEOs may have an incentive to boost organic growth not necessarily by taking more risks, but by lowering the firm's margins, hence gaining market shares. This will provide a signal to the market about the value of the CEO (*managerial signaling*) and provide a justification for an increase in compensation due to the higher complexity associated with managing a larger company (*compensation incentive*). At the same time, since firm growth may happen at the expenses of profitability, this can create a wedge between the CEO and the shareholders' incentives.

When the quantile regression estimator in Eq.3 is applied at different conditional percentiles (p10, p25, p50, p75, p90) of the sales growth rate distribution, we uncover that the relationship is statistically relevant for episode of positive growth (either mild or fast), while it is not significant for episode of firm contraction (Table 5).

[Insert Table 5 about here]

This result may be explained by CEO compensation being sensitive to episodes of firm expansion while not to episodes of firm contraction (Bebchuck and Grinstein, 2005). Moreover, the effect is stronger at the highest percentiles (p90) of the right tail of the distribution, i.e. for episodes of fast/big expansion. This result is coherent with the results shown by Yim (2013) on the negative relationship

between CEO age and acquisitions, which the author found significant only for episodes of relevant acquisitions (i.e. deal value exceeding 5% of the firm's market capitalization, which would more likely affect CEOs' compensation).

In Section 4.2, we conduct a battery of robustness checks and explore: (i) different time horizons over which the growth rate is calculated, to lessen the issue related to a possible (unobserved) turnover of the CEO; (ii) a possible reverse-causality bias, due to firms with certain characteristics and growth trajectories which choose a young CEO; (iii) the survival-bias issue; (iv) the robustness of the 45 years old threshold and a possible non-linearity in the relationship between CEO age and firm growth; (v) the role of CEO tenure; (vi) the confounding effect of M&As; (vii) the existence of country specificities in the relationship between CEO age and firm growth.

In Section 4.3, we inquire, through the lens of a P-A framework, into the possible mechanisms that enhance or moderate the relationship between CEO age and organic growth.

4.2 Robustness checks

4.2.1 Testing for a shorter time horizon and CEO turnover

As we have discussed in Section 3, our baseline specification looks at firm organic growth over a six-year period after the age of the CEO is observed. Ideally, we would want to know the age of the CEO at the time of appointment and track firm growth thereafter, but the structure of data does not allow us to undertake this empirical strategy. The choice of measuring growth over a medium-run span of time is motivated by the fact that (i) we aim at lessening the role of noise and measurement errors in our measure of growth (Pieri, 2018) and (ii) growth will be more likely the direct consequence of CEOs' strategies. However, the cross-sectional nature of the information on CEO age (retrieved from EFIGE) does not allow us to exclude that the CEO has changed at some point over the period 2009-2014: consequently, the growth of the firm may not be attributable to the CEO whose age we observe in 2009.

To alleviate this concern, we run a regression in which the dependent variable is the average annual growth rate computed over a shorter period, i.e. 2009-2011. Indeed, by considering that previous studies have provided evidence of a yearly CEO turnover between 7 and 9 percent for privately held and relatively small firms (Lel et al., 2014; Gao et al., 2017), we face a smaller chance of CEO turnover over this shorter time horizon.

Results in Table 6 are broadly in line with our baseline estimates (Table 4) and thus do not suggest any systematic difference the probability of CEO turnover across CEO age categories, that would eventually bias our estimates.

[Insert Table 6 about here]

The conditional median growth is 0.5 percentage points higher in firms managed by young CEOs, although imprecisely estimated. The difference at 90th percentile is magnified when we look at growth over a shorter period (2.25 percentage points).

Even if we cannot completely disregard that (unobserved) CEO turnover may bias our results, we submit that this should not be a major concern for our analysis, for two orders of reasons. First, one issue for our analysis may come from non-random factors affecting the probability of CEO turnover across CEO age categories (conditional on observables, $\bar{Z}_{i,2001-2008}$ and $W_{i,2008}$). In this perspective, the evidence of a systematic relation between CEO age and CEO turnover (once controlled for other CEO and firm characteristics) is mixed and several studies do not find support for it (see Lausten, 2002; Brunello et al. 2003; Kato and Long, 2006; among others). Second, at each turnover episode one of these four transitions may occur: (i) young (Y) $\rightarrow$ Y, (ii) Y $\rightarrow$ old (O), (iii) O $\rightarrow$ Y and (iv) O $\rightarrow$ O. Being interested in the firm and not in the firm-CEO pair, if (i) and (iv) happen during the considered time-period, these episodes would not affect our main result. Transitions (ii) and (iii) may instead be more problematic for our analysis. The problem would rest on the fact that we would observe that either firms managed by younger CEOs grow faster, but in fact the CEO driving the growth would be an older CEO (ii); or firms managed by an older CEO grow less, but in fact the CEO was a younger one (iii). We expect case (ii) not to be frequent, given most of the theoretical and empirical works discussed in Section 2. Transition (iii), i.e. old CEOs are substituted by young CEOs, who systematically make their firm grow less, may happen –among other things—because of a more difficult assessment of the quality of CEOs among the youngest (less years of observation in the market). However, to the same extent, old CEOs may be substituted by talented young CEOs and there are no solid reasons to think that one possibility may dominate the other.

Overall, the use of a shorter time horizon may help us in partially mitigating the problems related to the (unobserved) CEO turnover. At the same time, by shortening the time horizon, the number of observations increases from 5,613 to 6,654, since we have information on the growth rate per unit of time over the period 2009-2011 for a larger number of firms. This is also related to a higher survival rate over the shorter period: we will explicitly consider this issue in Section 4.2.3.

4.2.2 Testing for reverse causality: matched sample analysis and controlling for past growth

One important concern is that there may be some selection effect so that younger CEOs are appointed in firms with certain characteristics (Joos, et al. 2003; Allgood and Farrell, 2003), so we need to account for possible reverse causality issues. The lack of a longitudinal dimension in the age of CEO

and the impossibility to ascertain growth before and after appointing a young CEO do not allow us to provide a definitive answer to this issue, but we can certainly provide some reassuring arguments.

In particular, we can (i) implement a propensity score matched (PSM) sample estimation (Rosenbaum and Rubin, 1983) and (ii) control for the past growth of the firm in the baseline specification.

In Tables 7, 8 and 9 we implement a PSM sample estimator. The idea is to identify a control group of firms that are run by an older CEO but that are not different --in terms of their observable characteristics-- with respect to the firms run by their younger counterparts. To this end, in Table 7 we first estimate a probit model where the dependent variable is a dummy equal to one for firms managed by a CEO younger than 45, and zero otherwise. We enrich the set of determinants at the firm-level with a vector of territorial units at sub-national level. Indeed, works on the geography of managerial supply (Fee et al., 2013; Yonker, 2017) have shown that top executives join firms that are geographically located in close territories and that the pool among which firms choose depends on some characteristics of the location, which are exogenous to the firm's specific choice of a CEO.²⁵ In line with Fee et al. (2013), who adopt a 100-mile radius to define the area in which the firm is located, we use NUTS 3²⁶ units as the geographical level of aggregation for the location of the firm's headquarters. Consistently with the descriptive statistics presented in Table 2, the selection probit in Table 7 shows that firms managed by younger CEOs had grown faster over the 2001-2008 period, are smaller and younger, more indebted and tend to introduce more process innovation than their counterparts. The other differences that are observable in Table 2 are not robust to the multivariate analysis.

In Table 8 we show that, indeed, a one-to-one nearest neighbor matching -- obtained after the estimation shown in Table 7-- delivers a sample of firms with CEO older than 45, but similar in virtually all observable characteristics to those managed by CEOs younger than 45. Most notably, firms in the matched sample are not different even in characteristics that have not been used to compute the propensity score, such as labor productivity, the ratio of cash-flow to total assets, being

²⁵ The argument here is that the “thinness” of the pool of potential CEOs (in terms of their personal characteristics) may vary across sub-national territories. “Larger” pools of potential CEOs (which, in our case, may relate to a higher availability of young CEOs), may be typical of locations with specific features, such as certain climate properties (the proportion of sunny versus cloudy days in a year) or agglomeration economies (typically higher in more dense --in terms of population-- areas). In a cross-sectional setting like ours, these features are best captured by a vector of dummies identifying relatively granular levels of geographies.

²⁶ Nomenclature of Units for Territorial Statistics (NUTS) indicates a hierarchical classification of administrative areas used by the European statistical office (Eurostat). NUTS levels (1–3) indicate different degrees of aggregation. The Amadeus-EFIGE database employs the NUTS 2010 classification. More information on the classification can be retrieved from: <https://ec.europa.eu/eurostat/web/nuts/background>

listed in the stock exchange or having engaged in acquisitions. Some differences remain in terms of the gender of the CEO.

[Insert Tables 7, 8 and 9 about here]

Once we have identified the firms in the matched sample, we run our quantile regression model on the matched sample. Results, presented in Table 9, are in line with our baseline results (Table 4).²⁷

Finally, in Table 10, we show that while firm organic growth in the period 2009-2014 is clearly correlated with past growth (i.e., over the period 2001-2008), the difference in growth between firms managed by young and old CEOs is only marginally reduced when we control for past growth.

[Insert Table 10 about here]

4.2.3 Testing for survival bias

A possible survival bias due to firms that exit the market may affect our main results. Indeed, if a positive correlation exists between the probability of exiting the market and that of being managed by a young CEO, we may have an upward biased estimate the coefficient of the *CEO* ($< 45 \text{ y. o.}$)_{*i*,2009} variable, if we only consider the surviving (and fastest growing) firms among those managed by young CEOs. This constitutes the selection (survival) bias. In general terms (see Lotti et al. 2009; among others), the problem we face may be written as:

$$\begin{cases} Pr(\chi_i = 1) = \Phi(\alpha' z_i) & (4) \\ \overline{gr}_{i,2009-2014} = \delta' X_i + \varepsilon_i, \text{ observed only if } \chi_i = 1 & (5) \end{cases}$$

Eq.4 is the survival equation, χ_i is an indicator variable that takes value equal to one if the firm is still observed in 2014, and zero otherwise, Φ is the cumulative density function of the Normal distribution, z_i is the vector of determinants of firm survival and Eq.5 is the growth equation (as previously specified).

To deal with this issue, we have implemented a 2-step procedure *à la* Heckman (1979). First, in order to estimate Eq.4, episodes of firm survival have been identified as the spells in firms' sales without interruptions (missing values) over the period 2008-2014; conversely, episodes of firm exit have been identified as the spells in firms' sales that start in 2008 but finish before 2014.²⁸ This allows

²⁷ Based on the same reasoning, we have also estimated a specification in which we directly include NUTS 3 dummies in Eq. 2: the coefficient of the *CEO* ($< 45 \text{ y. o.}$)_{*i*,2009} dummy slightly decreases in terms of magnitude (from 0.0066 in Table 4 --which constitutes our baseline result-- to 0.0061), but it is still significant at conventional levels. Results are available from authors upon request.

²⁸ Admittedly, we deduce exits from the spells of sales in the Amadeus database, while we do not properly observe exits from the market: indeed Amadeus contains the legal status of the firm at 2014, i.e. "active" in the market or not, but this does not allow us to account properly for episodes of exiting the market. Indeed, firms may take a huge variety of

us to build a binary variable, which takes value equal to one if a firm has “survived” through the 6-year period, and zero if it has “exited” between 2009 and 2014: this is the dependent variable of the probit model that we use to estimate the survival equation. Second, to precisely identify the δ' coefficients in the growth equation, X_i has to be a strict sub-set of z_i (Wooldridge, 2010) and three exclusion restrictions have been included in the survival equation (at the beginning of the period, 2008), namely labor productivity (defined as the ratio between a firm’s value added and total employees – end of the year; Dosi, 2012), the ratio of cash flow to total assets (as a rough proxy for a firm’s degree of liquidity; Arrighetti et al. 2016) and their interaction. Third, after having estimated the probit/survival model, the inverse Mills’s ratio $\lambda_i = \frac{\varphi(\alpha'z_i)}{\Phi(\alpha'z_i)}$ is obtained for each observation and included in Eq. 5 in order to account for the selection bias, where φ is the probability density function of the Normal distribution. In col. (1) of Table 11, we estimate the probit model that we use to recover the inverse Mills’s ratio.

[Insert Table 11 about here]

In cols. (2), (3) and (4), a quantile regression of Eq.5 is performed at different percentiles (p50, p75 and p90) of the conditional growth rate distribution, adding the inverse Mills’s ratio to the growth model. Results highlight that firm survival is indeed associated with different firm and CEO characteristics with respect to firm growth: firm size and age are positively associated with survival (Bartelsman et al., 2005), but negatively associated with growth. Instead, firms with younger CEOs do not exhibit a higher probability of survival but they grow significantly faster, even after controlling for any survival bias through the inclusion of the inverse Mills’s ratio. The magnitude of the coefficient associated with CEO age remain largely unchanged after having controlled for the survival bias.

4.2.4 Testing for different age threshold and non-linear effects of CEO age

Our baseline specification (Eq.2) collapses all the information on CEO age into a dummy variable, taking value one for firms whose CEO is younger than 45. The choice of this threshold, while in line with previous literature, can also be deemed arbitrary. Moreover, it does not allow for non-linearity in the relation. We address this issue by including a second dummy variable, which takes value one if the CEO is between 45 and 54 years old. Results in Table 12 reveal that the 50th, 75th and 90th percentile of the growth rate distribution of firms with a CEO younger than 45 are significantly higher

typologies of inactivity whose length vary –among other things– on national regulations. Typologies of inactivity statuses are “bankruptcy”, “dissolved (demerger)”, “dissolved (merger or take-over)”, “in liquidation”, “inactive (no precision)”.

than the corresponding percentiles of the growth rate distribution of firms managed by a CEO who is 55 or older (baseline).

[Insert Table 12 about here]

Conversely, the growth rate of firms managed by CEOs between 45 and 54 is not different from the baseline, across the entire distribution (except for the 90th percentile, which is slightly higher, but rather imprecisely measured). Moreover, equality in the coefficients of the two categories of CEOs is rejected at the 50th, 75th and 90th percentiles. These results support the choice of a “45 years old threshold” and reject any non-linearity in the relation between CEO age and firm organic growth.

4.2.5 Testing for the role of CEO tenure and firm age

One concern with our baseline specification is that CEO age could conflate both the role of demographics and of tenure. In fact, due to the lack of data on the number of years since appointment, it is likely that younger CEOs are also those with less tenure in the job. Since growth and contraction strategies tend to be pursued in the first years of tenure (Pan et al. 2016), we may wrongly attribute firm growth to CEOs’ age, while it should be attributed to their tenure. We address this issue by running the LAD regression on the sub-sample of firms established within the last 5 and 10 years before 2009. In this way, we are censoring the extent of tenure that CEOs can accrue. Incidentally, this also allows one to highlight better the role of CEO age as separate from the age of the firm. Results, shown in Table 13, are broadly consistent with our baseline specification, showing that firms managed by younger CEOs grow faster, especially at higher percentiles.

[Insert Table 13 about here]

In the sub-sample of firms that were born in the 5 years preceding 2009, the 90th percentile of the growth distribution of firms managed by a CEO younger than 45 is 3.92 percentage points higher than the 90th percentile for firms managed by old CEOs. Since the samples are much smaller, the coefficients tend to be less precisely estimated.

It is worth mentioning that results hold also in the complementary sample of relatively older firms (lower left and right panels of Table 13). In particular, coefficients are smaller in magnitude, but more precisely estimated, probably thanks to the larger sample size. Overall, the positive association between younger CEO and firm growth does not seem to be due to CEO tenure, nor to be a specific feature of young firms.

4.2.6 Excluding firms that have been involved in M&As

Finally, since this paper is about organic growth, we need to avoid any confounding effect on firm's growth in sales due to any M&A. This is a relatively minor concern, since our sales data are based on unconsolidated accounts, so that any M&A that would add a new legal unit to the company group would be reflected in consolidated turnover, but not on the unconsolidated one. However, we exploit some qualitative information contained in the EFIGE survey to provide further reassurance on this issue. In particular, we exclude from the sample firms that have declared to have acquired (totally or partially) or incorporated other firms in the three years prior to the date of the survey (2007-2009).

[Insert Table 14 about here]

Results, shown in Table 14, reveal that the sample drops to 5124 firms, implying that 489 firms had been involved in M&As, but excluding these firms do not affect our baseline estimates, which indeed are even slightly larger in magnitude.

4.2.7 Country specificities

One of the key features of the data used in this paper is that they allow a cross-country comparison of a firm-level relationship. In other words, they enable us to combine detailed firm and CEO-level information derived from a survey on a sample of firms representative of a population of small, medium and large firms, without the typical shortcoming of firm-level survey data that are administered in a single country, hence subject to country specificity. In our case, one may argue that differences in culture and institutions across EU countries may associate with the different attitudes of younger CEOs across countries. For example, in one country, being younger than 45 could be “young and reckless” while in another, it could be “old and conservative”. In order to account for the potential country-specificities of the relation we are studying, we estimate country-by-country regressions for France, Italy and Spain, which are the countries with the largest number of observations (accounting for 90% of the overall sample) and where relatively more precise estimates can be obtained.

[Insert Table 15 about here]

Results from the country-by-country regressions are presented in Table 15 and broadly confirm that the association between CEO age and firm growth is relatively stable across countries. Clearly, the coefficient estimates associated with the CEO being 45 or younger tends to be less precisely estimated, but the magnitudes are comparable across countries.

4.3 Identifying the mechanism in a P-A framework

In Section 2 we have highlighted that the higher growth achieved by firms managed by younger CEOs could be the result of a specific set of incentives of the top managers, which may diverge from shareholders' targets. In particular, we have argued that younger CEOs may have an incentive to boost firm growth both to signal their talent and to increase their compensation. However, shareholders are normally more interested in profit maximization, rather in the growth of sales and market share. In Table 16 we provide evidence of this potential divergence of interests. In fact, while firms managed by younger CEOs show higher growth of total assets (panel A), they do not show any difference in the growth of operating profits.

[Insert Table 16 about here]

This suggests that strategies pursued by younger CEOs may put a wedge between their own targets and the interests of their shareholders. As we discussed in Section 2, this divergence should be moderated by the ability of shareholders to monitor CEOs' decisions. It is established in the literature that in firms with more concentrated ownership shareholders are able to monitor CEOs more effectively, so we use this to test the arguments that led to Hp. 2. In Table 17 and 18 we estimate two variants of Eq. 6 below:

$$\overline{gr}_i = \alpha_\theta + \beta_\theta CEO (< 45 y. o.)_i + \eta_\theta OWN_i + \omega_\theta OWN_i * CEO (< 45 y. o.)_i + \delta' X_i + \mu_{\theta j} \cdot \tau_{\theta c} + \varepsilon_{\theta i} \quad (6)$$

where OWN_i is a measure of ownership concentration. Notation has been simplified by dropping indication of time periods and control variables have been collapsed in the vector X_i .

[Insert Table 17 about here]

In the first variant of Eq. 6 (Table 17), we interact the CEO age dummy with a dummy which takes value equal to one for firms where the first shareholder owns 50% or more of the firm's equity and zero otherwise. Results show that this interaction indeed negatively moderates the effect of CEO age on firm growth, although the coefficient is significantly different from zero only at the 90th percentile. At the 90th percentile firms with relatively more dispersed ownership and young CEOs grow faster than their counterparts with young CEOs but more concentrated shareholders ($H_0: \eta_\theta + \omega_\theta = 0$, rejected). This suggest that concentrated ownership curbs the incentives of young CEOs to achieve more growth in firm size. Symmetrically, no difference in growth is found between firms with younger or older CEOs if the ownership is concentrated ($H_0: \beta_\theta + \omega_\theta = 0$, not rejected).

[Insert Table 18 about here]

In Table 18, we estimate a variant of Eq. 6, where the measure of ownership concentration is continuous. In particular, we simply introduce in the regression the share of equity owned by the first (largest) shareholder. Results indicate that, at the 90th percentile, the degree of ownership concentration negatively moderate the effect of CEO age on firm growth. In robustness checks, available upon request, we run our baseline specification on two subsamples of firms, based on whether the first shareholder owns more or less than 50% of the equity. Results show that in the sample of firms with more concentrated ownership those with younger CEOs grow faster than those with CEO older than 45 and this difference is statistically significant at the 75th and 90th percentile. However, the magnitude of the coefficients is smaller than in the sub-sample of firms with less concentrated ownership, thus confirming the moderating role of monitoring, made easier by more concentrated ownership. Finally, it is worth mentioning that our results are qualitatively similar when we use growth in total assets rather in total sales.

5. Concluding remarks

We show that the age of CEOs is significantly associated with firm organic growth. In a large sample of mostly privately held European manufacturing firms which covers a vast array of industries and gather small, medium and large enterprises, we find that the median annual growth in sales (and total assets) over the 2009-2014 period has been 0.66 (0.52) percentage point higher in firms managed by a CEO younger than 45. This difference is twice as large if observed at the 90th percentile, suggesting that firms with younger CEOs are more likely to be very fast-growing firms. Our results are robust to the inclusion of a large vector of firm and CEO characteristics, as well as industry-country unobserved heterogeneity, time horizon, endogeneity and survival bias.

We argue that the negative relation between CEO age and firm organic growth can be explained – within a P-A framework— by an incentive of younger CEOs to boost firm sales and assets, possibly at the expense of profit margins, in order to signal their value and to increase firm size, so that an increase in their compensation can be justified. Clearly, this is unlikely to be in the interests of shareholders. Consistently with this interpretation, we find no significant statistical relationship between CEO age and the growth in operating profits, and we provide evidence that in firms characterized by a more effective monitoring governance (more concentrated ownership), the relationship between CEO age and firm organic growth is much weaker.

This paper provides a contribution to the modern literature on industrial dynamics, by offering insights on the role played by the age of the top executive in firm growth, “net of” the growth effects ensured by the stochastic, structural, financial and technological firm-level characteristics. Indeed, while the growth effect of firm characteristics such as age, size, efficiency, innovative activities and

the one associated with demand factors have been deeply studied, less evidence has been provided regarding the role played by the characteristics of the individuals who lead the firm.

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Tables and Figures

Figure 1

Histogram on the percentage of firms by CEO age category.

This figure shows a histogram in which on the x-axis the 7 categories of age of the CEO are reported, as they are available in the EFIGE survey. Overall, 13533 manufacturing firms included in the Amadeus-EFIGE sample have the information regarding the age category of their CEO. The y-axis shows the percentages of firms corresponding to each CEO age class.

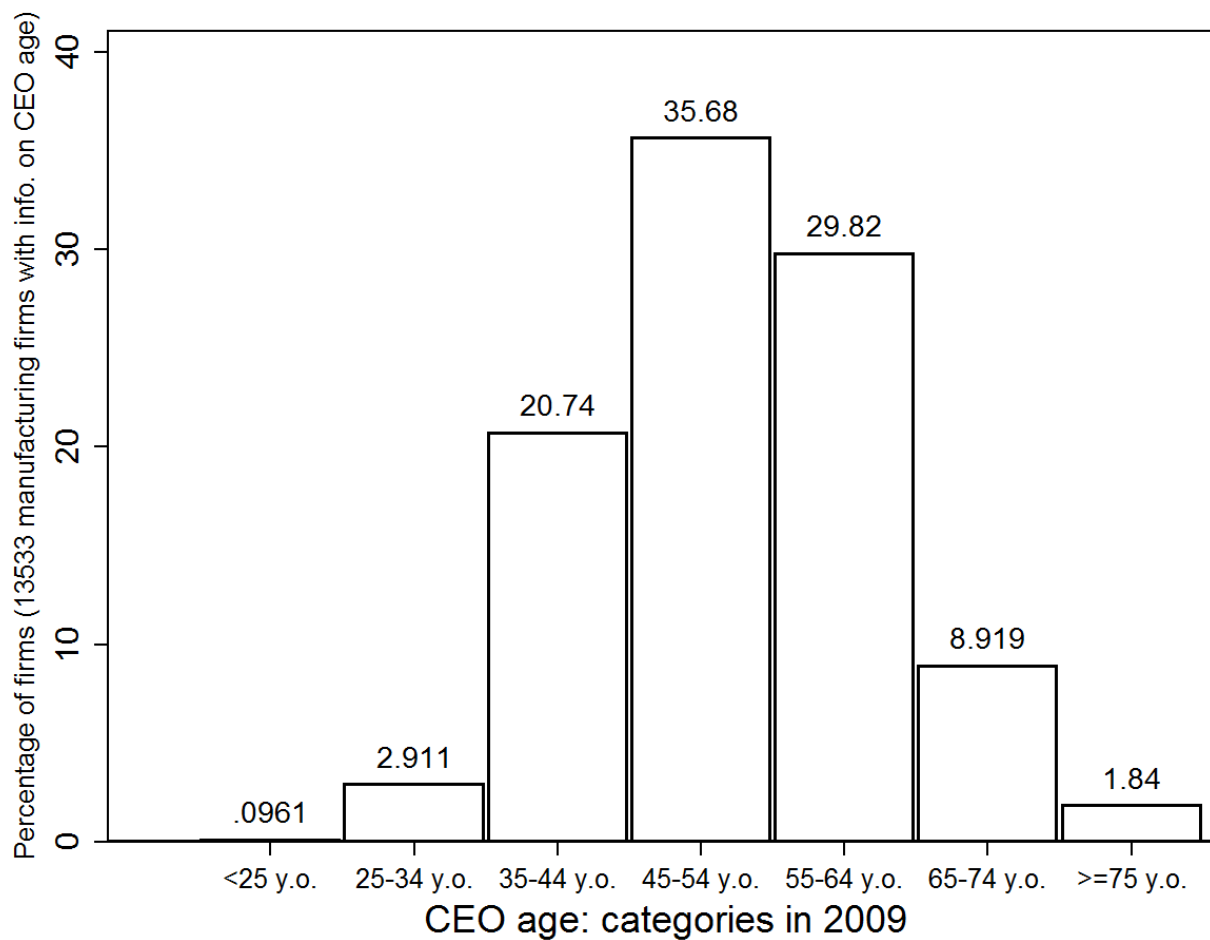


Figure 2

Distributions of average (1-year) sales growth rates in the period 2009-2014 by CEO age category.

This figure plots the distributions of average (1-year) sales growth rates calculated over the period from 2009 to 2014 by CEO age category for those manufacturing firms in the Amadeus-EFIGE database with information on both CEO age and growth in the period 2009-2014. The x-axis indicates the average (1-year) sales growth rates (only values within the interval from -0.4 to 0.4 have been reported in the plot to make it more readable), while the y-axis reports the percentage of firms. Firms' sales have been normalized by industry (2-digit), country and year averages in order to remove common trends, such as inflation and business cycles effects (see Bianchini et al. 2017, among others).

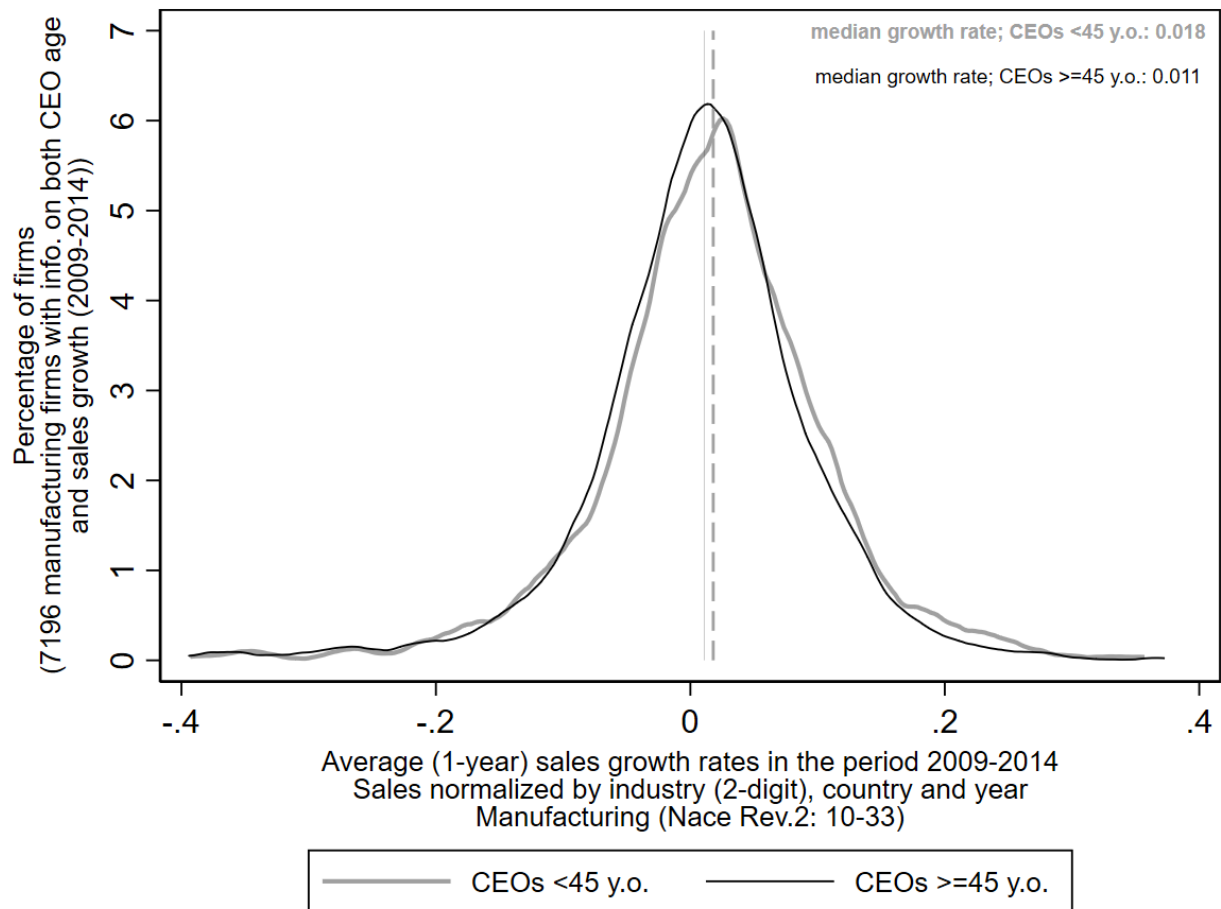


Table 1

Descriptive statistics of the average (1-year) sales growth in the period 2009-2014.

In panel (b) firms' sales have been normalized by industry (2-digit), country and year averages in order to remove common trends, such as inflation and business cycles effects in sectoral demand (see Bianchini et al. 2017, among others), while in panel (a) reported figures have not been normalized. At the bottom of panel (b), the Wilcoxon; Mann-Whitney test on the equality of median growth rates between the 2 categories of CEO age has been reported.

Average (1-year) sales growth rates in the period 2009-2014					
Panel A: Non-normalized figures					
CEO age category (in 2009)	Mean	p50	SD	Skewness	Firms
<45 y.o.	-0.026	-0.003	0.148	-3.752	1710
>=45 y.o.	-0.032	-0.009	0.148	-4.128	5486
Total	-0.031	-0.008	0.148	-4.036	7196
Panel B: Normalized figures					
CEO age category (in 2009)	Mean	p50	SD	Skewness	Firms
<45 y.o.	0.002	0.018	0.144	-3.668	1710
>=45 y.o.	-0.006	0.011	0.144	-3.923	5486
Total	-0.004	0.012	0.144	-3.860	7196
Equality of medians across CEO age categories; Wilcoxon; Mann-Whitney test					
H0: median gr(<45 y.o.)= median gr(>=45 y.o.); $p > z = 0.0007$					

Table 2

Descriptive statistics by CEO age category.

This table reports firm characteristics by CEO age category. While the first two columns report the name of the variable and its definition, the third column reports the unit of measure. The fourth and the fifth column report the variable's figures by category of CEO age and the sixth one the total figure in the sample. The last column reports the p-value of a test of equality of proportions or medians, respectively. In the case in which the variables are continuous, the Wilcoxon; Mann-Whitney test is conducted and the p-value is reported (H0: median gr(<45 y.o.)= median gr(>=45 y.o.); $p > |z|$). In the case of dummy variables, the p-value of the Pearson's chi-squared test is reported (H0: equal distribution of characteristics across CEO age classes).

Variable	Definition	CEO age category					
		Unit of measure	< 45 y.o.	>= 45 y.o.	Total	Firms	p-value
Firm characteristics							
Firm size	Sales (= operating revenues; end of the year); average value in the period 2001-2008	Th. Euro (median value)	2605	3359	3135	12231	0.000
Firm age	Years since firm establishment; average value in the period 2001-2008	No. of years (median value)	17.5	21.5	20.5	13522	0.000
ROE	Profit/loss (end of the year) /Shareholder's funds (end of the year); average value in the period 2001-2008	Ratio (median value)	0.103	0.091	0.094	10681	0.001
Debt to assets ratio	Current liabilities (end of the year) + Non-current liabilities (end of the year) / Book value of total assets (end of the year); average value in the period 2001-2008	Ratio (median value)	0.707	0.682	0.687	12836	0.000
Product innovation	On average, in the period 2007-2009, the firm introduced at least one product innovation; dummy	% of firms	48.7%	49.2%	49.1%	13532	0.634
Process innovation	On average, in the period 2007-2009, the firm introduced at least one process innovation; dummy	% of firms	46.2%	43.6%	44.2%	13532	0.008
Exporter to 0 countries	No. of countries the firm exported its products in 2008: 0; dummy	% of firms	47.0%	42.5%	43.5%	12885	0.000
Exporter to 1-5 countries	No. of countries the firm exported its products in 2008: from 1 to 5; dummy	% of firms	27.7%	26.9%	27.1%	12885	0.359
Exporter to 6-30 countries	No. of countries the firm exported its products in 2008: from 6 to 30; dummy	% of firms	21.8%	25.9%	24.9%	12885	0.000
Exporter to >31 countries	No. of countries the firm exported its products in 2008: higher than or equal to 31; dummy	% of firms	3.5%	4.7%	4.4%	12885	0.003
Importer	The firm purchased for its domestic production any service (i.e. transport, communication, financial and R&D), raw material or intermediate input from abroad in 2008; dummy	% of firms	40.6%	42.2%	41.8%	13532	0.114
Share of university graduates in the workforce	Share of university graduates in a firm's total employees; 2008	% (median value)	5.7%	5.3%	5.3%	12677	0.146
Quality certification	The firm has gone through any form of quality certification (e.g. ISO9000); 2009; dummy	% of firms	57.6%	61.0%	60.2%	13504	0.001
Product range widened	The firm's product range has widened; 2009; dummy	% of firms	49.3%	48.7%	48.8%	13517	0.533
Past growth	1-year sales growth rate; average value in the period 2001-2008; non-normalized figures	% variation (median value)	5.4%	4.1%	4.4%	11592	0.000
CEO characteristics							
Male CEO	If the firm is managed by a male CEO; 2009; dummy	% of firms	88.4%	93.6%	92.4%	13530	0.000
Over-confident	If the ratio of a firm's overall investments (in plants, machines, equipment and ICT) to revenues (end of the year) >5%; 2007-2009; dummy	% of firms	52.8%	48.4%	49.5%	13522	0.000
Risk-tolerant	If the firm does not hedge against exchange rate risk or sell only to countries with the same currency of its domestic market; 2008; dummy	% of firms	19.4%	21.3%	20.9%	13101	0.018
International experience of the executives	At least one executive of the firm has worked abroad for a period longer than or equal to one year; 2008; dummy	% of firms	21.9%	21.3%	21.4%	13404	0.434

Table 3

LAD (median) regressions of the average (1-year) sales growth in the period 2009-2014 on firm characteristics.

This table shows quantile regressions at the 50th percentile of the conditional average (1-year) sales growth rate distribution. All regressions include a vector of firm characteristics, which are introduced in a “hierarchical” fashion (where in col. 8 the most complete vector of firm characteristics is included) plus country-industry fixed effects, where industries are defined at the 2-digit NACE rev.2 classification. Coefficients of country*industry dummies are not reported to save space. Full tables are available from authors upon requests. Heteroskedastic-robust standard errors are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated by *, ** and ***, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO (<45 y.o.)	0.0073*** (0.0020)	0.0059*** (0.0022)	0.0067*** (0.0024)	0.0066*** (0.0023)	0.0059** (0.0024)	0.0063*** (0.0024)	0.0062** (0.0026)	0.0072*** (0.0024)
Firm size: sales (log)		-0.0010 (0.0007)	-0.0007 (0.0008)	-0.0007 (0.0008)	-0.0016** (0.0008)	-0.0037*** (0.0008)	-0.0037*** (0.0009)	-0.0038*** (0.0009)
Firm age (+1, log)		-0.0054*** (0.0011)	-0.0057*** (0.0012)	-0.0057*** (0.0012)	-0.0055*** (0.0013)	-0.0059*** (0.0012)	-0.0056*** (0.0013)	-0.0055*** (0.0013)
ROE			0.0002*** (0.0000)	0.0002*** (0.0000)	0.0001*** (0.0000)	0.0002*** (0.0000)	0.0002*** (0.0000)	0.0001*** (0.0000)
Debt to assets ratio				0.0002 (0.0015)	-0.0006 (0.0019)	-0.0008 (0.0020)	-0.0007 (0.0014)	-0.0010 (0.0014)
Product innovation					0.0047** (0.0022)	0.0023 (0.0022)	0.0027 (0.0023)	0.0015 (0.0023)
Process innovation					0.0093*** (0.0022)	0.0089*** (0.0022)	0.0109*** (0.0022)	0.0099*** (0.0022)
Exporter to 1-5 countries						0.0045* (0.0026)	0.0046 (0.0028)	0.0039 (0.0028)
Exporter to 6-30 countries						0.0116*** (0.0028)	0.0112*** (0.0029)	0.0103*** (0.0029)
Exporter to >31 countries						0.0283*** (0.0050)	0.0250*** (0.0057)	0.0234*** (0.0056)
Importer						0.0057** (0.0023)	0.0040 (0.0024)	0.0042* (0.0025)
Share of university graduates in the workforce							0.0140 (0.0103)	0.0068 (0.0090)
Quality certification								0.0069*** (0.0024)
Product range widened								0.0041* (0.0024)
Constant	0.0736*** (0.0104)	0.0426*** (0.0148)	0.1761*** (0.0135)	0.1757*** (0.0137)	0.1708*** (0.0137)	-0.7216*** (0.0153)	0.0626*** (0.0174)	0.0558*** (0.0176)
Country*Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firms	7196	7194	6465	6462	6461	6147	5825	5822
Goodness of fit: Corr.(gr, pr_gr)^2	0.0671	0.0705	0.0821	0.0827	0.0851	0.0923	0.0840	0.0852

Table 4

LAD (median) regressions of the average (1-year) sales growth in the period 2009-2014 on firm and CEO characteristics.

This table shows quantile regressions at the 50th percentile of the conditional sales growth rate distribution. All regressions include a vector of firm and CEO characteristics, which are introduced in a “hierarchical” fashion (where in col. 5 the most complete vector of firm and CEO characteristics is included) plus country-industry fixed effects, where industries are defined at the 2-digit NACE rev.2 classification. Coefficients of country*industry dummies are not reported to save space. Full tables are available from authors upon requests. Heteroskedastic-robust standard errors are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated by *, ** and ***, respectively.

	(1)	(2)	(3)	(4)	(5)
CEO (<45 y.o.)	0.0069*** (0.0024)	0.0068*** (0.0025)	0.0067*** (0.0025)	0.0066*** (0.0025)	0.0066*** (0.0025)
Firm size: sales (log)	-0.0039*** (0.0009)	-0.0037*** (0.0009)	-0.0043*** (0.0010)	-0.0044*** (0.0010)	-0.0043*** (0.0010)
Firm age (+1, log)	-0.0054*** (0.0013)	-0.0056*** (0.0013)	-0.0054*** (0.0014)	-0.0054*** (0.0013)	-0.0052*** (0.0013)
ROE	0.0001*** (0.0000)	0.0002*** (0.0000)	0.0001*** (0.0000)	0.0001*** (0.0000)	0.0002*** (0.0000)
Debt to assets ratio	-0.0007 (0.0014)	-0.0015 (0.0014)	-0.0016 (0.0027)	-0.0012 (0.0014)	0.0003 (0.0057)
Product innovation	0.0016 (0.0023)	0.0005 (0.0024)	0.0015 (0.0025)	0.0013 (0.0024)	0.0002 (0.0024)
Process innovation	0.0098*** (0.0022)	0.0083*** (0.0022)	0.0103*** (0.0023)	0.0092*** (0.0022)	0.0084*** (0.0023)
Exporter to 1-5 countries	0.0037 (0.0028)	0.0038 (0.0029)	0.0036 (0.0030)	0.0037 (0.0029)	0.0030 (0.0030)
Exporter to 6-30 countries	0.0102*** (0.0029)	0.0107*** (0.0029)	0.0101*** (0.0034)	0.0106*** (0.0030)	0.0084*** (0.0032)
Exporter to >31 countries	0.0231*** (0.0057)	0.0246*** (0.0058)	0.0265*** (0.0063)	0.0241*** (0.0058)	0.0253*** (0.0061)
Importer	0.0040 (0.0025)	0.0042* (0.0025)	0.0033 (0.0026)	0.0037 (0.0025)	0.0045* (0.0025)
Share of university graduates in the workforce	0.0085 (0.0099)	0.0126 (0.0100)	0.0127 (0.0100)	0.0098 (0.0096)	0.0128 (0.0096)
Quality certification	0.0069*** (0.0024)	0.0066*** (0.0023)	0.0061** (0.0024)	0.0074*** (0.0024)	0.0066*** (0.0024)
Product range widened	0.0040* (0.0023)	0.0056** (0.0023)	0.0042* (0.0025)	0.0037 (0.0024)	0.0041* (0.0024)
Male CEO	0.0037 (0.0035)				0.0027 (0.0035)
Over-confident		0.0077*** (0.0023)			0.0093*** (0.0022)
Risk-tolerant			0.0028 (0.0032)		0.0047 (0.0030)
International experience of the executives				0.0050 (0.0033)	0.0059* (0.0035)
Constant	0.2258*** (0.0169)	0.2241*** (0.0168)	0.0786*** (0.0163)	0.0239 (0.0165)	0.0613*** (0.0171)
Country*Industry FE	Yes	Yes	Yes	Yes	Yes
Firms	5821	5818	5667	5770	5613
Goodness of fit: Corr.(gr, pr_gr)^2	0.0851	0.0860	0.0772	0.0826	0.0763

Table 5

Quantile regression of the average (1-year) sales growth in the period 2009-2014 on firm and CEO characteristics.

This table shows quantile regressions at different percentiles (p10, p25, p50, p75 and p90) of the conditional average (1-year) sales growth rate distribution. All regressions include a vector of firm and CEO characteristics plus country-industry fixed effects, where industries are defined at the 2-digit NACE rev.2 classification. Coefficients of country*industry dummies are not reported to save space. Full tables are available from authors upon requests. Heteroskedastic-robust standard errors are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated by *, ** and ***, respectively.

	(1) p10	(2) p25	(3) p50	(4) p75	(5) p90
CEO (<45 y.o.)	-0.0014 (0.0074)	0.0024 (0.0044)	0.0066*** (0.0025)	0.0124*** (0.0029)	0.0141*** (0.0042)
Firm size: sales (log)	-0.0081** (0.0035)	-0.0058*** (0.0019)	-0.0043*** (0.0010)	-0.0061*** (0.0012)	-0.0089*** (0.0017)
Firm age (+1, log)	0.0001 (0.0036)	-0.0038* (0.0020)	-0.0052*** (0.0013)	-0.0094*** (0.0015)	-0.0118*** (0.0023)
ROE	0.0001* (0.0001)	-0.0001*** (0.0000)	0.0002*** (0.0000)	0.0001*** (0.0000)	0.0000* (0.0000)
Debt to assets ratio	-0.0218 (0.0169)	-0.0042 (0.0079)	0.0003 (0.0057)	0.0063 (0.0071)	0.0053 (0.0099)
Product innovation	-0.0070 (0.0073)	-0.0029 (0.0040)	0.0002 (0.0024)	0.0042 (0.0028)	0.0014 (0.0047)
Process innovation	0.0162** (0.0072)	0.0135*** (0.0039)	0.0084*** (0.0023)	0.0074*** (0.0026)	0.0084** (0.0042)
Exporter to 1-5 countries	-0.0025 (0.0076)	-0.0011 (0.0047)	0.0030 (0.0030)	0.0086*** (0.0033)	0.0113** (0.0047)
Exporter to 6-30 countries	0.0168 (0.0108)	0.0092* (0.0056)	0.0084*** (0.0032)	0.0100*** (0.0038)	0.0140*** (0.0051)
Exporter to >31 countries	0.0322 (0.0204)	0.0300*** (0.0085)	0.0253*** (0.0061)	0.0195*** (0.0059)	0.0194* (0.0109)
Importer	0.0027 (0.0068)	0.0050 (0.0036)	0.0045* (0.0025)	0.0066** (0.0027)	0.0013 (0.0035)
Share of university graduates in the workforce	0.0153 (0.0370)	0.0235* (0.0135)	0.0128 (0.0096)	0.0413*** (0.0138)	0.0420*** (0.0162)
Quality certification	0.0021 (0.0066)	0.0021 (0.0039)	0.0066*** (0.0024)	0.0060** (0.0026)	0.0060 (0.0038)
Product range widened	0.0124** (0.0058)	0.0075** (0.0035)	0.0041* (0.0024)	0.0041 (0.0026)	0.0027 (0.0036)
Male CEO	-0.0055 (0.0119)	0.0004 (0.0069)	0.0027 (0.0035)	0.0084** (0.0039)	0.0092 (0.0062)
Over-confident	0.0059 (0.0064)	0.0047 (0.0032)	0.0093*** (0.0022)	0.0094*** (0.0025)	0.0091*** (0.0034)
Risk-tolerant	0.0061 (0.0079)	0.0010 (0.0045)	0.0047 (0.0030)	0.0009 (0.0030)	-0.0074* (0.0044)
International experience of the executives	-0.0072 (0.0109)	0.0002 (0.0055)	0.0059* (0.0035)	0.0020 (0.0031)	0.0038 (0.0042)
Constant	0.1109** (0.0457)	0.1081*** (0.0267)	0.0613*** (0.0171)	0.0858*** (0.0150)	0.1357*** (0.0222)
Country*Industry FE	Yes	Yes	Yes	Yes	Yes
Firms	5613	5613	5613	5613	5613
Goodness of fit: Corr.(gr, pr_gr)^2	0.0560	0.0775	0.0763	0.0605	0.0373

Table 6

Quantile regression of the average (1-year) sales growth in the period 2009-2011 on firm and CEO characteristics.

This table shows quantile regressions at different percentiles (p50, p75 and p90) of the conditional sales growth rate distribution. All regressions include a vector of firm and CEO characteristics plus country-industry fixed effects, where industries are defined at the 2-digit NACE rev.2 classification. Coefficients of country*industry dummies and the vector of controls are not reported to save space. Full tables are available from authors upon requests. Heteroskedastic-robust standard errors are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated by *, ** and ***, respectively.

	(1)	(2)	(3)
	p50	p75	p90
CEO (<45 y.o.)	0.0055 (0.0037)	0.0086** (0.0035)	0.0225*** (0.0065)
Firm and CEO characteristics	Yes	Yes	Yes
Constant	0.2738*** (0.0234)	0.2736*** (0.0218)	0.2411*** (0.0372)
Country*Industry FE	Yes	Yes	Yes
Firms	6654	6654	6654
Goodness of fit: Corr.(gr, pr_gr)^2	0.1107	0.1019	0.0692

Table 7

Propensity score matching. The probability of being managed by a CEO younger than 45.

The propensity score, $p(X)$, which is defined as the probability of receiving treatment conditional on the vector of covariates X_i , is estimated via a probit model. The dependent variable is a dummy variable, which is equal to one for firms with a CEO younger than 45 years old and zero otherwise. The vector of firm characteristics refers to the period 2001-2008 (variables from Amadeus) or the year 2008 (variables from EFIGE). The specification includes both NUTS 3 (province) and industry fixed effects, where industries are defined at the 2-digit NACE rev.2 classification. Coefficients of NUTS 3 and industry dummies are not reported to save space. Full tables are available from authors upon requests. Statistical significance at the 10%, 5% and 1% level is indicated by *,** and ***, respectively.

Dependent variable	(1) D=1 for firms managed by a CEO younger than 45, and 0 otherwise
Past growth	0.3836*** (0.1349)
Firm size: sales (log)	-0.0440*** (0.0200)
Firm age (+1, log)	-0.1128*** (0.0255)
ROE	-0.0016 (0.0028)
Debt to assets ratio	0.1468* (0.0801)
Product innovation	0.0355 (0.0459)
Process innovation	0.1537*** (0.0423)
Exporter to 1-5 countries	-0.0438 (0.0517)
Exporter to 6-30 countries	-0.0750 (0.0612)
Exporter to >31 countries	0.0252 (0.1163)
Importer	0.0071 (0.0454)
Share of university graduates in the workforce	-0.0591 (0.1819)
Quality certification	-0.0067 (0.0451)
Product range widened	0.0577 (0.0436)
Constant	0.4859 (0.6356)
NUTS 3 FE	Yes
Industry FE	Yes
Firms	5354
Pseudo R2	0.0743

Table 8

Propensity score matching. Tests on the equality of means in the two samples of firms (unmatched and matched). Cols. (1), (2) show the average values for the vector of firm and CEO characteristics for the groups of firms managed by CEO younger than 45 versus those managed by older CEOs in the unmatched (original) sample. Cols (4) and (5) show the same figures for the two groups of firms, in the matched sample. Cols (3) and (6) show the p-value of the statistical tests for significant differences in means in each covariate, between the two groups of firms.

	Unmatched sample		t-test for equality of means in the two samples; p>t	Matched sample		t-test for equality of means in the two samples; p>t
	(1)	(2)	(3)	(4)	(5)	(6)
	Treated: CEO (<45 y.o.)	Control: CEO (>=45 y.o.)		Treated: CEO (<45 y.o.)	Control: CEO (>=45 y.o.)	
<i>Firm characteristics used to estimate the propensity score</i>						
Past growth	8.91%	6.09%	0.000	8.99%	9.51%	0.449
Firm size: sales (log)	8.0923	8.3505	0.000	8.1333	8.1594	0.600
Firm age (+1, log)	2.8869	3.1034	0.000	2.8624	2.8988	0.318
ROE	0.3213	0.2594	0.374	0.1135	0.0891	0.678
Debt to assets ratio	0.6941	0.6898	0.265	0.6668	0.6624	0.631
Product innovation	48.96%	49.11%	0.564	48.07%	47.38%	0.724
Process innovation	46.00%	43.30%	0.000	49.38%	51.69%	0.239
Exporter to 1-5 countries	27.41%	26.63%	0.001	29.35%	28.35%	0.574
Exporter to 6-30 countries	21.16%	25.47%	0.000	22.80%	23.88%	0.516
Exporter to >31 countries	3.32%	4.72%	0.000	3.77%	4.08%	0.686
Importer	39.89%	41.42%	0.000	44.30%	44.22%	0.968
Share of university graduates in the workforce	9.76%	9.63%	0.092	9.00%	8.72%	0.566
Quality certification	56.50%	60.54%	0.000	57.16%	58.01%	0.662
Product range widened	49.75%	48.77%	0.000	50.69%	50.23%	0.814
<i>Firm and CEO characteristics not used to estimate the propensity score</i>						
Male CEO	88.31%	93.60%	0.000	87.51%	94.38%	0.000
Over-confident	52.65%	48.25%	0.000	51.04%	50.00%	0.596
Risk-tolerant	19.44%	21.63%	0.000	20.04%	19.25%	0.612
International experience of the executives	22.89%	21.87%	0.000	18.85%	18.39%	0.762
Labor productivity (2008; thousands of euro per employee)	51.328	50.705	0.441	59.047	51.651	0.390
Cash-flow/Total assets (2008; ratio)	0.2982	0.2584	0.202	0.0808	0.0788	0.569
Firms listed in the stock exchange (2008; dummy)	2.34%	2.30%	0.556	2.00%	1.62%	0.462
The firm has acquired (totally or partially) or incorporated other firms during the period 2007-2009 (dummy)	9.92%	10.20%	0.067	7.55%	8.47%	0.386

Table 9

Propensity score matching. Quantile regression of sales growth in the 2009-2014 period on firm-level and CEO characteristics. Matched sample.

This table shows quantile regressions at different percentiles (p50, p75 and p90) of the conditional sales growth rate distribution. Regressions are performed on the matched sample (see Table 8). All regressions include a vector of firm and CEO characteristics plus country-industry fixed effects, where industries are defined at the 2-digit NACE rev.2 classification. Coefficients of country*industry dummies are not reported to save space. Full tables are available from authors upon requests. Heteroskedastic-robust standard errors are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated by *, ** and ***, respectively.

	(1)	(2)	(3)
	p50	p75	p90
CEO (<45 y.o.)	0.0054 (0.0036)	0.0161*** (0.0036)	0.0274*** (0.0046)
Firm and CEO characteristics	Yes	Yes	Yes
Constant	0.0265 (0.0245)	0.0157 (0.0191)	0.0212 (0.0237)
Country*Industry FE	Yes	Yes	Yes
Firms	2526	2526	2526
Goodness of fit: Corr.(gr, pr_gr)^2	0.0705	0.0556	0.0300

Table 10

Quantile regression of the average (1-year) sales growth in the 2009-2014 period on past growth (average 2001-2008), firm and CEO characteristics.

This table shows quantile regressions at different percentiles (p50, p75 and p90) of the conditional sales growth rate distribution, once controlled for past growth of the firm in the period 2001-2008. All regressions include a vector of firm and CEO characteristics plus country-industry fixed effects, where industries are defined at the 2-digit NACE rev.2 classification. Coefficients of country*industry dummies and the vector of controls are not reported to save space. Full tables are available from authors upon requests. Heteroskedastic-robust standard errors are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated by *, ** and ***, respectively.

	(1)	(2)	(3)
	p50	p75	p90
CEO (<45 y.o.)	0.0057** (0.0025)	0.0129*** (0.0028)	0.0103** (0.0044)
Past growth rate	0.0376*** (0.0140)	0.0332*** (0.0121)	0.0319*** (0.0078)
Firm and CEO characteristics	Yes	Yes	Yes
Constant	0.2172*** (0.0173)	0.2026*** (0.0186)	0.2275*** (0.0217)
Country*Industry FE	Yes	Yes	Yes
Firms	5558	5558	5558
Goodness of fit: Corr.(gr, pr_gr)^2	0.0759	0.0611	0.0359

Table 11

Accounting for survival bias.

In order to account for a possible survival bias, a 2-step procedure (Heckman, 1979) is implemented. In the first stage (col. (1)) a probit model is estimated in which the episodes of survival (identified as the spells in firms' sales without interruptions in the period 2008-2014) and those of exit (spells started in 2008 but finished before 2014) are explained by a set of firm and executive characteristics at the beginning of the period (either in 2008 or calculated as averages in the period 2001-2008). Three exclusion restrictions are used in the survival equation (and excluded from the growth equation), namely labor productivity (defined as the ratio between a firm's value added and total employees at the end of the year), the ratio of cash flow to total assets (rough proxy for a firm's degree of liquidity) and their interaction. The three variables are all included at the beginning of the period (2008). In the second stage, a quantile regression of the average (1-year) sales growth in the period 2009-2014 at different percentiles (p50, p75 and p90) of the conditional growth rate distribution is performed, adding the inverse Mills's ratio --recovered from the first stage-- to the growth equation. The specification in col. (1) include both country and industry fixed effects, and regressions in cols. (2)-(4) include a vector of country-industry fixed effects, where industries are defined at the 2-digit NACE rev.2 classification. Coefficients of country, industry and country*industry dummies are not reported to save space. Full tables are available from authors upon requests. Heteroskedastic-robust standard errors are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated by *, ** and ***, respectively.

Dependent variable	Survival equation	Growth equation		
	D=1 for "survivors" at 2014 and 0 otherwise	$\bar{g}r_{i,2009-2014}$		
	(1)	(2)	(3)	(4)
		q50	q75	q90
CEO (<45 y.o.)	0.0102 (0.0381)	0.0067*** (0.0025)	0.0124*** (0.0029)	0.0132*** (0.0045)
Cash flow/Total assets (2008)	4.2998*** (0.7073)			
Labor productivity (log; 2008)	0.0980** (0.0438)			
Cash-flow/Total Assets*Labor productivity (log)	-0.7879*** (0.1817)			
Firm size: sales (log)	0.0624*** (0.0170)	-0.0049*** (0.0012)	-0.0056*** (0.0012)	-0.0074*** (0.0017)
Firm age (+1, log)	0.0501*** (0.0186)	-0.0056*** (0.0013)	-0.0090*** (0.0015)	-0.0105*** (0.0024)
ROE	0.0027 (0.0020)	0.0001*** (0.0000)	0.0001*** (0.0000)	0.0001** (0.0000)
Debt to assets ratio	-0.8931*** (0.0757)	0.0065 (0.0148)	-0.0043 (0.0116)	-0.0087*** (0.0017)
Product innovation	-0.0234 (0.0372)	0.0003 (0.0024)	0.0042 (0.0027)	0.0009 (0.0045)
Process innovation	0.0617* (0.0349)	0.0083*** (0.0024)	0.0079*** (0.0026)	0.0104** (0.0042)
Exporter to 1-5 countries	-0.0014 (0.0432)	0.0032 (0.0030)	0.0084** (0.0033)	0.0129*** (0.0047)
Exporter to 6-30 countries	0.0905* (0.0520)	0.0084** (0.0033)	0.0105*** (0.0039)	0.0148*** (0.0052)
Exporter to >31 countries	0.1740* (0.0958)	0.0238*** (0.0062)	0.0209*** (0.0062)	0.0229* (0.0131)
Importer	-0.0182 (0.0362)	0.0046* (0.0025)	0.0055** (0.0027)	0.0012 (0.0038)
Share of university graduates in the workforce	0.0574 (0.1448)	0.0138 (0.0101)	0.0419*** (0.0142)	0.0412** (0.0178)
Quality certification	-0.0990*** (0.0364)	0.0067*** (0.0024)	0.0049* (0.0027)	0.0047 (0.0041)
Product range widened	0.0820** (0.0353)	0.0036 (0.0024)	0.0043* (0.0026)	0.0052 (0.0040)
Male CEO	-0.0206 (0.0601)	0.0024 (0.0036)	0.0079** (0.0039)	0.0084 (0.0060)
Over-confident	0.0870** (0.0338)	0.0088*** (0.0023)	0.0105*** (0.0028)	0.0110*** (0.0033)
Risk-tolerant	0.0040 (0.0453)	0.0044 (0.0030)	0.0006 (0.0030)	-0.0074 (0.0046)
International experience of the executives	-0.0063 (0.0455)	0.0057 (0.0035)	0.0017 (0.0030)	0.0020 (0.0044)
Inverse Mills's ratio		-0.0122 (0.0202)	0.0199 (0.0162)	0.0497** (0.0222)
Constant	-0.1116 (0.2760)	0.2274*** (0.0190)	0.1941*** (0.0178)	0.2059*** (0.0257)
Country*Industry FE	No	Yes	Yes	Yes
Country FE	Yes	No	No	No
Industry FE	Yes	No	No	No
Firms	7848	5613	5613	5613
Pseudo R2	0.1415			
Goodness of fit: Corr.(gr, pr_gr)^2		0.0765	0.0603	0.0370

Table 12

Quantile regression of the average (1-year) sales growth in the period 2009-2014 on firm and CEO characteristics. Considering three categories of CEO age.

This table shows quantile regressions at different percentiles (p10, p25, p50, p75 and p90) of the conditional average (1-year) sales growth rate distribution. All regressions include a vector of firm and CEO characteristics plus country-industry fixed effects, where industries are defined at the 2-digit NACE rev.2 classification. Coefficients of country*industry dummies and the vector of controls are not reported to save space. Full tables are available from authors upon requests. Heteroskedastic-robust standard errors are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated by *, ** and ***, respectively.

	(1) p10	(2) p25	(3) p50	(4) p75	(5) p90
CEO (<45 y.o.)	0.0018 (0.0082)	0.0020 (0.0046)	0.0081*** (0.0026)	0.0144*** (0.0029)	0.0177*** (0.0048)
CEO (>=45 & <55 y.o.)	0.0068 (0.0066)	-0.0008 (0.0036)	0.0034 (0.0024)	0.0036 (0.0025)	0.0076* (0.0041)
Firm and CEO characteristics	Yes	Yes	Yes	Yes	Yes
Constant	0.1076** (0.0424)	0.1088*** (0.0260)	0.0618*** (0.0174)	0.0812*** (0.0150)	0.1254*** (0.0201)
Country*Industry FE	Yes	Yes	Yes	Yes	Yes
Firms	5613	5613	5613	5613	5613
Goodness of fit: Corr.(gr, pr_gr)^2	0.0556	0.0774	0.0762	0.0610	0.0369
F-test; H0: CEO (<45 y.o.)= CEO (>=45 & <55 y.o.)					
p-value	0.5630	0.5355	0.0913	0.0005	0.0390

Table 13

Quantile regression of the average (1-year) sales growth in the period 2009-2014 on firm and CEO characteristics. Samples of firms 10 y.o. or younger and 5 y.o. or younger (Panel A) and older than 10 y.o. and 5 y.o. (Panel B).

This table shows quantile regressions at different percentiles (p50, p75 and p90) of the conditional sales growth rate distribution. In Panel A, regressions are conducted on the sample of firms that are 10 years old or younger or 5 years old or younger, respectively. In Panel B, the regression is conducted on the sample of firms that are older than 10 years old or older than 5 years old, respectively. All regressions include a vector of firm and CEO characteristics plus country-industry fixed effects, where industries are defined at the 2-digit NACE rev.2 classification. Coefficients of country*industry dummies and the vector of controls are not reported to save space. Full tables are available from authors upon requests. Heteroskedastic-robust standard errors are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated by *, ** and ***, respectively.

Panel A							
Firms 10 y.o. or younger				Firms 5 y.o. or younger			
	(1) p50	(2) p75	(3) p90		(1) p50	(2) p75	(3) p90
CEO (<45 y.o.)	0.0101 (0.0101)	0.0167* (0.0090)	0.0196** (0.0099)	CEO (<45 y.o.)	0.0140 (0.0171)	0.0288 (0.0179)	0.0392*** (0.0132)
Firm and CEO characteristics	Yes	Yes	Yes	Firm and CEO characteristics	Yes	Yes	Yes
Constant	0.1765*** (0.0607)	0.1981*** (0.0641)	0.3663*** (0.0595)	Constant	0.2425** (0.0950)	0.2881*** (0.0576)	0.3856*** (0.0527)
Country*Industry FE	Yes	Yes	Yes	Country*Industry FE	Yes	Yes	Yes
Firms	806	806	806	Firms	270	270	270
Goodness of fit: Corr.(gr, pr_gr)^2	0.1021	0.0849	0.0675	Goodness of fit: Corr.(gr, pr_gr)^2	0.1336	0.0947	0.0774

Panel B							
Firms older than 10 y.o.				Firms older than 5 y.o.			
	(1) p50	(2) p75	(3) p90		(1) p50	(2) p75	(3) p90
CEO (<45 y.o.)	0.0047* (0.0026)	0.0116*** (0.0031)	0.0118*** (0.0045)	CEO (<45 y.o.)	0.0062** (0.0026)	0.0122*** (0.0027)	0.0122*** (0.0047)
Firm and CEO characteristics	Yes	Yes	Yes	Firm and CEO characteristics	Yes	Yes	Yes
Constant	0.0625*** (0.0177)	0.0844*** (0.0151)	0.1167*** (0.0223)	Constant	0.0606*** (0.0169)	0.0826*** (0.0149)	0.1283*** (0.0204)
Country*Industry FE	Yes	Yes	Yes	Country*Industry FE	Yes	Yes	Yes
Firms	4807	4807	4807	Firms	5343	5343	5343
Goodness of fit: Corr.(gr, pr_gr)^2	0.0793	0.0611	0.0368	Goodness of fit: Corr.(gr, pr_gr)^2	0.0813	0.0646	0.0375

Table 14

Quantile regression of average (1-year) sales growth in the 2009-2014 period on firm and CEO characteristics. Firms that have declared to have acquired (totally or partially) or incorporated other firms in the last 3 years (2007-2009) have been excluded from the sample.

This table shows quantile regressions at different percentiles (p50, p75 and p90) of the conditional sales growth rate distribution. All regressions include a vector of firm and CEO characteristics plus country-industry fixed effects, where industries are defined at the 2-digit NACE rev.2 classification. Coefficients of country*industry dummies and the vector of controls are not reported to save space. Full tables are available from authors upon requests. Heteroskedastic-robust standard errors are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated by *,** and ***, respectively.

	(1) p50	(2) p75	(3) p90
CEO (<45 y.o.)	0.0077*** (0.0026)	0.0129*** (0.0031)	0.0156*** (0.0044)
Firm and CEO characteristics	Yes	Yes	Yes
Constant	0.2238*** (0.0181)	0.2014*** (0.0182)	0.2088*** (0.0281)
Country*Industry FE	Yes	Yes	Yes
Firms	5124	5124	5124
Goodness of fit: Corr.(gr, pr_gr)^2	0.0760	0.0610	0.0373

Table 15

Country-specific regressions.

Quantile regression of average (1-year) sales growth in the 2009-2014 period on firm and CEO characteristics for the sub-samples of French, Italian and Spanish firms.

This table shows quantile regressions at different percentiles (p50, p75 and p90) of the conditional sales growth rate distribution. All regressions include a vector of firm and CEO characteristics plus industry fixed effects, where industries are defined at the 2-digit NACE rev.2 classification. Coefficients of industry dummies and the vector of controls are not reported to save space. Full tables are available from authors upon requests. Heteroskedastic-robust standard errors are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated by *, ** and ***, respectively.

	France			Italy			Spain		
	p50	p75	p90	p50	p75	p90	p50	p75	p90
CEO (<45 y.o.)	0.0053 (0.0035)	0.0115*** (0.0041)	0.0120** (0.0057)	0.0065 (0.0042)	0.0030 (0.0044)	0.0115* (0.0065)	0.0102 (0.0074)	0.0160*** (0.0058)	0.0102 (0.0082)
Firm and CEO characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.0539** (0.0265)	0.1061*** (0.0205)	0.1208*** (0.0208)	0.1102*** (0.0217)	0.1089*** (0.0229)	0.1177*** (0.0239)	0.1143** (0.0476)	0.1438*** (0.0319)	0.1959*** (0.0489)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firms	1596	1596	1596	2134	2134	2134	1324	1324	1324
Goodness of fit: Corr.(gr, pr_gr)^2	0.0339	0.0376	0.0212	0.0244	0.0153	0.0099	0.1232	0.1034	0.0601

Table 16

Quantile regression of total assets growth (panel A) and profit growth (panel B) in the period 2009-2014 on firm-level and CEO characteristics.

This table shows quantile regressions at different percentiles (p50, p75 and p90) of the conditional total assets (panel A) and profit (panel B) growth rate distributions. All regressions include a vector of firm and CEO characteristics plus country-industry fixed effects, where industries are defined at the 2-digit NACE rev.2 classification. Coefficients of country*industry dummies and the vector of controls are not reported to save space. Full tables are available from authors upon requests. Heteroskedastic-robust standard errors are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated by *, ** and ***, respectively.

Panel A: Total assets growth	(1) p50	(2) p75	(3) p90
CEO (<45 y.o.)	0.0052* (0.0029)	0.0079*** (0.0030)	0.0105*** (0.0040)
Firm and CEO characteristics	Yes	Yes	Yes
Constant	0.0884*** (0.0170)	0.0980*** (0.0157)	0.1154*** (0.0187)
Country*Industry FE	Yes	Yes	Yes
Firms	6103	6103	6103
Goodness of fit: Corr.(gr, pr_gr)^2	0.0442	0.0367	0.0296
Panel B: Profit growth	(1) p50	(2) p75	(3) p90
CEO (<45 y.o.)	0.0096 (0.0109)	-0.0147 (0.0179)	-0.0162 (0.0537)
Firm and CEO characteristics	Yes	Yes	Yes
Constant	0.1017 (0.0782)	-0.1410 (0.2246)	-0.8185*** (0.2920)
Country*Industry FE	Yes	Yes	Yes
Firms	5569	5569	5569
Goodness of fit: Corr.(gr, pr_gr)^2	0.0005	0.0005	0.0007

Table 17

The role of monitoring (concentrated ownership).

In order to account for the moderating role of concentrated ownership in the effect of CEO age on firm growth, we interact the dummy variable capturing CEO youth with a dummy, which identifies those firms whose 1st shareholder holds an equity share equal or larger than 50%. Col. (1) reports the median regressor of the most complete specification for purpose of comparison. In col. (2) the dummy variable which captures a concentrated ownership is introduced and in cols. (3)-(5) the interaction is also included and the effect is estimated at different percentiles (p50, p75 and p90) of the conditional sales growth rate distribution. All regressions include a vector of firm and CEO characteristics plus country-industry fixed effects, where industries are defined at the 2-digit NACE rev.2 classification. Coefficients of country*industry dummies and the vector of controls are not reported to save space. Full tables are available from authors upon requests. Heteroskedastic-robust standard errors are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated by *,** and ***, respectively.

	(1) p50	(2) p50	(3) p50	(4) p75	(5) p90
CEO (<45 y.o.)	0.0066*** (0.0025)	0.0057** (0.0025)	0.0067 (0.0046)	0.0159** (0.0068)	0.0306*** (0.0082)
1 st shareholder owns >=50% of equity		0.0027 (0.0024)	0.0028 (0.0026)	0.0024 (0.0027)	0.0096** (0.0038)
CEO (<45 y.o.)*(1 st shareholder owns >=50% of equity)			-0.0014 (0.0056)	-0.0048 (0.0077)	-0.0241*** (0.0092)
Firm and CEO characteristics	Yes	Yes	Yes	Yes	Yes
Constant	0.0613*** (0.0171)	0.2192*** (0.0178)	0.2195*** (0.0178)	0.1989*** (0.0173)	0.2366*** (0.0210)
Country*Industry FE	Yes	Yes	Yes	Yes	Yes
Firms	5613	5374	5374	5374	5374
Goodness of fit: Corr.(gr, pr_gr)^2	0.0763	0.0723	0.0725	0.0565	0.0372
Statistical tests					
H0: Young/dispersed = Young/concentrated (p-value)			0.7754	0.7289	0.0918
H0: Young/concentrated =Old/concentrated (p-value)			0.0866	0.0008	0.1804

Table 18

The role of monitoring (concentrated ownership).

In order to account for the moderating role of concentrated ownership in the effect of CEO age on firm growth, we interact the dummy variable capturing CEO youth with the share of equity owned by the 1st shareholder. Col. (1) reports the median regressor of the most complete specification for purpose of comparison. In col. (2) the variable measuring the share of equity of the 1st shareholder is introduced and in cols. (3)-(5) the interaction is also included and the effect is estimated at different percentiles (p50, p75 and p90) of the conditional sales growth rate distribution. All regressions include a vector of firm and CEO characteristics plus country-industry fixed effects, where industries are defined at the 2-digit NACE rev.2 classification. Coefficients of country*industry dummies and the vector of controls are not reported to save space. Full tables are available from authors upon requests. Heteroskedastic-robust standard errors are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated by *,** and ***, respectively.

	(1) p50	(2) p50	(3) p50	(4) p75	(5) p90
CEO (<45 y.o.)	0.0066*** (0.0025)	0.0054** (0.0025)	0.0070 (0.0059)	0.0175** (0.0077)	0.0407*** (0.0112)
% of equity owned by the 1st shareholder		-0.0007 (0.0042)	-0.0004 (0.0045)	0.0011 (0.0045)	0.0187*** (0.0064)
CEO (<45 y.o.)*(% of equity owned by the 1st shareholder)			-0.0025 (0.0089)	-0.0068 (0.0106)	-0.0426*** (0.0145)
Firm- and CEO-level controls	Yes	Yes	Yes	Yes	Yes
Constant	0.0613*** (0.0171)	0.2216*** (0.0180)	0.0579*** (0.0169)	0.0827*** (0.0149)	0.1250*** (0.0187)
Country*Industry FE	Yes	Yes	Yes	Yes	Yes
Firms	5613	5374	5374	5374	5374
Goodness of fit: Corr.(gr, pr_gr)^2	0.0763	0.0724	0.0727	0.0565	0.0383

On-line Appendix

A.1 The distribution of firm growth rates: a graphical analysis

A graphical analysis has been conducted on the general characteristics of the distribution of sales growth rates in the period 2009-2014, by drawing two hanging rootograms (Wainer, 1974). In a hanging rootogram the bars of the histogram “hang” from the theoretical distribution (instead of standing on the x-axis and being the theoretical distribution simply plotted on top of them). In this way, it is more immediate to *focus* on the “deviations” of the data from the theoretical distribution (Buis, 2007): indeed, these are now shown as offsets from the horizontal line (y-axis). Bars’ length is equal to the square root of the number of observations that fall within each bin: square roots stabilize the sampling variation across bins.

Deviations from the y-axis are precisely the most interesting objects in the graph, because they are the residuals of the empirical distribution from the theoretical one. In particular, deviations above the y-axis correspond to “insufficient” numbers of observations (in each respective bin) with respect to the ones contemplated by the theoretical distribution; conversely, deviations below the y-axis correspond to some “excessive” observations with respect to those expected by the theoretical distribution. Confidence intervals referring to the deviations are drawn at the bottom of each bar. In Figure A.1,²⁹ the empirical distribution is compared with the theoretical Gaussian distribution: sales growth rates depart from the normal distribution (deviations from the y-axis) in terms of (i) a higher frequency of zero-growth episodes, (ii) a lower frequency of moderate (both positive and negative) growth episodes and (iii) a higher frequency of “extreme” episodes of fast growth and heavy contractions, i.e. “fat tails”. Figure A.2 shows the rootogram obtained by comparing the empirical distribution of firm growth rates with the Laplace distribution. Deviations are much smaller at any bin. Overall, this impressionistic evidence seems to confirm (as previous works) that the Laplace distribution “fits” the empirical density of growth rates much better than the Gaussian distribution.

²⁹ Rootograms in Figures A.1 and A.2 have been drawn by using the Stata package `hangroot` written by Maarten L. Buis.

Figure A. 1
 The empirical distribution of average sales growth rates versus the theoretical Normal distribution

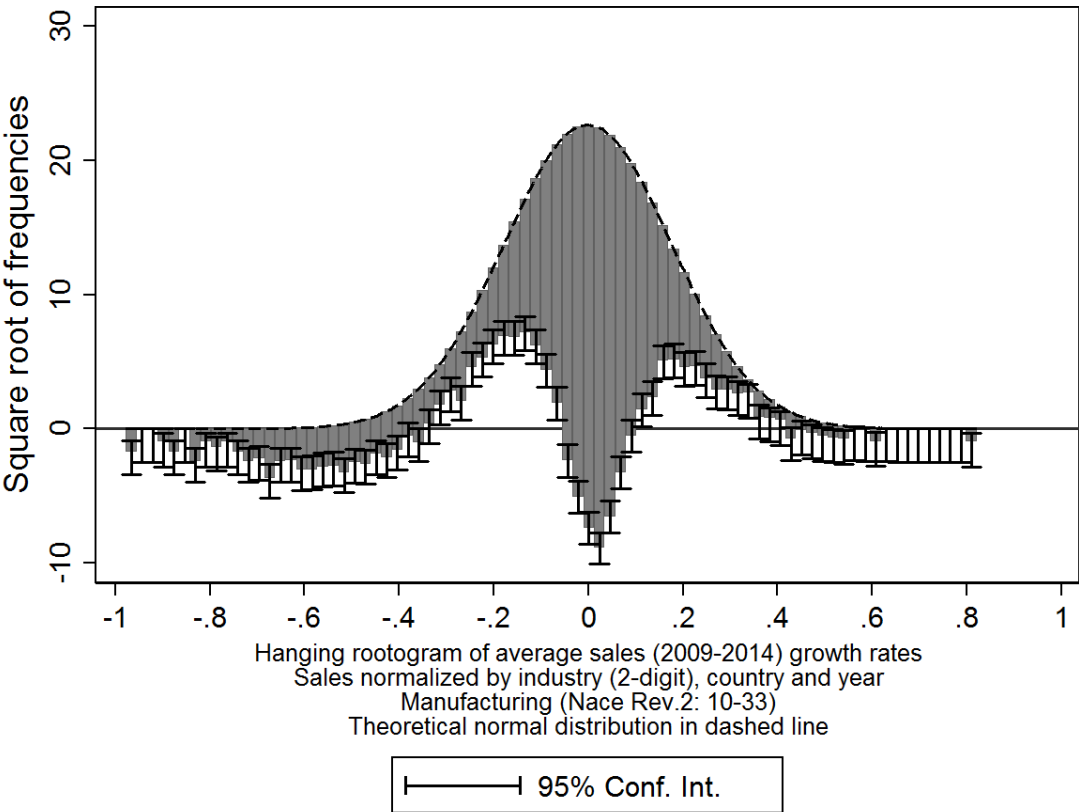
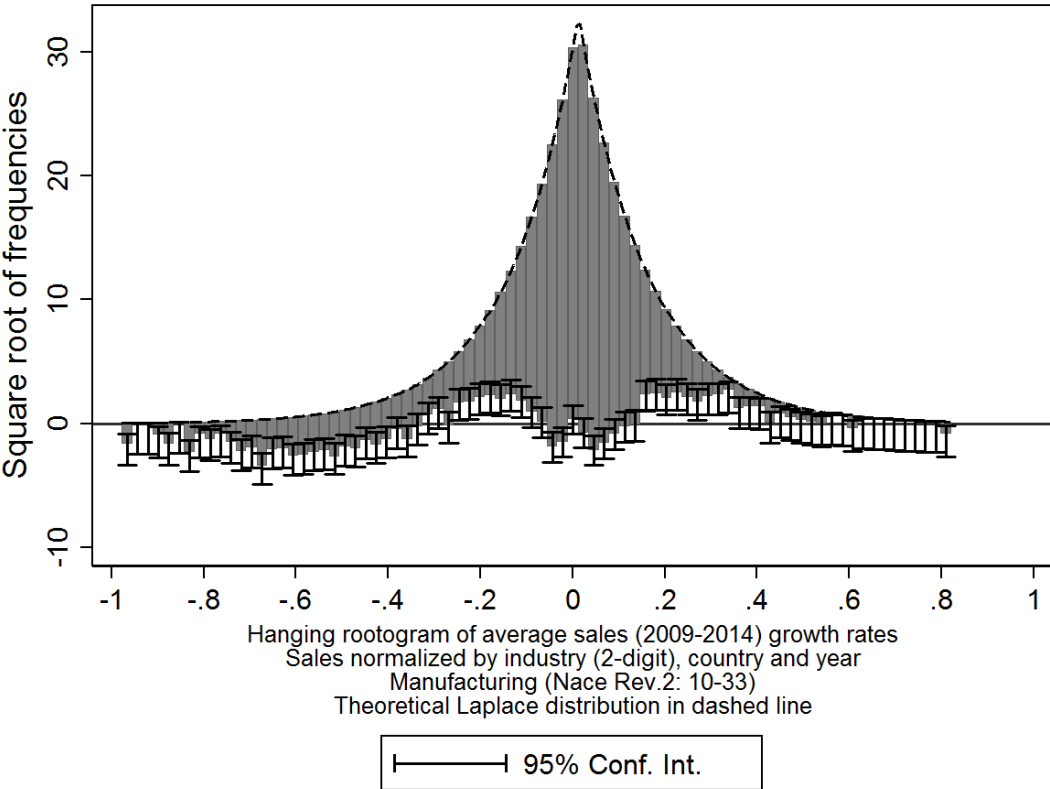


Figure A. 2
 The empirical distribution of average sales growth rates versus the theoretical Laplace distribution



A. 2 Additional information on the sample

Table A. 1

Distribution of firms by industries (2-digit NACE rev.2). The first column refers to all manufacturing firms contained in the Amadeus-EFIGE database with non-missing information on CEO age and the industry they belong to. In the second column, percentages refer to the sample for which the information on CEO age is available and the 2009-2014 average sales growth rate can be computed.

Manufacturing industries (2-digit NACE rev.2)	Amadeus-EFIGE sample (%)	Sample of reference: see Table 1 and col. 1 of Table 3 (%)
10: Manufacture of food products	8.93	8.73
11: Manufacture of beverages	1.32	1.49
12: Manufacture of tobacco products	0.05	0.06
13: Manufacture of textiles	3.10	3.25
14: Manufacture of wearing apparel	2.53	2.57
15: Manufacture of leather and related products	1.61	1.97
16: Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	4.07	3.42
17: Manufacture of paper and paper products	2.23	2.45
18: Printing and reproduction of recorded media	4.42	3.35
19: Manufacture of coke and refined petroleum products	0.14	0.19
20: Manufacture of chemicals and chemical products	3.03	3.39
21: Manufacture of basic pharmaceutical products and pharmaceutical preparations	0.59	0.79
22: Manufacture of rubber and plastic products	6.84	6.80
23: Manufacture of other non-metallic mineral products	4.74	5.20
24: Manufacture of basic metals	2.32	2.42
25: Manufacture of fabricated metal products, except machinery and equipment	22.52	22.94
26: Manufacture of computer, electronic and optical products	4.73	4.74
27: Manufacture of electrical equipment	4.20	4.41
28: Manufacture of machinery and equipment n.e.c.	10.89	11.53
29: Manufacture of motor vehicles, trailers and semi-trailers	2.11	2.24
30: Manufacture of other transport equipment	0.93	0.81
31: Manufacture of furniture	4.15	3.75
32: Other manufacturing	3.61	2.57
33: Repair and installation of machinery and equipment	0.93	0.94
Total	100	100
Firms	13533	7196

Table A. 2

Distribution of manufacturing firms by country and CEO age both in the Amadeus-EFIGE sample (Panel 1) and in the sample for which the information on CEO age is available and the 2009-2014 average sales growth rate can be computed (Panel 2; see Table 1 and col. 1 of Table 3).

Panel 1								
CEO age category	AUT	FRA	GER	HUN	ITA	SPA	UK	Total
<45 y.o.	26.45%	25.78%	23.08%	25.38%	18.68%	30.96%	17.10%	23.75%
>=45 y.o.	73.55%	74.22%	76.92%	74.62%	81.32%	69.04%	82.90%	76.25%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Firms	363	2921	2673	457	2949	2655	1515	13533
Pearson's chi-squared test								
H0: equal distribution of CEO age classes across countries								
Chi ² (6) = 164.4843 Pr = 0.000								
Panel 2								
CEO age category	AUT	FRA	GER	HUN	ITA	SPA	UK	Total
<45 y.o.	21.28%	25.71%	23.88%	26.61%	17.68%	31.08%	18.60%	23.76%
>=45 y.o.	78.72%	74.29%	76.12%	73.39%	82.32%	68.92%	81.40%	76.24%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Firms	94	1879	850	248	2302	1538	285	7196

References

- Buis, M. L. (2007) "HANGROOT: Stata module creating a hanging rootogram comparing an empirical distribution to the best fitting theoretical distribution," Statistical Software Components, Boston College Department of Economics. Revised 18 May 2011.
- Wainer, H. (1974), "The Suspended Rootogram and Other Visual Displays: An Empirical Validation", *The American Statistician*, 28, 143-145.