CEO's Age and the Performance of Closely Held Firms*

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Abstract

Research summary: Using detailed ownership and financial information from a large sample of owner-managed private firms in three Western European countries, this paper examines the relationship between CEO's age and firm's performance. Tracking firms over time, we find that as a CEO ages, the firm experiences lower investment, lower sales growth and lower profitability, but also higher probability of survival, suggesting a trade-off between the managerial approaches of younger and older CEOs. These results are stronger in industries more reliant on human capital, such as service and creative industries. Our evidence also suggests that regional financial development moderates the relationship between a CEO's age and a firm's performance by facilitating the reallocation of assets from firms owned by older CEOs to firms owned by younger CEOs.

Managerial summary: How do management styles change as CEOs grow older? Using a large firm-level dataset, we examine the behavior and performance of firms with CEOs of different ages. We find that as a CEO grows older, firm investment, growth and profitability decline, but probability of survival increases. The results are stronger in industries where human capital and creativity are more important. Regional financial development moderates the age-performance relationship by facilitating reallocation of assets from firms with old CEOs to firms with younger CEOs. Our findings suggest that management styles change with age, as older CEOs tend to emphasize survival at the expense of higher profits and faster growth.

Keywords: CEO's age, closely held firms, firm growth, financial development.

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1 Introduction

Understanding the determinants of firm growth is a central goal of organization theory and strategic management (Penrose, 1959; Roberts, 2004). Factors that influence firm growth can be internal to the firm, including the quality of its management, the CEO's strategic vision, the firm's technological capabilities (Penrose, 1959; Lucas, 1978; Bertrand and Schoar, 2003; Baum and Locke, 2004; Van den Steen, 2005; Thornhill, 2006), or external, such as the country's level of financial development (which affects a firm's access to funds) or the competitiveness of the industry (Scherer, 1980; Davidsson, 1989; Carter and Van Auken, 2005; Hvide and Moen, 2010). In this paper, we examine how patterns of firm growth and performance are related to an important managerial characteristic, CEO's age.

The upper echelons perspective holds that top managers, both individually and as a team, exert a significant influence on firm strategies (Hambrick and Mason, 1984; Adner and Helfat, 2003; Hambrick, 2007; Finkelstein, Hambrick, and Cannella, 2009) and finds that the demographic profiles of executives, including age, are correlated with firms' decisions and performance (e.g., Carpenter, Geletkanycz, and Sanders, 2004; Hambrick, 2005; Finkelstein *et al.*, 2009). While an enormous volume of research in the upper echelons literature has included CEO age as an important variable,[1] the effect of CEO age on firm outcomes has not been investigated in sufficient depth. In this paper, we examine the moderating effects of external factors such as industry dynamism and creativity and also explore the role of financial institutions in alleviating the costs associated with old CEO age and succession. Another issue with existing research is that it has mostly focused on large firms. However, strategic decisions in large firms are typically taken by teams, and it is not clear what effect a CEO's age might have when a team is composed of members of different ages. Moreover, the separation of ownership and control in large corporations creates the potential for agency problems, which could further complicate the interpretation of results. The present paper sidesteps these complications by focusing on a relatively simple environment – closely-held small firms managed by their owners. For these firms, the owner-manager effect is likely to be large.

We suggest that, in closely-held small firms, management youth is associated with higher growth and performance. This could be due to younger CEOs' lower risk aversion (Bertrand and Schoar, 2003; Serfling, 2014), lower commitment to the status quo and higher probability of strategic change (e.g., Finkelstein and Hambrick, 1990), higher aspirations and preferences for growth (Gray, 2002; Ebner, Freund and Baltes, 2006), and lower likelihood of adverse health events (Bennedsen, Perez-Gonzalez and Wolfenzon, 2018). The more aggressive behaviors of younger CEOs could also be associated with lower

[1] See, for example, Finkelstein *et al.* (2009) for a comprehensive literature review.

survival of their firms. We further suggest that the effects of a CEO's age will be moderated by external factors. For example, firms operating in fast-moving industries can benefit more from aggressive strategies adopted by younger CEOs. The level of financial development of a region (Rajan and Zingales, 1998) may also moderate the relationship between CEO's age and firm growth and performance. Regional financial development can help improve the matching of owners with firms. Thus, more developed capital markets may facilitate the transfer of ownership from older to younger CEOs, mitigating the effects of old age.

We use a comprehensive dataset of 157,996 owner-managed firms from France, Italy, and the UK. We define a firm as owner-managed if its listed CEO is also its majority shareholder. To implement this classification, we textually match the CEO's name to a list of shareholders. Our estimation sample includes firms for which we can identify the leading shareholder (at least 50% of the equity) and determine the CEO's age (in our data, age information is available for managers, but not for owners). Importantly, we track firm growth and performance over time (2002–2012), which allows us to study the effect of the CEO's age on within-firm changes in firm growth and performance rather than making a cross-sectional comparison of firms managed by CEOs of different ages. Within-firm analysis also mitigates the unobserved heterogeneity problem. A potential concern is the extent to which our results can be interpreted causally. To address this concern, we exploit several exogenous sources of variation (regional level of financial development, industry variation in creativity and dynamism) and perform instrumental variable estimations. The results indicate that selection (low performing firms are disproportionately managed by older owners) is not the main driver of our results.

Our paper makes four main contributions. First, we document the distribution of firm assets across owner-manager age for a large fraction of the economy. The average effective retirement age of workers in the countries in our data is between 60 and 63 years of age.[2] We find that firms with a CEO who is at least 60 years old control 28% of the assets and 26% of the employment and that firms with a CEO who is at least 54 control 53% of the assets and 45% of the employment in our sample. These figures show that firms with older CEOs are widespread and constitute a significant share of economic activity within small and closely-held firms.

Second, we demonstrate that the CEO's age is related to changes in firm growth and performance. We find that investment and sales growth slows down as CEOs age and is especially pronounced for CEOs above 59. For instance, in a nine-year period, investment of CEOs above 59 decreases by 45% compared to the youngest CEOs group; for CEOs aged 35 to 40, the decline is 7%. We also find that performance

[2] The OECD computes the average effective retirement age as the average age of exit from the labor force during a five-year period. See http://www.oecd.org/els/emp/average-effective-age-of-retirement.htm

declines with a CEO's age. In a nine-year period, firms managed by individuals older than 59 have a 13% lower return on assets (ROA) compared to the youngest CEOs group; for CEOs between 35 and 40**,** ROA declines only by 2.4%. We further show that this lower performance is partially offset by firm-specific experience – no significant differences in ROA are observed for CEOs with at least 12 years of tenure. This is not the case for firm growth. The higher average growth and performance of firms led by younger CEOs comes at the cost of higher risk of exit. We find that firms with CEOs younger than 25 years old are about 1.5 times more likely to exit from business than firms with CEOs older than 60. Overall, our results indicate that older CEOs follow more conservative practices than their younger counterparts.

Third, we explore some of the mechanisms that may aggravate or alleviate the negative relationship between a CEO's age and firm growth and performance. Our results highlight the role of human capital. We find that the decline in firm growth is greater in service industries, where human capital is arguably very important, than in manufacturing industries, where human capital is arguably less important. Firms in creative industries are particularly affected by the presence of older CEOs. We observe that investment and growth in sales is slower respectively by 10.4% and 5.3% for the oldest CEO group as compared to the youngest CEO group. The decline in investment and sales growth is less pronounced for CEOs aged 40 to 59 in creative industries, but is still substantial, varying from 7% to 10% for investment and about 4% for sales.

Fourth, we examine contextual factors that can moderate the relationship between the CEO's age and firm growth and performance. In particular, we focus on how regional financial development may influence the propensity of older owner-managers to stay with or leave their firms. We find that financial markets play an important role in moderating the negative effect of older CEOs by facilitating their exit. First, we find a substantially higher prevalence of firms with older CEOs in regions with less developed financial markets, where the share of firms with CEOs who are at least 60 is 23%, relative to only 16% in regions of high financial development. Second, to explore what drives this striking difference, we examine patterns of ownership change across regions. In regions with more developed financial markets, there are more ownership changes, reducing the average CEO's age. Moreover, the negative relationship between age and firm growth is weaker for firms in regions with more developed financial markets. This may be driven by a selection effect of better or more motivated older CEOs choosing not to exit or by a moderating effect of access to financial resources that allow older CEOs to maintain high growth rates. These results highlight the role of financial markets in moderating the central phenomenon documented in this paper – the negative relationship between CEO's age and firm's growth – by facilitating the allocation of assets from firms with older CEOs to those with younger CEOs.

We stress that our results should not be interpreted as showing that younger CEOs are "better" than older CEOs in some objective sense. Our favored interpretation of the results is that younger CEOs adopt higher risk strategies than their older, more conservative counterparts. Younger CEOs may perform better, but this superior *average* performance may be associated with higher risk. This assertion is further supported by higher exit rates observed for firms led by younger CEOs.

The remainder of the paper proceeds as follows: Section 2 discusses the theoretical background and outlines our hypotheses. Section 3 describes the data. Section 4 discusses our estimation procedures. Section 5 presents the main empirical results. Section 6 concludes.

2 Theoretical background

Firm growth comes from expanding the current business or from exploiting new business opportunities. The rate and direction of growth depend on the firm's resources and capabilities (Penrose, 1959; Teece, Pisano, Shuen, 1997; Pettus, 2001; George, 2005). Upper echelons theory and the dynamic managerial perspective emphasize the importance of managerial characteristics for firm growth (Penrose, 1959; Hambrick and Manson, 1984; Castanias and Helfat, 1991, 2001; Adner and Helfat, 2003; Teece, 2009). However, the relationship between the age of managers and firm growth has not been extensively studied. CEO age is commonly controlled for, but few studies have systematically explored the effect of CEO age on firm outcomes (Krause and Semadeni, 2014). Moreover, these studies do not examine the factors moderating this relationship.

Existing studies suggest that CEO youth is associated with corporate growth (Hart and Mellors, 1970; Child, 1974; Bhabra and Zhang, 2016). Firms with younger CEOs have been shown to exhibit higher average growth, but also considerably more variation in their growth rates. Corporate growth could be achieved through internal development, R&D, and mergers and acquisitions. Younger CEOs have been shown to be more likely to invest in research and development (Barker and Mueller, 2002; Serfling, 2014) and more likely to acquire other firms (Matta and Beamish, 2008; Levi, Li and Zhang, 2010; Yim, 2013). They open and close new plants more frequently (Li, Low, and Makhija, 2017), exhibit higher levels of strategic change (Wiersema and Bantel, 1992; Huber *et al.*, 1993; Yang, Zimmerman, and Jiang, 2011; Datta, Rajagopalan, and Zhang, 2003; Zhang and Rajagopalan, 2010), and overall generate higher market value (Bhabra and Zhang, 2016; Cline and Yore, 2016).

There are several reasons why firms with younger CEOs might exhibit higher growth and performance. First, upper echelons literature has linked managerial youth with increased risk-taking propensity. While inexperienced younger CEOs could find it challenging to assess strategic risks associated with the alter-

native risky actions, older CEOs, relying on their experience and past success in dealing with the similar projects, should be better able to select the projects with the higher probability of success. Because older managers, in particular owner-managers, may be more concerned with their future financial security and thus may try to reduce the risk of personal wealth destruction (Williamson, 1963; Sharma, Chrisman and Chua, 1997),[3] they could be unwilling to take risks associated with investments in new business development or venturing activities as they approach retirement age (Morin and Suarez, 1983; Barker and Mueller, 2002; Serfling, 2014). As a result, older CEOs may behave cautiously and commit resources to initiatives where the possible outcomes are fully understood to ensure survival of their firms and to leave a legacy for future generations. A number of studies demonstrate that younger CEOs tend to pursue riskier strategies (Karami, Analoui, and Kakabadse, 2006), including R&D investment (Serfling, 2014), and adopt riskier modes of entry into a new market, such as greenfields as opposed to joint ventures (Herrman and Datta, 2006).

Second, older age is often associated with longer tenure in office. As CEO tenure increases, firms may become less willing to act on entrepreneurial initiatives. Hambrick and Fukutomi (1991) argue that longer CEO tenures are associated with firm performance deterioration. They offer a comprehensive model of the "seasons of a CEO's tenure". Seasons are characterized by several critical changes in CEO attention and behavior. Hambrick and Fukutomi (1991) argue that CEOs start their job with relatively strong commitment to their paradigms, followed by a short period of experimentation and paradigm recalibration and then further strengthening of the commitment to their updated paradigm. This process is accompanied by gradual decrease in number of information sources used, and decline in quality of information gathering and analysis (Tushman and Romanelli, 1985; Miller, 1991). Further, as CEO tenure advances, level of task interest and the speed of acquiring task knowledge decrease, while a manager's power increases. This model of the "seasons of a CEO's tenure" is supported by Miller's (1991) logic that CEOs become "stale in the saddle." Longer tenure also promotes manager's greater psychological commitment to the organizational status quo (Stevens, Beyer, and Trice, 1978; Hambrick and Mason, 1984; Hambrick, Geletkanycz and Fredrickson, 1993).

Third, owner-managers of private firms may also choose to reduce their effort in the firm in favor of greater consumption and leisure (e.g., Ando and Modigliani, 1963; Gourinchas and Parker, 2002; Gray, 2002; Dynan, Skinner, and Zeldes, 2002). For example, Kanfer and Ackerman (2004) argue that the prospect of working seventy to eighty hours per week is manageable for younger adults, but is typically

[3] For example, the Federal Reserve Board's Survey of Consumer Finances for 2010 (SCF) finds that equity in the firm represents on average 30% of the total wealth of the owner. Another 30% of their wealth comes from the labor income that owners earn from their firms (e.g., Hamilton, 2000; SCF).

becomes increasingly less attractive for middle-aged and older adults. Moreover, older CEOs may be forced to reduce their effort in the firm due to adverse health events. Bennedsen *et al.* (2018), for instance, show that CEO hospitalization or death, the occurrence of which is likely to increase with age, has a significantly adverse effect on firm profitability, revenue and investment outcomes.

Finally, aspirations and personal goal orientations may change across adulthood. For example, Ebner *et al.* (2006) find that young adults report growth as their primary goals, while older adults lean toward maintenance and loss prevention. Further, orientation toward prevention of loss is negatively correlated with well-being of younger adults, but positively correlated with well-being of older adults. At the same time, studies demonstrate that small business managers' aspirations to expand their business activities are positively related to actual growth (Wiklund and Shepherd, 2003). Together these findings suggest that younger owners are most likely to seek financial independence and self-fulfillment, which may result in higher firm growth and performance, while older owner-managers may desire to maintain stable income with a flexible lifestyle (Gray, 2002).

All of these considerations can lead to less aggressive strategies pursued by older CEOs and in turn to lower average growth and performance of their firms. We therefore hypothesize

Hypothesis 1. *A CEO's age is negatively associated with a firm's (a) investment, (b) growth, (c) performance.*

At the same time, less aggressive strategies pursued by the older CEOs can be good for the firm. Higher expected return is often associated with higher risk and, consequently, a higher risk of failure. Hart and Mellors (1970) and Child (1974) show that firms led by younger CEOs exhibit higher return volatility. It is consistent with the idea that inexperienced young CEOs do not know ex ante their own entrepreneurial skills, but they learn over time by observing the returns to their activity. Therefore, the observed volatility of returns is expected to be large when CEO is young, but due to selection induced by learning it is expected to decrease as CEOs age (Campanale, 2010). Younger CEOs may also be willing to take more risks because their cost of exit from business in case of failure is lower. When a risky project fails, younger owner-managers are more likely to exit from the business for an alternative employment, which makes them more risk-tolerant (Vereshchagina and Hopenhayn, 2009). We therefore hypothesize

Hypothesis 2. *A CEO's age is positively associated with a firm's survival.*

Several factors can influence the strength of the relationship between a CEO's age and firm growth and performance. We examine three industry and environmental characteristics that can be expected

to have a clear-cut effect on the relationship: industry creativity, technological dynamism, and financial development.

Creative industries. The discussion above suggests that CEO's age can be particularly important for firm growth and performance in specific industries. We begin with creative industries that supply goods and services broadly associated with cultural, artistic, or entertainment value (e.g., advertising and fashion). They are characterized by a high level of uncertainty in demand, risk (Caves, 2000; Townley and Beech, 2010) and novelty, though not necessarily technological advancement (Power and Scott, 2004; Stoneman, 2010).

In owner-managed firms, the human capital of top managers is often a key input. If their creativity and propensity to change decline, we would expect the growth and performance of their firms to suffer, especially in creative industries. Psychological studies have found that the highest creativity values are either attained by the youngest age groups (Ruth and Birren, 1985) or have an inverted U-shape culminating before the age of 40 (Alpaugh and Birren, 1977; Levinson, 1989). Innovators and top scientists are found to be more creative early in their careers (Galenson and Weinberg, 2000, 2001; Weinberg and Galenson, 2005; Jones and Weinberg, 2011). Further, using the sample of the US publicly traded firms, Acemoglu, Akcigit, and Celik (2014) show that younger CEOs tend to work with younger inventors; thus, the effect of a CEO's age may not be confined to his or her individual contribution. Also, team creativity appears to be enhanced by young members (Packalen and Bhattacharya, 2015). As we focus on small firms in which CEOs are also majority shareholders, it is important to stress that even when top managers are not the ones to come up with original ideas, they are still the ones who approve or veto them. We therefore hypothesize:

Hypothesis 3. *The negative relationship of a CEO's age with firm investment, growth and performance is stronger in creative industries.*

Technologically dynamic industries. An environmental change is likely to require adaptation (Thompson, 1967). However, the managerial cognition literature suggests that bounded rationality prevents managers from developing a complete understanding of their firms' operating environments (Bogner and Barr, 2000). Managers focus their attention on those domains they consider to be most relevant, while selectively ignoring others (Hambrick and Mason, 1984; Dutton and Jackson, 1987; Bogner and Barr, 2000; Fiol and O'Connor, 2003). Thus, firms will not respond to environmental changes unless those changes are noticed and perceived as important by managers (Nadkarni and Barr, 2008). This is particularly important in fast-changing environments, where CEOs need to process large quantities of am-

biguous information to identify the most pressing issues. Older CEOs may be at a disadvantage in these environments, as they may possess more established knowledge structures and preferences, resulting in larger biases in dealing with incoming information. They may have a stronger commitment to status quo and would rationalize the observed changes in the environment to fit their view and make their previous actions sensible (Daft and Weick, 1984). In addition, longer-tenured CEOs may receive narrower, more finely filtered information from trusted internal sources (Hambrick and Fukutomi, 1991; Miller, 1991). Building on this more finely filtered information, older CEOs may not see the need to reconfigure their business.

By contrast, less dynamic environments could be more forgiving. They are characterized by less dramatic and more predictable changes (Eisenhardt and Martin, 2000). CEOs can gradually build and improve their understanding of the environment over time, which could translate into better performance. For example, Henderson *et al.* (2006) find that firms in the relatively stable branded-foods industry continued to steadily increase their performance over a CEO's tenure for about fifteen years before it started to decline gradually. Authors argue that in more stable industries the existing strategies could stay relevant for longer without considerable penalties and could even benefit from incremental fine-tuning. We therefore hypothesize:

Hypothesis 4. *The negative effect of a CEO's age on firm investment, growth and performance is stronger in technologically dynamic industries.*

Financial development. Growth may not be the major objective of firm owners managing the firm (Chrisman, Chua and Zahra, 2003). The literature distinguishes between lifestyle firms and growth-oriented firms. Lifestyle firms are set up to satisfy more personal goals of the owner whilst also providing an adequate income, and growth-oriented firms are set up with the intent to expand. While family firm owners as a broad category may prioritize family concerns over business concerns (Budge and Janoff, 1991; Whiteside and Brown, 1991), a substantial share of them may nevertheless be growth-oriented (Harvey and Evans, 1994; Kets de Vries, 1993).

Owners that are not interested in growing the firm (perhaps because they are getting too old) may choose to sell the firm. One of the channels through which financial development could contribute to growth is by facilitating ownership change. Financial development affects the ability of potential investors seeking to purchase a firm to obtain additional funding from either banks or private equity investors (Giannetti, 2003). They will have better access to such resources in more financially developed regions as financial development has been shown to enhance the probability of starting a business, to favor entry of

new firms and to promote growth (Guiso, Sapienza and Zingales, 2004).

Firm sale is likely to occur earlier in a owner-manager's life if he or she can get a better deal. This, in turn, can help to avoid the negative effects associated with age. Thus, the financial development of a region promotes economic growth not only by providing better access to finance for start-ups, but also by assisting ownership transfers from those who are less motivated and not interested in growing business to those who are more motivated and ambitious. We therefore hypothesize:

Hypothesis 5. *Financial development moderates the negative effect of a CEO's age on firm investment, growth and performance by facilitating ownership transfers between younger and older CEOs.*

3 Data

To empirically document the relationship between a CEO's age and the firm's growth and performance, we develop a new dataset on ownership and management of private firms operating in three countries of Western Europe. We use data from Amadeus, a database maintained by Bureau van Dijk (BvD), which contains ownership, management, and financial information on European firms. BvD obtains its data from regulatory filings, third-party vendors, and its own proprietary sources. Amadeus contains not only detailed financial information for both private and public firms, but also detailed ownership information that includes the name of each shareholder, the number and type of shares held, and information on each firm's management and board of directors. We focus on the period from 2002 to 2012 to analyze firm growth and performance, as well as firm exit and changes in ownership structure during this period.

We restrict our attention to firms that are managed and at least partially owned by the same person. By focusing on owner-managed firms, we eliminate the potential agency problems from the separation of ownership and control, which could affect managerial actions and hence firm growth and performance. To identify which CEOs are also firm owners, we developed a name-matching algorithm that compares the list of firm managers to the list of firm owners. In the vast majority of cases, leading shareholders are also listed as CEOs, especially for the smaller and younger firms in our sample.

Our matched sample includes 157,996 firms from France (33%), Great Britain (64%) and Italy. German firms are excluded because small German firms are not required to disclose balance sheet information, making it impossible to calculate financial performance outcomes such as ROA. We retain only those firms for which we have ownership and age information and we exclude firms for which we are unable to identify at least 90% of the reported shareholders and those for which annual sales are not reported.

A major contribution of our analysis is tracking private firms' ownership changes over time. Of the surviving firms, we have ownership information for 111,269 firm-years.[4] For the rest, ownership information is either missing or too incomplete to allow us to credibly determine the ownership structure. We base our analysis of ownership changes on firms for which we have comprehensive ownership coverage and base our analysis of firm growth and performance on the complete sample of 625,987 firm-years. To address the concern that changes in firm outcomes may be driven by changes in management or ownership rather than associated with the CEO's age, we also report the results for a clean subsample of firms with no ownership and management changes in the robustness section of the paper.

3.1 Descriptive Statistics

Table 1 presents summary statistics for the main variables in our sample. The average firm has \$3.2 million in assets, generates \$6.0 million in sales, and has 31 employees. The average CEO's age is 50.6 (the median is 50.2) and the average firm's age is 11 (the median is 7). Average profits over the period from 2003-2012 are about \$205,000 and ROA is 0.10. Average investment over the same period is 0.035 and the sales growth is 0.08. The correlation matrix is reported in the online supplement (*Table OA1*).

[**Insert Table 1 here**]

Table 2 presents the distribution of assets and firm characteristics by the CEO's age. The top panel demonstrates that firms with CEOs over 53 own the majority of assets in our sample: 25% of the assets are owned by firms with CEOs between 54 and 59; 28% are owned by firms with CEOs 60 and older. As we show later in the empirical analysis, these same two groups of firms experience the sharpest decline in growth and performance. Table 2 also shows that firms with older CEOs are substantially larger and older. However, ROA is lower for firms with the oldest CEOs than for any other age category and is less than half the ROA for firms with the youngest CEOs.

[**Insert Table 2 here**]

Table 3 presents the distribution of CEO's ages by main industries. Firms in our sample are drawn from a wide industry distribution. For ease of presentation, we aggregate the three-digit SIC codes into broad industry-level categories.[5] We manually classify industries as service or manufacturing, based on

[4] We check which types of firm have missing ownership information in 2011. Firms for which there is ownership information are much larger than those for which there is no ownership information. Average sales for firms with ownership information is \$8.8 million; for those without, it is only \$0.5 million. The same very large differences are found when we examine assets (\$5.9 million versus \$0.4 million) and employment (39 versus 3). Thus, our analysis of ownership changes disproportionately represents the larger firms in our sample.

[5] Details on our classification of SIC codes into main industry categories are available upon request.

their text description. We find that manufacturing firms generally have older CEOs (the average age being 53.3 versus 49.8) and a higher incidence of CEOs over 59 (28 versus 18.7). The most represented industries in our sample are construction (25,807 firms) and retail and apparel (11,928 firms). Other common industries include engineering and architectural (8,587 firms), food stores and restaurants (6,814 firms) and real estate (6,594 firms). The incidence of firms with CEOs over 59-our sample's 90th percentile-varies from 15.6% in food stores and restaurants to 40.3% in chemicals.

[Insert Table 3 here]

4 Econometric Specifications

Our main interest is in the relationship between CEO age and firm growth (firm investment and sales growth) and performance (return on assets). We estimate the following specification for the relationship between CEO age and changes in firm outcomes (i indexes firms):

$$y_{it} = \alpha_1 \ln Assets_{it-1} + \alpha_2 \ln FirmAge_{it} + \alpha_3 \ln CEOAge_{it} + \varphi_j + c_c + \epsilon_{it}, \quad (1)$$

y_{it} denotes the outcome variable (firm investment, sales growth or ROA) of firm i at time t. CEO Age is the age of firm owner-manager. We also control for assets and firm age. Controlling for firm age is especially important due to the strong positive correlation between firm age and CEO age. Later we report robustness checks where we break the sample by different firm age brackets and show that our results continue to hold in each subsample. φ and c are complete sets of three-digit SIC codes and country dummy variables. ϵ is an iid error term.

In separate regressions we also replace CEO age with a set of dummies for different age brackets to pick up a non-linear effect in CEO age. These dummies are for the following age categories: less than 34 (10th percentile), 35-40 (10th percentile to 25th percentile), 41-46 (25th percentile to 50th percentile), 47-53 (50th percentile to 75th percentile), 54-59 (75th percentile to 90th percentile) and above 59. We expect that outcomes would be more negative for older managers ($\widehat{\alpha}_3 < 0$).

Instrumental Variables. A potential concern is that ownership structures could be chosen based on certain firm characteristics (e.g., Demsetz and Lehn, 1985). For example, the better firms may be more likely to have ownership transferred from an older CEO to a younger CEO at an earlier age, while firms performing less well may not change their ownership and management. To address these concerns, we use an instrumental variable strategy. Specifically, we use the average age of the founder at the country, industry, and year level at the time of firm founding to instrument the likelihood of old CEOs. The idea

is that the level of experience needed to start a business varies by country, industry and year. The higher the average age of the founder at the time of firm founding, the higher incidence of old CEOs observed later in the sample. At the same time, the average age of the founder at founding would not correlate with current firm growth and performance. Note that to account for firm-specific time-invariant unobserved heterogeneity we include firm fixed effects in all specifications.

Survival analysis. We employ Cox proportional hazards model to estimate the effect of CEO age on the firm survival. The model is formulated as follows:

$$h_i(t|X_i) = h_0(t)\exp(X_i\beta), \tag{2}$$

where the hazard function for the i^{th} firm, $h_i(t|X_i)$, is conditional on covariates X_i. $h_0(t)$ is the baseline hazard, which corresponds to the value of the hazard when all the predictors (X_i) are equal to zero ($h_i(t|X=0)$). Covariates X_i include firm assets, firm age and a set of dummies for age categories. The estimated $\exp(\beta)$ is the hazard ratio comparing the likelihood of the exit from business, for example, for firms with young versus firms with old CEOs. A hazard ratio of 1.0 is then suggests that CEO's age does not affect business survival, holding all other variables constant. A hazard ratio lower (greater) than 1.0 suggests a lower (higher) likelihood of business failure.[6]

5 Estimation Results

5.1 CEO age and changes in firm outcomes

We start exploring the relationship between the CEO's age and firm outcomes by estimating basic regressions. *Table 4* presents the regression estimation results. We find a clear negative relationship, which is mostly linear and is strongly driven by the oldest CEO category in our sample.

Columns 1-5 show the results for investment. We find that older CEOs invest less. Columns 1-4 include a single continuous variable for the CEO's age. As expected, the coefficient estimate on age is negative and significant. This result is robust to between firm estimation, 3-year differencing, and inclusion of firm fixed effects to control for time-invariant firm heterogeneity. Column 5 replaces the CEO's age with a set of dummies for age categories. Using the youngest CEOs in our sample (34 or younger) as the omitted base category, the coefficient estimate on the dummies for the oldest CEO category is -0.451 (with a standard error of 0.009), while the coefficient estimate on the second-youngest CEO category is -0.071. These estimates indicate that firms owned by the oldest category of CEOs invest 45 percentage points

[6] STATA statistical software package is used to conduct the analysis. Specifically, we use *areg* command for the main estimations; *reghdfe* command is used for the instrumental variable analysis; survival analysis is performed using *stcox* command.

less than firms owned by the youngest CEOs. We further confirm, using a Wald test, that the coefficients for the various age windows are statistically different from each other.[7]

Columns 6-10 examine age effects for sales growth. As we did for investment, we find a slower growth in sales for CEOs aged 53 and above relative to younger CEOs. The coefficient estimate for CEOs aged 54 to 59 is -0.389; it is -0.110 for CEOs aged 35 to 40. Thus, sales by older CEOs grow at a rate 28% slower than the rate for younger CEOs. Our interpretation of the lower investment and slower growth in sales for firms with older CEOs is that those managers have less incentive to invest in the firm due to lower preference for growth. However, it is also possible that the observed decline in growth is in fact the result of older owners liquidating their firms so they can retire.

To shed further light on the nature of the lower investment and slower growth in firm sales, we explore the relationship between the CEO's age and firm performance. Columns 11-15 focus on ROA. We find a strong decline in ROA for the oldest CEO category. For CEOs 60 and older, ROA is 13.2% lower than for the youngest CEO age category. Lower ROA together with lower investment and growth in sales are consistent with Hypothesis 1.[8]

[Insert Table 4 here]

We further address the endogeneity concern by reestimating our main specification using an instrumental variable (IV) strategy. We use the average age of the founder at the industry, year and country level at the time of firm founding to instrument the likelihood of old CEOs. *Table 5* reports the estimation results. In Column 2 we observe a strong negative age effect on firm investment. The sign and magnitude of the coefficient estimated by IV model is similar to the one of OLS (Column 3). Same holds for growth in sales (Columns 5-6) and ROA (Columns 8-9).[9] Overall, the observed pattern is consistent with our main estimations reported in Table 4.

[Insert Table 5 here]

We further investigate whether firms led by older CEOs exhibit higher survival rates. *Table 6* studies the relationship between firm survival and CEO age. Column 1 shows that the probability of firm exit decreases as the age of a CEO increases (the estimated hazard ratio is $0.991 < 1$). We control for firm assets and firm age to ensure that results are not driven by younger firms, which have the highest failure

[7] The test results are available upon request.

[8] The potential concern is that the period of our study contains a period of considerable economic upheal which may limit the generalizability of our results. We therefore reestimate our main specification for years before the crisis (2002-2007). The sign and the magnitude of estimated coefficients are in line with our main findings. These results are available upon request.

[9] The results are also robust to employing the average age of the founder at the industry, year, country and gender level at the time of firm founding as an instrument. These results are available upon request.

rates. Model in Column 2 uses a dummy variable for age that equals to one if the CEO is younger than 30 years old at the year of incorporation and zero otherwise. Then, the estimated hazard rate of 1.357 implies that firms with CEOs younger than 30 years old are about 1.4 times more likely to exit business than firms with CEOs of 30 years old and above. Column 3 presents more detailed age categories. The base category is defined as firms with CEOs older than 59 (the oldest group). Firms with youngest CEOs (18-25 years old) are nearly 1.5 times more likely to exit from business than firms led by the older CEOs (60 and above). The likelihood of exit gradually decreases with the age of the CEO. These results are consistent with Hypothesis 2.

[Insert Table 6 here]

5.2 Mechanisms

There are several potential mechanisms through which the aging of a CEO could affect firm growth and performance. We examine industry variation by paying attention to creative and technological components that could be crucial for aging CEOs' firms' outcomes, as put forth in Hypotheses 3 and 4.

5.2.1 CEO age and creativity

As creativity has been shown to decrease with age, the effect of a CEO's age on firm growth could be particularly pronounced in creative industries, including advertising, architecture, art, crafts, design, fashion, film, music, performing arts, publishing, research and development (R&D), software, toys and games, radio, TV, and video games (Howkins, 2001).[10] These industries are referred to as the creative economy and account for a significant share of gross value added. For example, according to the UK Department of Culture, Media and Sport, creative industries accounted for five percent of the total UK gross value added in 2013.[11]

Estimation results are reported in *Table 7*. Overall, the results are consistent with our main estimations – higher CEOs' age is associated with lower investment, lower growth in sales and lower ROA. However, the impact of older CEOs on outcomes of firms operating in creative industries is more pronounced as well. The coefficient estimates for CEOs who are 60 and older in creative industries are -0.104 (with a standard error of 0.019) for investment, -0.053 (with a standard error of 0.019) for changes in sales, and

[10] We adopt the detailed classification of creative industries provided by the UK Department for Culture, Media and Sport, available at http://webarchive.nationalarchives.gov.uk/20150514120656/https://www.gov.uk/government/statistics/creative-industries-economic-estimates-january-2015

[11] http://webarchive.nationalarchives.gov.uk/20150514120656/https://www.gov.uk/government/statistics/creative-industries-economic-estimates-january-2015

-0.054 (with a standard error of 0.010) for ROA when compared to the youngest age category (34 or less). These results support Hypothesis 3.

[Insert Table 7 here]

5.2.2 CEO age and technological dynamism

Creativity is important to innovation, but there is much more to the creation and commercialization of new products and processes than creativity. Because these activities must be paid for, R&D expenditures—or the share of employment devoted to R&D—have been used to measure innovative activity. Intensity of R&D at the industry level characterizes an industry's technological dynamism. We use Eurostat's industry classification to measure technological dynamism and distinguish between manufacturing and service industries. Aggregation of manufacturing industries is based on the R&D intensity (R&D expenditure to value added) of economic activities. Economic sectors are classified as high-technology, medium-high-technology, medium-low-technology, or low-technology. While direct R&D intensities are not useful for service activities, those sectors are aggregated into knowledge-intensive services and less-knowledge-intensive services, based on the share of tertiary-educated employees at the two-digit industry level.[12]

The estimation results are reported in *Table 8*. We do not find support for Hypothesis 4 that the aging of CEOs negatively affects firm outcomes in technologically dynamic manufacturing industries. However, firms that operate in knowledge-intensive and less knowledge-intensive service industries and whose CEOs are 60 and older do have lower investment (about 3%), lower sales growth (about 4%) and lower ROA (about 2%) than firms whose managers are younger than 60. This finding is consistent with our previous result on creativity, as many knowledge-intensive service industries could be characterized as creative because the problems faced by their clients are often unique, context-specific, and highly specialized (Salter and Tether, 2006).

[Insert Table 8 here]

5.3 Regional financial development

In this section, we present evidence that the incidence of firms with older CEOs is lower in regions with higher financial development. Then we examine a potential mechanism for this effect, as posited in Hypothesis 5: ownership transfer. Specifically, we show that both ownership change and firm exit are more likely in regions with higher financial development, especially for firms with older owner-managers.

[12] The detailed Eurostat classification of manufacturing industries according to their technological intensity and service industries according to their knowledge intensity is available at http://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf

Finally, we show that the decline in firm investment associated with older CEOs is less pronounced in regions of high financial development.

To study these issues, we exploit variation in credit availability across regions within Europe. A challenge is that firms in Amadeus are not classified to regions. Nevertheless, for each firm we have information on its city address. We use this information to manually match each firm/city to a region. Regions are identified according to the Nomenclature of Territorial Units for Statistics (NUTS).[13]

The data on financial development that measures the ease of obtaining external financing comes from several sources.

Number of Financial Institutions. Information on the number of financial institutions in each region comes from Structural Business Statistics (SBS) provided by Eurostat. SBS collects information on credit institutions, where a credit institution is "an undertaking whose business is to receive deposits or other repayable funds from the public and to grant credits for its own account" (SBS definition). All credit institutions in this measure operate in the following business segments: "other monetary institution" (NACE 65.12), and "other financial intermediation" (NACE 65.2). The number of financial institutions varies considerably across regions, from as low as 283 to a high of 3,886 (the average number of financial institutions is 1,781, the median is 1,836). Because regions vary by size and population, in all regressions we control for a region's geographical size and population. We also explore specifications where we normalize the number of financial institutions by region size. The same pattern of results holds in the normalized specifications.

Financial Sector Productivity. Financial sector productivity is the ratio between total revenues by financial institutions in a region and number of financial sector employees, and is from the European Competitiveness Index 2006-07 report (Huggins and Davies, 2006).[14] Financial sector productivity varies from a low of 60,190 EU per employee to a high of 107,830 EU per employee (an average value of 77,092 and a median value of 69,389).

Private equity investment. Private equity investment data is from the statistical annexes of each country's private equity or venture capital association.[15] Private equity investment varies a lot across regions from as low as $9 million to a high of $3,590 million, The 25th percentile of investment is $418 million and the 75th percentile is $1,266 million (an average value of $1,337 million and a median value of $556 million).

[13] For further details concerning the NUTS classification see http://ec.europa.eu/eurostat/web/nuts/overview

[14] Accessed through http://www.cforic.org/

[15] Country sources are the following. France: The French Private Equity Association (AFIC), https://www.afic-data.com/. Great Britain: The British Private Equity & Venture Capital Association (BVCA). Numbers include all investments in a year 'made' of 'advised by' the BVCA members regardless of whether the investing fund is domestic or overseas-based.

5.3.1 Financial development and CEO age

We have shown that older CEOs are associated with lower investment, lower growth in sales, and lower ROA. This is especially true in the service and creative industries in which the manager's human capital is more likely to matter. In this section, we explore how the likelihood of a firm having an older CEO is affected by the regional level of financial development.

Table 9 shows how the share of assets and employees in firms with CEOs who are 60 and older varies by regions with high and low financial development. In regions with high financial development, the share of both assets and employment in firms with older CEOs is substantially lower. In particular, 23.4% of assets are controlled by CEOs older than 59 in less financially developed regions, compared to only 16.3% in more financially developed regions. We also find that older CEOs employ 18.5% of the workers in less financially developed regions but only 12.7% in more financially developed regions. In more financially developed regions, older CEOs in manufacturing industries control fewer assets and employ fewer workers than older CEOs in service industries. No difference is observed in less financially developed regions.

[Insert Table 9 here]

In *Table 10*, we look at the same relation between regional financial development and CEO's age in a linear probability model. The dependent variable is a dummy for firms with CEOs who are 60 and older.

Columns 1-3 establish a strong negative relationship between regional financial development and the incidence of older CEOs. Column 1 presents the results for the number of financial institutions in the region. The estimated effect is large: moving from the first quartile to the forth quartile of number of financial institutions reduces the incidence of older CEOs by 3.2 percentage points, or 32% of the sample mean. Columns 2 and 3 present the results for financial sector productivity and the amount of private equity investment, respectively. We find similarly negative effects for both. Taken together, these results indicate that financial development is associated with less assets managed by older CEOs. If financial markets reduce the prevalence of firms run by older CEOs because they increase asset tradability, we would expect the negative effect of financial development to be stronger in industries in which assets, being more tangible, are more likely to be traded across markets.

Columns 4-6 test this prediction by distinguishing between service and manufacturing industries. We find a negative and significant coefficient estimate on the number of financial institutions for both industry types; however, as expected, the coefficient estimate for manufacturing is substantially larger in absolute value (-0.035 versus -0.023). Column 6 includes an interaction between the number of financial institutions and a dummy for manufacturing industries and shows that the coefficient estimate on the

number of financial institutions is significantly larger in absolute value for manufacturing firms.

[Insert Table 10 here]

5.3.2 Financial development, ownership changes and exit

We next examine the relation between regional financial development and the likelihood that firms change ownership.

Columns 1-3 of *Table 11* present linear probability models that examine the likelihood of ownership change as a function of measures of financial development, CEO's age, and other firm and geography controls. We use three measures of financial development: number of financial institutions, financial sector productivity, and level of private equity investment. We find that according to all three measures, greater financial development is associated with a greater likelihood of ownership change. Moving from the 10th percentile to the 90th percentile of the number of financial institutions distribution increases the probability of an ownership change by 17.4 percentage points, or 43% of the sample average. This is consistent with the idea that more developed financial markets facilitate the transfer of private asset ownership and thus mitigate the negative effect associated with older CEOs by allowing them to sell their companies earlier.

In Columns 4-6 of *Table 11*, we explore the relationship between regional financial development and the likelihood that a firm exits the sample. If exits are an indicator of poor performance, we should expect that in regions with more financial development, we would observe fewer exits because financial markets facilitate more efficient ownership structures through ownership changes. The negative coefficients on our three measures of financial development suggest that this is the case. Lastly, we examine whether the decline in firm investment as CEOs age is less severe in more financially developed regions than in less financially developed regions. If financial markets help CEOs sell their firms when it is efficient to do so, we should see higher investment in more developed financial markets.

[Insert Table 11 here]

In *Table 12*, we run our main investment regressions on subsamples of firms in less financially developed regions (Columns 1-3) and in more financially developed regions (Columns 4-6). Indeed, firm investment is 30% lower for firms owned by CEOs who are 60 and older relative to CEOs aged 34 and younger in less financially developed regions, but only 20% lower in more financially developed regions. This finding is consistent with the idea that financial development moderates the negative effect of older CEOs on firm

growth.

[Insert Table 12 here]

To aid in the comparison of coefficients on the CEO-age categories across specifications, *Figure OA1* in the online supplement plots each coefficient in the regressions in *Table 12*. Figure 1.a compares the coefficients for more and less financially developed regions for firms in all industries. Figures 1.b and 1.c show the comparison for service and manufacturing industries, respectively. In all three figures, the gap between more and less financially developed regions increases when CEOs reach age 60 and above, consistent with suboptimal management by older CEOs. We also formally test whether the observed differences in coefficients are statistically significant between more and less financially developed regions using seemingly unrelated model (*suest* command in Stata). The tests show that the coefficient estimates differ significantly for CEOs older than 40 years old. These results are provided in *Table OA2* of the online supplement.

5.4 Robustness tests

In this section we examine the robustness of our main findings to alternative subsamples and controls. The tables are reported in the online supplement.

Managerial and ownership changes. As our sample spans over a relatively long time period (2003–2012), the potential concern is that CEOs move between firms and therefore may differ within firms from one period to the next. To address this concern, we check the robustness of our main results on the subsamples of firms with (*i*) no CEO changes (Columns 1-3, *Table OA3*) and (*ii*) no CEO and ownership changes (Columns 4-6, *Table OA3*). The magnitude and sign of the estimated coefficients mirror our main results.

Omitted variables. Research based on upper echelons theory found that such attributes of top executives as tenure, educational level and functional experience could also be proxies for managerial cognition. Educational level and functional experience do not change dramatically over time and therefore are taken care of by controlling for firm fixed effects.[16] We assume that CEOs do not move much between firms as the businesses we are focusing on are owned by the CEOs. At the same time, firm-specific experience or tenure of a manager is closely interrelated with the age of an executive. Tenure is often considered to be representative of a variety of additional variables that are not associated with age. Therefore, omitting tenure could potentially result in overestimation of the age effect.

[16] We cannot control for these characteristics directly as the information about education and functional experience of a manager is available for less than 1% of firms in our sample.

We check the robustness of our main results by re-estimating our main specification on three subsamples based on CEO tenure – under 5 years (the bottom quartile by tenure), between 5 and 11 years (the interquartile tenure range), and over 12 (the top quartile by tenure). *Table OA4* presents the estimation results. We observe a strong negative relationship between CEO's age and investment and sales growth, in all three subsamples. There is also a decline in firm performance, measured by ROA, below the 75th percentile (tenure 11 years), but it is less pronounced. Further, substantial firm-specific experience (above 12 years) seems to outweigh the negative effect of age on firm performance (Column 9).

Firm age. Throughout the analysis, we have controlled for firm age, in addition to manager age, to ensure that our results do not reflect difference in performance between younger and older firms. We further test the robustness of our results by repeating our analysis on three sub-samples based on firm age – under 5 years (the bottom quartile by firm age), between 5 and 16 years (the interquartile firm age range), and over 16 (the top quartile by firm age). *Table OA5* presents the estimation results. We see that for all firm ages higher CEO age is associated with lower investment and lower growth in sales. The negative effect of age on ROA is lower in magnitude for the set of oldest firms, but it is still present.

6 Conclusion

Using large-scale data on Western European small owner-managed firms, we show that firms run by older CEOs exhibit lower investment, lower growth in sales and lower performance, as measured by ROA. The negative effect of older CEOs on firm outcomes is particularly pronounced in industries in which creativity and human capital are important. We also find that in more financially developed markets, fewer firms are owned by older CEOs and that the decline in firm performance associated with older CEOs is less pronounced.

Our results contribute to research examining the effects of top managers on firm growth and performance. As CEOs grow older, they appear to become more conservative and less growth-oriented. This is not to say that younger CEOs should be favored. We tend to think that higher average firm growth and performance by younger CEOs is driven by adoption of higher-risk strategies. The industry analysis provides some clues on which industries should favor younger CEOs and which should favor older CEOs. For example, firms operating in industries that require managers to "move fast and break things" (e.g., creative industries) would benefit from being led by younger CEOs, while others may extract more benefits from sustainable growth and performance associated with older CEOs in charge.

We further demonstrate that younger CEOs are more likely to exit business. This further support the

assertion of younger managers adopting higher risk strategies. The observed higher average growth and performance by younger CEOs come at the cost of higher returns volatility and, consequently, a higher risk of failure. While firm exit does not necessarily imply firm bankruptcy, the likelihood of economic-forced exits has been demonstrated to be significantly higher than the likelihood of exits not related to firm performance (Harada, 2007; Manso, 2016). Owner-managers of closely-held small private firms may also decide to leave their firm because of disappointment with business ownership and unwillingness to put up with "limited success" (Mayer and Goldstein, 1961). These exit reasons are more likely to appeal to younger CEOs who have more external opportunities such as starting full-time education (Harada, 2007) or taking an alternative job (Taylor, 1999). We cannot formally differentiate between different alternatives for firm exit. We however believe that the likelihood of firm exit increases as the performance decrease.

Our evidence also suggest that financial development plays an important role in facilitating reallocation of assets from firms with older CEOs that are not interested in growing their firms to firms with younger CEOs. The lower growth and performance could be driven not only by changes in CEOs' behavior over time, but by the changes in the external environment that have accelerated as managers have aged. A change of CEO that better fits with current situation could potentially improve firm's performance. This idea is known as "fit-drift/shift-refit" situation (Finkelstein *et al.*, 2009). While an initial match of firm owner-manager with the external conditions facing the firm could be good, with time, the environment either gradually drifts or radically shifts and therefore executive's competencies match firm's needs less well. Once the manager retires or departs in any other way, there is an opportunity to refit CEO's competencies with the new requirements of environment and firm. In less financially developed regions, older owner-managers would stay with their firms longer and have a larger mismatch between competencies and firm needs. The opportunity to refit would come with the sale of the firm, making financial development that facilitates matching of owners with firms an important driver of firm growth and performance.

While we use a large sample of firms over relatively long period of time, one limitation of our study is that firms in focus are primarily from two Western European countries, namely, France and Great Britain. Future research could explore the generalizability of our findings across diverse institutional environments and cultures as well as to what extent certain types of financial markets and investors are most effective at facilitating the reallocation of assets from firms with older CEOs to firms with younger CEOs and in what contexts. For example, are private equity investors and other types of activist investors most effective at facilitating managerial or ownership change (Acharya, Gottschalg, Hahn, and Kehoe, 2013), or are more

arm's length sources of financing, such as bank financing, enough to allow owner-managers to choose to transfer control of their firms to younger generations.

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Table 1. Summary statistics

				Distribution		
Variable	Firms	Mean	Std. Dev.	10th	50th	90th
CEO age	157,996	50.6	10.3	38	50	64
Assets ($,'000)	157,996	3,174	50,300	14	274	3,819
Sales ($,'000)	109,640	6,002	31,300	249	857	11,000
Number of employees	68,425	31	193	1	6	56
Firm age	157,996	11	11	3	7	24
Investment	157,996	0.035	0.745	-0.576	0.049	0.585
Sales growth	105,082	0.082	0.271	-0.146	0.063	0.333
Return on assets	108,951	0.101	0.325	-0.086	0.055	0.362

Notes: This table provides summary statistics for the main firm-level variables used in the econometric analysis. Unit of observation is the firm. *Firm age* is years from date of incorporation. *Return on assets* is net income over assets. *Investment* is the annual change in log total assets. *Sales growth* is the annual change in log sales. Investment and Sales growth are computed for each year from 2003 to 2012. Each firm's attributes are then averaged for all available years at the firm-year level.

Table 2. Distribution of firm fharacteristics by CEO age

CEO age:	Age≤ 34	34<Age ≤ 40	40<Age ≤ 46	46<Age ≤ 53	53<Age ≤59	Age >59
Number of firms	11,237	22,132	39,286	33,494	27,438	24,409
Share of total assets by age bracket	1.9%	6.0%	23.0%	15.3%	25.6%	28.1%
Share of total employment by age bracket	3.4%	7.6%	27.0%	16.2%	19.7%	26.2%
Average firm characteristics:						
Assets ($,'000)	864	1,370	2,941	2,288	4,672	5,779
Sales ($,'000)	2,994	3,397	6,116	4,783	6,971	10,042
Return on assets	0.128	0.136	0.102	0.124	0.073	0.055
Number of employees	14.4	16.5	33.2	23.3	34.6	51.8
Firm age	5.6	7.4	11.0	8.9	13.3	17.5

Notes: This table presents the distribution of firm characteristics by CEO age brackets. Unit of observation is the firm.

Table 3. Distribution of CEO age by main industries

Industry	Number of firms	Average CEO age	% CEO age > 59
Total services	52,378	49.8	18.7
Total manufacturing	15,680	53.3	28.0
Advertising	1,323	49.3	16.3
Automotive repairs and services	2,943	50.2	17.6
Banking and finance	4,251	52.9	24.7
Car dealers	817	50.2	17.3
Chemicals	357	56.6	40.3
Construction	25,807	49.7	16.2
Education and social services	981	51.7	24.2
Engineering and architectural	8,587	51.7	22.5
Food stores and restaurants	6,814	48.8	15.6
Health services	1,575	50.9	22.5
Hotels	1,267	54.0	32.0
Industrial machines	1,935	53.3	27.9
Metals and minerals	519	53.9	30.6
Paper lumber and furniture	1,263	52.2	24.3
Personal services	4,401	51.3	23.1
Real estate	6,594	53.7	31.0
Retail and apparel	11,928	51.0	21.8
Transportation services	5,457	51.7	23.9

Notes: This table presents the distribution of CEO age by main industries. Industries are classified as services or manufacturing manually based on their description. For ease of presentation, we manually group industries into main categories based on multiple two-digit SIC codes.

Table 4. CEO age and firm outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Dependent variable	*Investment*					*Sales growth*					*Return on assets*				
	Pooled	Between firms	3-year differenced	Firm FE	Firm FE	Pooled	Between firms	3-year differenced	Firm FE	Firm FE	Pooled	Between firms	3-year differenced	Firm FE	Firm FE
ln(*CEO age*)	-0.079	-0.180	-0.500	-1.221		-0.089	-0.133	-1.093	-1.402		-0.072	-0.120	-0.176	-0.390	
	(0.003)	(0.010)	(0.019)	(0.014)		(0.003)	(0.005)	(0.025)	(0.018)		(0.003)	(0.006)	(0.009)	(0.012)	
Dummy for CEO age ≤ 34 (base)															
Dummy for 34 < CEO age ≤ 40					-0.071					-0.110					-0.024
					(0.007)					(0.007)					(0.005)
Dummy for 40 < CEO age ≤ 46					-0.253					-0.294					-0.081
					(0.008)					(0.009)					(0.006)
Dummy for 46 < CEO age ≤ 53					-0.157					-0.200					-0.054
					(0.008)					(0.009)					(0.006)
Dummy for 53 < CEO age ≤ 59					-0.350					-0.385					-0.108
					(0.009)					(0.010)					(0.007)
Dummy for CEO age > 59					-0.451					-0.481					-0.132
					(0.009)					(0.011)					(0.007)
ln(*Assets*)	-0.023	0.079	0.173	-0.254	-0.262	0.001	0.013	0.142	-0.199	-0.229	-0.023	-0.009	0.045	-0.022	-0.027
	(0.000)	(0.001)	(0.002)	(0.002)	(0.002)	(0.000)	(0.001)	(0.004)	(0.003)	(0.003)	(0.000)	(0.001)	(0.002)	(0.001)	(0.001)
ln(*Firm age*)	-0.021	-0.112				-0.057	-0.057				-0.020	-0.025			
	(0.001)	(0.003)				(0.001)	(0.001)				(0.001)	(0.001)			
Firm Fixed Effects	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	No	No	No	Yes
Three-digit SIC code dummies	Yes	Yes	No	No	No	Yes	Yes	No	No	No	Yes	Yes	No	No	No
Country dummies	Yes	Yes	No	No	No	Yes	Yes	No	No	No	Yes	Yes	No	No	No
R^2	0.092	0.081	0.138	0.402	0.395	0.104	0.048	0.031	0.327	0.318	0.081	0.097	0.015	0.600	0.599
Observations	619,563	144,135	336,340	625,987	625,987	463,632	105,103	195,394	462,459	462,459	470,063	136,142	258,344	470,742	470,742

Notes: This table presents the results of OLS regressions examining how firm outcomes are related to manager age. The dependent variables are computed for the period 2002-2012, and the level of analysis is at the firm-year level. *Investment* and *Sales growth* measure the change in log total assets, log sales from the previous year to the focal year. *Return on assets* is calculated as net income over total assets for the focal year. The 3-year differenced result for ROA (Column 13) is the log change in ROA between the focal year (t) and t-3 year. All specifications control for log of total assets in the previous year. Standard errors (in brackets) are robust to arbitrary heteroscedasticity.

Table 5. Instrumental variable estimation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent Variable	*Investment*			*Sales growth*			*Return on assets*		
	First stage	Second stage, IV	OLS	First stage	Second stage, IV	OLS	First stage	Second stage, IV	OLS
Instrumented Variable									
Dummy for CEO age >59		-1.154	-0.190		-0.777	-0.124		-0.267	-0.026
Instrument		(0.169)	(0.010)		(0.197)	(0.011)		(0.071)	(0.007)
ln(*Industry-year average founder age at founding*)	0.110			0.110			0.185		
	(0.003)			(0.003)			(0.003)		
Controls									
Dummy for CEO age ≤ 34 (base)									
Dummy for 34 < CEO age ≤ 46	-0.461	-0.494	-0.076	-0.463	-0.361	-0.052	-0.434	-0.110	-0.007
	(0.001)	(0.078)	(0.006)	(0.001)	(0.091)	(0.007)	(0.001)	(0.031)	(0.005)
Dummy for 46 < CEO age ≤ 49	-0.768	-0.840	-0.159	-0.773	-0.579	-0.089	-0.754	-0.203	-0.023
	(0.000)	(0.130)	(0.008)	(0.001)	(0.152)	(0.009)	(0.001)	(0.053)	(0.006)
Dummy for 49 < CEO age ≤ 53	-0.641	-0.689	-0.127	-0.646	-0.488	-0.074	-0.619	-0.165	-0.019
	(0.001)	(0.108)	(0.007)	(0.001)	(0.127)	(0.008)	(0.001)	(0.044)	(0.005)
Dummy for 53 < CEO age ≤ 59	-0.882	-0.988	-0.176	-0.885	-0.669	-0.102	-0.875	-0.237	-0.026
	(0.000)	(0.149)	(0.009)	(0.000)	(0.174)	(0.010)	(0.000)	(0.062)	(0.007)
ln(A ssets)	0.002	-0.249	0.272	0.008	-0.178	0.203	0.005	0.090	0.092
	(0.000)	(0.001)	(0.001)	(0.000)	(0.002)	(0.001)	(0.000)	(0.001)	(0.001)
ln(Firm age)	0.143	-0.049	-0.415	0.145	-0.194	-0.499	0.133	-0.069	-0.122
	(0.000)	(0.025)	(0.003)	(0.000)	(0.029)	(0.003)	(0.000)	(0.010)	(0.002)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.985	0.345	0.384	0.983	0.247	0.342	0.984	0.572	0.611
Observations	587,781	587,781	611,039	441,754	441,754	454,964	446,612	446,612	463,180

Notes: This table presents the results of regressions examining the robustness of our results to potential endogeneity concerns. Dummy for the oldest CEO age category is instrumented by average age of the founder at the SIC-year-country level. All specifications control for log of total assets in the previous year. Standard errors (in brackets) are robust to arbitrary heteroscedasticity and allow for serial correlation through clustering by firms.

Table 6. CEO age and firm exit

	(1)	(2)	(3)
Dependent Variable		*Dummy for exit*	
CEO age	0.991		
	(0.001)		
Dummy for CEO age ≤ 30		1.357	
		(0.050)	
Dummy for 18 ≤ CEO age ≤ 25			1.464
			(0.115)
Dummy for 25 < CEO age ≤ 30			1.432
			(0.053)
Dummy for 30 < CEO age ≤ 34			1.236
			(0.037)
Dummy for 34 < CEO age ≤ 40			1.131
			(0.025)
Dummy for 40 < CEO age ≤ 53			1.058
			(0.023)
Dummy for 53 < CEO age ≤ 59			0.991
			(0.026)
Dummy for 59 CEO age (base=1)			
ln(*Assets*)	1.016	1.015	1.017
	(0.003)	(0.003)	(0.003)
ln(*Firm age*)	0.234	0.231	0.233
	(0.003)	(0.003)	(0.003)
Country dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
Log-Likelihood Ratio	-180,750.6	-180,774.1	-180,730.1
$\chi 2$	30,044.5	29,997.6	30,085.5
Exits (total)	17,202	17,202	17,202
Observations	143,290	143,290	143,290

Notes: This table presents the hazard ratios from a Cox Proportional Hazard regression of exit rates of 143,290 firms by CEO age. The risk set consists of firms that were founded between 2002 and 2011, the event is firm exit, and the hazard ratios are estimated on an annual basis. Exit year is defined as the last year beyond which the following firm attributes are unobserved in the BvD database: sales, income, total assets, employment, cash flow, profits before tax, or profit margin (there are 17,202 total observed exits from 2002 to 2011). CEO age is defined as the age of the CEO at the year of incorporation.

Table 7. CEO age and creative industries

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	*Investment*		*Sales growth*		*Return on assets*	
ln(*CEO age*)	-0.616		-0.547		-0.997	
	(0.027)		(0.031)		(0.018)	
× *Creative*	-0.083		-0.137		-0.100	
	(0.026)		(0.029)		(0.017)	
Dummy for 34 < CEO age ≤ 40		-0.029		-0.034		-0.003
		(0.012)		(0.012)		(0.006)
× *Creative*		-0.059		-0.026		-0.017
		(0.015)		(0.015)		(0.008)
Dummy for 40 < CEO age ≤ 46		-0.086		-0.064		-0.014
		(0.015)		(0.014)		(0.008)
× *Creative*		-0.090		-0.038		-0.037
		(0.017)		(0.018)		(0.009)
Dummy for 46 < CEO age ≤ 53		-0.067		-0.050		-0.010
		(0.013)		(0.013)		(0.007)
× *Creative*		-0.076		-0.036		-0.028
		(0.016)		(0.017)		(0.009)
Dummy for 53 < CEO age ≤ 59		-0.092		-0.068		-0.016
		(0.015)		(0.015)		(0.008)
× *Creative*		-0.102		-0.052		-0.044
		(0.018)		(0.018)		(0.010)
Dummy for CEO age > 59		-0.099		-0.089		-0.012
		(0.016)		(0.016)		(0.009)
× *Creative*		-0.104		-0.053		-0.054
		(0.019)		(0.019)		(0.010)
ln(Assets)	0.270	0.270	0.203	0.202	0.092	0.089
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
ln(Firm age)	-0.345	-0.411	-0.422	-0.497	-0.101	-0.099
	(0.005)	(0.003)	(0.006)	(0.004)	(0.004)	(0.002)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.390	0.390	0.342	0.342	0.612	0.644
Observations	619,563	619,563	462,459	462,459	470,742	470,742

Notes: This table presents the results of FE regressions examining how firm outcomes are related to CEO age in creative industries. The dependent variables are computed for the period 2002-2012, and the level of analysis is at the firm-year level. *Investment* and *Sales growth* measure the change in log total assets and log sales respectively from the previous year to the focal year. *Return on assets* is calculated as net income over total assets for the focal year. All specifications control for log of total assets in the previous year. Standard errors (in brackets) are robust to arbitrary heteroscedasticity.

Table 8. CEO age and technological dynamism

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	*Investment*		*Sales growth*		*Return on assets*	
ln(*CEO age*)	-0.176		-0.314		-0.023	
	(0.050)		(0.065)		(0.032)	
× *High-technology*	-0.549		-0.385		-0.197	
	(0.110)		(0.132)		(0.062)	
× *Medium-high-technology*	-0.406		-0.242		-0.111	
	(0.063)		(0.077)		(0.036)	
× *Medium-low-technology*	-0.262		-0.097		-0.087	
	(0.073)		(0.086)		(0.045)	
× *Low-technology*	-0.379		-0.084		-0.045	
	(0.067)		(0.081)		(0.040)	
× *Knowledge-intensive services*	-0.620		-0.523		-0.231	
	(0.049)		(0.063)		(0.032)	
× *Less knowledge-intensive services*	-0.448		-0.153		-0.273	
	(0.051)		(0.064)		(0.032)	
Dummy for CEO age > 59		-0.008		-0.005		-0.001
		(0.010)		(0.011)		(0.007)
× *High-technology*		-0.020		-0.096		-0.004
		(0.023)		(0.024)		(0.013)
× *Medium-high-technology*		-0.010		-0.027		0.000
		(0.013)		(0.014)		(0.008)
× *Medium-low-technology*		-0.023		-0.015		0.005
		(0.014)		(0.015)		(0.009)
× *Low-technology*		0.025		-0.009		-0.002
		(0.014)		(0.015)		(0.009)
× *Knowledge-intensive services*		-0.033		-0.041		-0.016
		(0.011)		(0.012)		(0.007)
× *Less knowledge-intensive services*		-0.030		-0.012		-0.018
		(0.011)		(0.012)		(0.008)
ln(*Assets*)	0.270	-0.249	0.204	0.179	0.089	0.103
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
ln(Firm age)	-0.345	-0.220	-0.421	-0.484	-0.077	-0.135
	(0.005)	(0.003)	(0.006)	(0.003)	(0.003)	(0.002)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.390	0.404	0.343	0.354	0.644	0.625
Observations	619,563	619,563	462,459	462,459	470,742	470,742

Notes : This table presents the results of FE regressions examining how firm outcomes are related to CEO age in technologically dynamic industries. The dependent variables are computed for the period 2002-2012, and the level of analysis is at the firm-year level. Investment and Sales growth measure the change in log total assets and log sales respectively from the previous year to the focal year. Return on assets is calculated as net income over total assets for the focal year. All specifications control for log of total assets in the previous year. Standard errors (in brackets) are robust to arbitrary heteroscedasticity.

Table 9. Share of assets and employment in old-CEO firms by regional financial development

Regional financial development:	Low financial development			High financial development		
	All	Services	Manufacturing	All	Services	Manufacturing
Share of total assets by CEOs older than 59	23.4%	23.4%	23.2%	16.3%	16.6%	14.8%
Share of total assets by CEOs age 53 to 59	25.3%	24.8%	27.3%	44.3%	48.0%	25.1%
Share of total assets by CEOs age 46 to 53	25.3%	25.5%	25.1%	16.6%	14.6%	27.6%
Share of total assets by CEOs age 40 to 46	17.9%	18.1%	17.2%	13.2%	12.0%	18.9%
Share of total assets by CEOs age 34 to 40	8.1%	8.2%	7.2%	9.6%	8.8%	13.6%
Share of total employment by CEOs older than 59	18.5%	17.5%	20.9%	12.7%	13.0%	12.2%

Notes: This table shows how the share of assets and employment in firms with CEOs of age 60 and above varies by region financial development. Regions are classified to high and low financial development based on the median value on number of financial institutions in a region.

Table 10. Regional financial development and CEO age

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	*Dummy for CEO age > 59*					
	All	All	All	Services	Manu-facturing	All
ln(*Number of financial institutions*)	-0.029			-0.023	-0.035	-0.024
	(0.005)			(0.005)	(0.006)	(0.005)
Financial sector productivity		-0.26				
		(0.059)				
ln(*Private equity investment*)			-0.016			
			(0.005)			
ln(*Number of financial institutions*) × *Dummy for manufacturing*						-0.011
						(0.002)
ln(*GDP*)	0.050	0.138	0.018	0.05	0.052	0.051
	(0.031)	(0.065)	(0.046)	(0.026)	(0.042)	(0.029)
ln(*Size*)	0.000	-0.022	-0.016	0.002	-0.002	0.001
	(0.007)	(0.006)	(0.010)	(0.006)	(0.010)	(0.007)
ln(*Population*)	0.001	0.005	0.029	0.000	-0.001	-0.000
	(0.012)	(0.010)	(0.016)	(0.010)	(0.015)	(0.011)
ln(*Assets*)	0.004	0.004	0.004	0.004	0.001	0.003
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
ln(*Firm age*)	0.086	0.087	0.086	0.084	0.1	0.087
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Three-digit SIC code dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.078	0.076	0.072	0.071	0.089	0.076
Observations	92,405	110,195	110,195	86,323	23,872	110,195

Notes: This table reports the results of OLS regressions examining the how the incidence of older CEOs vary by regional financial development. Standard errors (in brackets) are robust to arbitrary heteroscedasticity and allow for serial correlation through clustering by regions.

Table 11. Regional financial development, CEO age and ownership change

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	*Dummy for ownership change*			*Dummy for exit*		
ln(*Number of financial institutions*)	0.067			-0.048		
	(0.014)			(0.014)		
Financial sector productivity		0.651			-0.407	
		(0.125)			(0.130)	
ln(*Private equity investment*)			0.047			-0.029
			(0.012)			(0.009)
ln(*GDP*)	-0.006	-0.224	0.058	0.011	0.128	-0.051
	(0.093)	(0.163)	(0.129)	(0.104)	(0.175)	(0.137)
ln(*Size*)	0.023	0.083	0.069	-0.019	-0.06	-0.051
	(0.022)	(0.021)	(0.028)	(0.024)	(0.021)	(0.027)
ln(*Population*)	-0.024	-0.038	-0.098	0.017	0.029	0.068
	(0.020)	(0.035)	(0.029)	(0.025)	(0.027)	(0.029)
ln(*CEO age*)	-0.006	-0.008	-0.022	-0.049	-0.044	-0.036
	(0.014)	(0.015)	(0.014)	(0.016)	(0.018)	(0.016)
ln(*Assets*)	0.027	0.025	0.023	-0.029	-0.028	-0.027
	(0.004)	(0.004)	(0.005)	(0.001)	(0.002)	(0.001)
ln(*Firm age*)	-0.03	-0.028	-0.025	-0.014	-0.016	-0.019
	(0.008)	(0.008)	(0.008)	(0.003)	(0.005)	(0.004)
Three-digit SIC code dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.033	0.031	0.026	0.050	0.046	0.043
Observations	48,950	48,950	48,950	110,195	110,195	110,195

Notes: This table presents estimation results of how the incidences of ownership change varies by region financial development and CEO age. Standard errors (in brackets) are robust to arbitrary heteroscedasticity and allow for serial correlation through clustering by regions.

Table 12. Changes in firm assets by CEO age and region financial development

	Dependent variable: *Investment*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Low financial development			High financial development		
	All	Services	Manu-facturing	All	Services	Manu-facturing
Dummy for CEO age ≤ 34 (base)						
Dummy for 34 < CEO age ≤ 40	-0.096	-0.099	-0.077	-0.069	-0.072	-0.062
	(0.015)	(0.019)	(0.040)	(0.006)	(0.006)	(0.021)
Dummy for 40 < CEO age ≤ 46	-0.164	-0.157	-0.199	-0.101	-0.098	-0.110
	(0.008)	(0.011)	(0.034)	(0.007)	(0.004)	(0.023)
Dummy for 46 < CEO age ≤ 53	-0.235	-0.228	-0.264	-0.146	-0.146	-0.148
	(0.009)	(0.011)	(0.035)	(0.014)	(0.017)	(0.020)
Dummy for 53 < CEO age ≤ 59	-0.272	-0.266	-0.301	-0.216	-0.216	-0.218
	(0.013)	(0.018)	(0.034)	(0.010)	(0.011)	(0.024)
Dummy for CEO age > 59	-0.300	-0.290	-0.343	-0.200	-0.203	-0.191
	(0.018)	(0.016)	(0.035)	(0.016)	(0.011)	(0.040)
ln(*GDP*)	0.063	0.048	0.137	0.031	0.027	0.048
	(0.109)	(0.108)	(0.114)	(0.049)	(0.082)	(0.065)
ln(*Size*)	0.001	-0.005	0.035	-0.011	-0.016	0.007
	(0.022)	(0.022)	(0.023)	(0.015)	(0.025)	(0.020)
ln(*Population*)	-0.045	-0.040	-0.061	-0.009	-0.003	-0.027
	(0.049)	(0.048)	(0.064)	(0.013)	(0.022)	(0.017)
ln(Assets)	-0.000	-0.008	0.035	0.000	-0.001	0.004
	(0.006)	(0.007)	(0.006)	(0.004)	(0.005)	(0.005)
ln(*Firm age*)	0.001	0.002	-0.010	-0.064	-0.059	-0.078
	(0.007)	(0.009)	(0.012)	(0.005)	(0.007)	(0.005)
Three-digit SIC code dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.027	0.025	0.048	0.042	0.040	0.046
Observations	41538	34451	7087	51042	38400	12642

Notes: This table presents the results of OLS regressions that examine how the relationship between firm investment and CEO age varies by region financial development. Investment is computed over the period 2006-2010. CEO age is for 2006. Regions are classified to high and low financial development based on median value of number of financial institutions in the region. We exclude firms that changed ownership in the period 2006-2010. Standard errors (in brackets) are robust to arbitrary heteroscedasticity and allow for serial correlation through clustering by firms.