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As firms grow older, their profitability seems to decline. We first document this phenomenon and show that it is very robust. Then we offer two non-exclusive explanations of why firms may age. First, corporate aging could reflect a cementation of organizational rigidities over time. Consistent with that, costs rise, growth slows, assets become obsolete, and investment and R&D activities decline. Second, older age could advance the diffusion of rent-seeking behavior inside the firm. This hypothesis is supported by the poorer governance, larger boards, and higher CEO pay we observe in older firms. Overall, firms seem to face a real senescence problem.

Keywords: firm age, organizational rigidities, rent-seeking, firm life cycle, corporate governance, firm performance

JEL codes: G30, L20

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1. Introduction

In biology, aging is a process associated with a general decline in the physical functioning of the human body, such as the ability to remember, react, move, and hear. We want to know whether firms also weaken and lose their ability to compete over time, and we want to know why that happens. The first part of the paper documents a steady profitability decay as firms get older. The second part then examines the possible economics of that phenomenon and offers two not mutually exclusive rationales, namely organizational rigidities and rent-seeking behavior.

Whereas the quest for organizational immortality has attracted considerable attention in the management, the organization, and the industrial organization literatures (Stinchcombe, 1965; Dunne, Roberts, and Samuelson, 1989; Singh and Lumsden, 1990; Brüderl and Schüssler, 1990; Barron, West, and Hannan, 1994; Hannan, 1998, Hannan, Pólos, and Carroll, 2003a, b), economists have generally paid comparatively little attention to the issue of the actual performance of older firms (Caves, 1998). This paper wants to contribute closing that gap.

Since firms are organizations that can be restructured as needs evolve, there is no a priori reason why they should age. In fact, as they mature, firms should be able to learn. They can learn by doing or by investing in research and development; they can hire human capital and train their employees; and they can learn from other firms in the same and in other industries (see, for example, Bahk and Gort, 1993, and the vast literature cited therein). Over time, firms should also discover what they are good at (Jovanovic, 1982). Consistent with this prior belief, various studies in the industrial organization literature report that life expectancy increases with age (Dunne, Roberts, and Samuelson, 1989), and better firms survive (Baker and Kennedy, 2002). Hopenhayn (1992) shows that, under plausible assumptions, older firms enjoy higher profits and value.

As mentioned above, this study begins with an examination of the relation between age and profitability. We study 10,930 listed firms with data on CRSP, COMPUSTAT, and COMPUSTAT Industry Segment between 1978 and 2004 (82,845 firm-years). We show that getting older is associated with lower profitability. Profit margins, return on assets, and Tobin's Q ratios fall. This pattern holds across different time periods, for different measures of age, for different industry definitions, and for different firm samples. This regularity is robust to a battery of alternative estimation techniques and specifications. Moreover, it is distinct from such phenomena as sample selection, concave investment opportunity sets, financial frictions (Cooley and Quadrini, 2001; Clementi, 2002), declining investor uncertainty (Pástor and Veronesi, 2003), increasing diversification (Campa and Kedia, 2002; Villalonga, 2004), post-IPO regularities (Jain and Kini, 2004; Fama and French, 2004), declining ownership concentration (Holderness, Kroszner, and Sheehan, 1999; Helwege, Pirinsky, and Stulz, 2007; Holderness, 2009), older management (Finkelstein and Hambrick, 1990; Faleye, 2007), and aging industry. Firm aging does not seem to be driven by family firms either (Anderson and Reeb, 2003; Villalonga and Amit, 2006).[1]

Why would firms age? In the second part of the paper, we propose two nonexclusive explanations for that possible phenomenon, namely organizational rigidities (Hannan and Freeman, 1984; Leonard-Barton, 1992) and rent-seeking behavior (Olson, 1982; Bertrand and

[1] Firm age also appears as a control variable in various empirical finance studies. For example, it is a control variable in default forecast models (Shumway, 2001) and in takeover prediction models (such as Bhattacharjee, Higson, Holly, and Kattuman, 2009). It is also used to measure increasing complexity of operations (see, among others, Boone, Field, Karpoff, and Raheja, 2007; Coles, Daniel, and Naveen, 2008). Our results suggest that firm age is more than a proxy for unspecified relations.

Mullainathan, 2003). Organizational rigidities can come about because success induces firms to codify their approach through organization and processes. This regulation can become capillary over time. This behavior seems increasingly to entangle firms in structural and process-related rigidities that are difficult to discard (Leonard-Barton, 1992) and that could cause companies to succumb to Schumpeter's "perennial gale of creative destruction." We refer to this hypothesis as organizational rigidity hypothesis. It could also be that older firms are incapable of solving collective action problems. As in the case of nations (Olson, 1982), firms might increasingly become organizations of rent-seeking factions as they get older. Rent seeking can take the form of the pursuit of a quieter life (Bertrand and Mullainathan, 2003).

Consistent with the existence of organizational rigidities, we find that older firms are less efficient compared to their industry peers, as manifested in higher costs, slower growth, older assets, and reduced R&D and investment activities. We also observe a progressive degeneration of corporate governance quality, larger boards, and higher CEO compensation, which is consistent with the inability to solve collective action problems.

Some studies have proposed a life-cycle theory of the firm. Biological arguments in economics go back at least to Marshall's "trees in the forest" analogy. A life-cycle argument, for example, has been offered to explain dividend payments (Fama and French, 2001; DeAngelo, DeAngelo, and Stulz, 2006) and financing decisions (Berger and Udell, 1990). In these papers, however, life cycles are defined based on specific patterns in firm profitability, investment opportunities, and size, not age per se. According to our results, age itself could define the firm's life cycle.

To the best of our knowledge, ours is one of the first large-scale studies to address the corporate aging phenomenon, at least in terms of its performance aspects (Agarwal and Gort, 1996, 2002, examine survival), and the first such study to document that aging exasperates organizational rigidities and fosters rent-seeking behavior. It is also the first study to show that, when investigating profitability or growth, corporate age is not simply a proxy for other variables or a generic control variable, but a genuine phenomenon separate, for example, from management age and industry age. Corporate geriatrics problems are real.

The paper is organized as follows. Section 2 describes the approach to measuring the correlation between firm age and profitability. Section 3 discusses the data. Section 4 documents a negative relation between firm age and profitability. Section 5 examines the robustness of that relation. Section 6 interprets the results within the context of our two aging hypotheses. Section 7 explores a number of alternative interpretations implied by the literature or suggested by economic logic. Finally, Section 8 concludes.

2. Firm age and profitability: the investigative design

In studying the relation between firm age and profitability, we want to differentiate that possible influence from a number of obvious spurious relations implied by previous articles. In Cooley and Quadrini (2001), for example, financial constraints prevent firms from raising all the funds necessary for the marginal product of capital to equal its opportunity cost. Consequently, as capital increases over time, its marginal product declines, and so does the firm's rate of growth. Clementi (2002) proposes a model that combines the industrial organization literature on firm dynamics and the corporate finance literature on IPOs. He embeds the IPO decision in a dynamic optimization model similar to that in Cooley and Quadrini (2001). The model is able to predict the post-IPO decline in operating return on assets documented in Jain and Kini (1994). According to this strand of the literature, age could be related to profitability because of financial frictions.

The finance literature has also looked at age-related profitability issues, although from different angles than ours. Pástor and Veronesi (2003) propose a risk argument. According to this view, investors' uncertainty lessens as the firm grows older (see also related arguments in James and Wier, 1990; Berger and Udell, 1990). Consistent with that, the variability of stock returns is negatively related with incorporation age (Adams, Almeida, and Ferreira, 2005) and with listing age (Cheng, 2008). Declining risk implies declining required rates of return. Hence, profitability could appear to deteriorate with age when in fact the driving factor is declining uncertainty.

Other finance papers have uncovered an inverse relation between age and ownership concentration (Holderness, Kroszner, and Sheehan, 1999; Helwege, Pirinsky, and Stulz, 2007; Holderness, 2009). In principle, if ownership were positively related to profitability, this regularity could induce a spurious negative relation between age and profitability. A spurious relation could also be induced by the age and tenure of the managers within the organization (Finkelstein and Hambrick, 1990; Graham, Harvey, and Puri, 2008). Finally, a relation between age and profitability is suggested by the diversification literature, too. Over time, the reasoning goes, as their original industries mature, firms may be forced to enter new industries. But unrelated, or conglomerate, diversification harms profitability (see, among others, Campa and Kedia, 2002; Villalonga, 2004). Age could therefore correlate with diversification, and thereby indirectly with profitability.

These considerations, taking into account additional control variables that have been suggested in the literature, imply a relation between firm profitability and age of the following form:

Profitability = f(age, financial frictions, management age, management tenure, ownership structure, risk, focus, size, capital expenditures)

We will estimate this relation with regression analysis. We hypothesize a negative, possibly nonlinear relation between age and profitability. The initial specification we choose is a quadratic function. We will switch to alternative specifications in the empirical section.

The remaining variables should have coefficients with the following signs. Financial frictions should impair profitability (Clementi, 2002; Cooley and Quadrini, 2001). The same is true for management age and tenure. Moreover, firms with concentrated ownership should have a better handle on agency problems with managers and therefore perform better. The coefficient of risk depends on the profitability measure we use. As explained later, we work with gross profit margins, returns on assets (ROA), and Tobin's Q ratios. Margins and ROAs should correlate positively with risk (high risk, high return). The risk coefficient of Tobin's Q, however, should be zero in a cross section, since Tobin's Q is a risk-adjusted measure of performance. In addition to that, more focused firms should be more profitable. Furthermore, profitability should be negatively related to firm size (Cooley and Quadrini, 2001) Finally, the sign of capital expenditures cannot be assessed a priori (see, however, McConnell and Muscarella, 1985). Firms that invest a lot may capture profitable growth opportunities and be able to stem obsolescence, but they may also throw good money after bad.

3. Data

3.1. Sample description

The sample consists of all listed firms with data on CRSP, COMPUSTAT, and COMPUSTAT Industry Segment between 1978 and 2004. Following Berger and Ofek (1995), among others, we exclude firm-years with total sales of less than USD 20 million, firm-years with missing values for total assets, and firm-years for which the sum of segment sales deviates from total sales by more than 1 percent. Unlike other studies, however, ours includes firms with business segments in the financial sector (SIC 6000–6999). The final sample consists of 10,930 firms and 82,845 firm-years, including 1,669 financials (6,644 firm-years).

We start with 2,285 firms in 1978 and end with 2,923 firms in 2004. Turnover is remarkably high: 8,654 firms enter and 7,896 firms leave between 1978 and 2004. Some of the firms that drop from the exchange may list again years later, for example in a reverse LBO. In our approach, we treat them as separate firms. According to Fama and French (2004), only 145 firms go public between 1973 and 2001 after having gone private. We come back to this potential sample-selection problem in the empirical analysis.

3.2. Firm age

We define firms as the corporations observed in practice. Our measures of age, therefore, refer to the age of these legal entities. One could object that legal entities do not necessarily correspond to what an economist would regard as firms. We acknowledge that problem. Still, our results apply to firms as typically defined and researched in the literature.

Shumway (2001) claims that the economically most meaningful measure of firm age is the number of years since listing. That event is a defining moment in a company's life. Not surprisingly, listing affects ownership and capital structure, multiplies growth opportunities, increases media exposure, and demands different corporate governance structures (Loderer and Waelchli, 2010). Most studies that look at firm age, including Shumway (2001), Pástor and Veronesi (2003), Fama and French (2004), and Chun et al. (2008), measure age in the same way.

Firm age is therefore the number of years (plus one) elapsed since the year of the company's IPO.[2] We refer to this variable as the firm's listing age. We add one year to avoid ages of zero. The information is from CRSP. Since CRSP goes back to 1925, the oldest a firm can be at the beginning of our sample period in 1978 is 54 years, compared with 80 years at the end of it, in 2004. For a random subsample of 5,000 firms, we also compute the number of years (plus one) elapsed since the year of incorporation and denote this variable as the firm's incorporation age. The information is hand-collected from *Mergent Webreports*.

Measuring age is not always straightforward, especially in the presence of mergers. Take the case of the AOL Time Warner deal in 2000. One could assign the resulting firm a listing age that starts in 2000, in 1992 (the CRSP inclusion date for AOL), or in 1964 (the CRSP inclusion date for Time Warner). In keeping with the literature, we go with the date suggested by CRSP, namely the year 2000. We come back to this problem further down and show that it does not seem to affect our results.

2 More precisely, we approximate a firm's year of birth with the earliest of: (a) the year in which the firm appears on CRSP; (b) the year in which the firm is included in COMPUSTAT; and (c) the year for which we find a link between CRSP and COMPUSTAT (based on COMPUSTAT data item LINKDT). If, for example, a firm enters CRSP or COMPUSTAT in 1996, its age is one year at the end of 1996 (1+1996-1996) and five years at the end of 2000 (1+2000-1996).

On average, listing age is 14 years; the median is 10 (Panel A of Table 1). The distribution of firm age remains fairly stable over the sample period, except in the late 1990s, when the median drops to 7, possibly as a result of the dot-com IPO wave. Panel B reports descriptive statistics for incorporation age. The median firm is 23 years old and goes public at the age of 8.

3.3. Profitability measures and control variables

We measure profitability alternatively with gross margins, return on assets (ROA), and Tobin's Q. Whereas gross margins and ROA measure current profitability, Tobin's Q reflects the market's expectations about future profitability. To account for industry-specific effects, the three metrics are computed as arithmetic deviations from the median industry value (based on two-digit SIC codes) in any given year. When interpreting the evidence, it is important to remember this adjustment. Most firms are in one industry only. Hence, there is not much sense constructing sales-weighted industry benchmarks. The results do not change when using the 48 industry grouping suggested by Fama and French (1997). To reduce the influence of outliers, we follow Campbell, Hilscher, and Szilagyi (2008) and winsorize all variables at the 5th and 95th percentile of their pooled distribution across all firm-years. This correction, however, is immaterial.

Table 2 reports descriptive statistics for all the variables in the analysis. Panel A is dedicated to our three profitability measures.[3] Panels B and C list the various control variables; their definitions are in Table 12 at the end of the paper. Panel B, in particular, shows the variables with data available for the full sample. Specifically, to assess financial constraints (*KZ*

[3] The correlation between gross margins and ROA is 0.285; that between gross margins and Tobin's Q is 0.341; and that between ROA and Tobin's Q is 0.328.

index), we use an index similar to that of Kaplan and Zingales (1997). The results do not change when we replace that index with alternative measures, such as financial leverage or a binary variable that identifies dividend payers. Our proxy for risk is the annualized standard deviation of the firm's daily stock return (*Volatility*). A Herfindahl index based on the sales in the firm's different segments captures the degree of specialization (*Focus*). Firm size (*Size*) is measured non-linearly, namely with the logged ratio of the firm's market capitalization divided by that of CRSP's NYSE/AMEX/Nasdaq equal-weighted index (Campbell, Hilscher, and Szilagyi, 2008). Lastly, the control variables include the firm's capital expenditures net of depreciation *(Capex*), standardized by the market value of its assets. For reading convenience, the descriptive statistics refer to the unstandardized measures of firm size and capital expenditures.

These variables, together with year dummies, form our so-called standard regression specification. Descriptive statistics about the age and tenure of CEOs and directors, as well as data about ownership structure and corporate-governance quality are in Panel C. These variables are available for only a limited subsample of firms, which is why we discuss them in a separate panel of the table and do not include them in the standard regression. We examine their relevance later in the analysis. Finally, Panel D shows descriptive statistics for variables used in our subsequent discussion about organizational inertia and rent-seeking behavior; these variables are also defined in Table 12.

Table 3 computes pairwise correlation coefficients between the regression arguments. Except for the correlation between listing and incorporation age, which equals 0.73, most coefficients are fairly low. In no case is there any concern about collinearity (listing and incorporation age do not appear jointly in any regression specification).

4. Firm age and profitability

To assess whether there is a relation between firm age and profitability, we estimate robust panel regressions. This enables us to distinguish between cohort and true aging effects. Cross-sectional OLS regressions are unable to make that distinction. This could explain why, in some cases, OLS regressions find no relation between firm age and profitability (see, for example, Villalonga and Amit, 2006).

Table 4 shows the results for the standard regression. The Hausman specification test reported at the bottom of the table prefers fixed to random effects. We therefore include firm-fixed effects to account for firm heterogeneity, and add period-fixed effects to capture the impact of the overall state of the economy. We assume that the regression coefficients are the same across industries and stationary over time. We come back to this assumption. Moreover, to control for a possible omitted-variable problem, in addition to the firm-fixed effects we include lagged profitability values in our regressions. If age also affects past profitability, however, this correction makes it more difficult to find an age effect. As it turns out, with and without correction, the results are qualitatively the same.

Regressions (1) to (3) in the table are estimated for the full sample; regressions (4) to (6) exclude financial firms (SIC codes 6000–6999). The evidence suggests a significant inverse relation between firm age and profitability, regardless of how we measure profitability. It should be pointed out that, since we are controlling for firm size, this finding is unrelated to declining returns to scale.

The linear age effect is statistically significant at the 1 percent level, irrespective of the profitability measure used and whether or not we include financials. The squared effect is generally positive and significant. Profitability seems to have a convex relation with age. We come back to this issue further down.

The numbers imply that profitability deteriorates from the very beginning. It is as if firms' desire and motivation to succeed weaken very quickly. At first sight, this seems to reject the existence of a life cycle of the firm. Our sample, however, includes only listed firms. To shed light on a potential life cycle, we reestimate the regressions in Table 4 for the firms with negative industry-adjusted profitability in the first year after listing. Presumably, these firms are still in the early stages of their life cycle. The evidence supports this conjecture, especially when measuring profitability with Tobin's Q (not shown): the coefficient of *Age* is positive and significant with confidence 0.95, whereas that of Age^2 is negative and significant with confidence 0.99. The turning point in this hump-shaped age-profitability relation is reached around a listing age of 9. Firms in the early stages of the life cycle therefore seem to get better with time, but eventually profitability falls. Relatively few firms, however, exhibit below-industry profitability at the time of their IPO (see also Fama and French, 2004). We therefore do not treat this subset of firms separately in the following investigation.

Coming back to Table 4, we find that the control variables have coefficients mostly in line with the predictions. Financial constraints impair firm profitability (Lamont, Polk, and Saá-Requejo, 2001). In contrast, strategic focus has a positive and significant effect on Tobin's Q. Unrelated diversification is therefore bad for business, consistent with the extant literature (see, among others, Campa and Kedia, 2002; Villalonga, 2004). We also find that larger firms do worse (see also Lang and Stulz, 2004) and so do firms with high stock volatility, which, in the case of gross margins and ROA, is difficult to square with a risk argument. Higher capital expenditures (net of depreciation) also seem to have a negative effect on profitability.

The two age covariates are highly collinear and the associated variance inflation factors by far exceed the rule of thumb of 10, which could explain why the coefficient of Age^2 is only borderline significant. To get around this problem and find out more about the actual shape of the age-profitability relation, we follow Morck, Shleifer, and Vishny (1988) and run piecewise linear regressions that allow for changes in the age coefficient at age 5, 10, 20, and 30, respectively. Age 5 defines the first quartile of the age distribution; 10 is the median age; 20 is approximately the third quartile; about 10 percent of all observations are beyond age 30. We therefore substitute *Age* and Age^2 with the following variables:

$$
\begin{aligned}
Age.1to5 &= Age \text{ if } Age < 5, \\
&= 5 \text{ if } Age \geq 5;
\end{aligned}
\qquad
\begin{aligned}
Age.6to10 &= 0 \text{ if } Age < 5; \\
&= (Age - 5) \text{ if } 5 \leq Age < 10, \\
&= 5 \text{ if } Age \geq 10;
\end{aligned}
$$

$$
\begin{aligned}
Age.11to20 &= 0 \text{ if } Age < 10 \\
&= (Age\text{–}10) \text{ if } 10 \leq Age < 20; \\
&= 10 \text{ if } Age \geq 20;
\end{aligned}
\qquad
\begin{aligned}
Age.21to30 &= 0 \text{ if } Age < 20 \\
&= (Age\text{–}20) \text{ if } 20 \leq Age < 30; \\
&= 10 \text{ if } Age \geq 30;
\end{aligned}
$$

$$
\begin{aligned}
Age.over30 &= 0 \text{ if } Age < 30 \\
&= (Age\text{–}30) \text{ if } Age \geq 20.
\end{aligned}
$$

A firm age of 18 years, for example, would imply that *Age.1to5* = 5*; Age.6to10* = 5*; Age.11to20* = 8*; Age.21to30* = 0*;* and *Age.over30* = 0.

The results are in Panel A of Table 5. For brevity, we report only the coefficients of the five age covariates. Overall, the evidence confirms a negative relation between age and profitability. Interestingly, there is no evidence of a U-shaped relation—performance does not rebound at very old age. The relation, however, is convex, in the sense that the negative marginal effect of age bottoms out over time. According to regressions (1) and (2), the industry-adjusted gross margin (ROA) drops by an annual 0.20 (0.15) percentage points during the first ten years and by roughly 0.15 (0.10) percentage points thereafter. Tobin's Q (regression 3) behaves similarly. The effect of age is not huge, but it is steady and it accumulates over time. Note that we are controlling for past performance. If we exclude the lagged dependent variable, the effect of age doubles (not shown). In that case, ROA (Tobin's Q) drops by an annual 0.29 percentage points (0.08) during the first five years of life. Between ages 5 and 10, the annual decline is still 0.21 percentage (0.04). Overall, during the first 20 years of life, the age effect eats up a sizeable 3.3 percentage points in ROA and 0.6 in Tobin's Q. The effect on gross margin is similar. Our remaining investigation relies on piecewise linear measures of age.

5. Robustness tests

The results suggest a significant relation between firm age and profitability. What follows probes the robustness of that relation. We ask whether the results change when we measure age from the time of incorporation. We also examine the importance of a possible simultaneous equations bias, the relevance of relistings and mergers in our definition of age, and how sensitive the results are to the estimation technique. Moreover, we want to know whether the relation is confined to specific time periods, and whether it is driven by the presence of many small firms in the sample. Unless explicitly stated, our tables report only the coefficients of the age covariates and their statistical significance.

5.1. Incorporation age

The results are robust to age definition. In Panel B of Table 5, we reestimate the piecewise linear standard regression but measure firm age since the year of incorporation. We choose the same percentiles as possible turning points as those used for listing age; hence, we allow the relation to change at incorporation ages 12, 23, 45, and 88, respectively. The message of the evidence is still that firm profitability weakens over time. Since the findings for listing age and incorporation age are generally the same, what follows reports the results for only one age definition. We choose listing age, because it is available for the full sample of firms.

5.2. Simultaneous equations bias

The results for incorporation age help us address the potential problem of simultaneous equations bias. Whereas age could affect profitability, it could also be the other way around: profitability could affect firm survival (Campbell, Hilscher, and Szilagyi, 2008; Jensen, 1986) and thereby firm age. The problem is that this reverse effect cannot be sizable: profitability in year t of a firm's life has little effect on the probability of survival until that time, especially when we measure age since the date of incorporation—the median incorporation age is 23. Hence, simultaneous equations bias should not be of great concern.

5.3. Relistings and mergers

Another concern is relistings. As mentioned in the data section, we ignore the fact that some firms relist after having gone private and classify them as newly listed companies. In principle, since firms that relist are presumably doing well, our classification could make the average profitability of older firms look worse than it really is, which could induce the negative age effect we observe. Yet only few firms in the sample relist after having gone private. More important, as we just saw, the same results obtain when age is measured from the date of incorporation. Older firms are not resurrected as young firms when they relist; they maintain their incorporation age. Relisting, therefore, can hardly explain our results.

Mergers raise questions about the proper measurement of firm age, too. In some cases, merged firms are treated by CRSP as new firms. To test whether this decision assigns good performing firms to the cohort of young firms and makes them look better than they really are, we repeat the analysis and drop all the firms that list in the year of their incorporation, since these could be new firms that arise from a merger. The results, however, do not change (not shown). Firm age and profitability remain negatively related.

5.4. Alternative specifications and estimation techniques

So far, we have used linear panel regressions with firm and time-fixed effects, and a lagged dependent variable to estimate our standard regression. To see how crucial this estimation setup is, we explore alternative specifications and estimation techniques.

In untabulated regressions, we control for financial leverage, dividend payments, and R&D expenses. Leverage could reduce agency costs, lower taxes, or increase the costs of financial distress (see, among many others, Harris and Raviv, 1991). Dividend payments could identify more profitable firms (Fama and French, 2001) or financially unconstrained ones. And R&D expenses are a proxy for growth opportunities (Mehran, 1995). The results do not change when we include these variables. The same conclusion follows when measuring firm size with the book value of assets, and when defining ROA as the ratio of NOPAT or income before extraordinary items to book value of assets. We also add the squared value of all control variables to allow for nonlinearities. Our conclusions stand—profitability seems to deteriorate over time.

Table 6 explores additional specifications and alternative estimation procedures. First, we use the logged value of profitability as the dependent variable to explore the importance of skewness. Second, we allow for two lagged terms of the dependent variable. Third, we replicate the analysis with the Arellano-Bond dynamic panel-data estimation approach, since the unobserved individual panel-level effects could be correlated with the lagged dependent variable. Finally, we estimate fixed-effect regressions with Driscoll and Kraay (1998) standard errors, which are robust to very general forms of cross-sectional and temporal dependence.

Panel A in the table is dedicated to ROA, whereas Panel B deals with Tobin's Q. Regardless of performance measure and estimation technique, the data yield the same conclusion, namely that corporate age is negatively related with profitability across the five age intervals. All age coefficients are statistically significant with confidence 0.99.

5.5. Different sample years and large firms

We also ask whether the results hold across different time periods. Table 7 shows the coefficients of the age covariates if we replicate our standard regression for the years 1978–1985, 1986–1995, and 1996–2004, separately. In the case of ROA, the coefficients are mostly negative and significant. The exception is the years 1986–1995, when the first five years of post-IPO life are associated with higher ROA. The age coefficients in the Tobin's Q regressions are almost uniformly negative and significant, including in the years 1986–1995. Overall, the negative age relation persists. Note that there is some variation in the coefficients. One possible reason is that the correlation in question changes over time. Another possibility is that the sample's industry-composition varies in time, and that the correlation differs across industries.

The results could also be due to the presence of many small firms. To test this conjecture, we repeat the estimation in Table 5 and limit the analysis to S&P 500 firms. However, age is still negatively related with profitability, especially when we measure profitability with Tobin's Q. Note that this finding confirms that age effects are distinct from size effects.

5.6. Industry-specific regressions

To find out more about the relation between age and performance at the industry level, we replicate our standard regression with Driscoll and Kraay (1998) standard errors for individual industries. Table 8 shows the results when sorting firms according to the ten industry classification suggested by Fama and French (1997) (plus financials). Alternative industry definitions yield similar results (not shown).

The results generally confirm the negative relation between age and profitability. With the exception of utilities, the relation is negative and significant in each industry for at least one measure of profitability. In the case of utilities, however, ROA increases over time. One possible reason is that older firms have more clout with regulators.

A possible problem with the industry breakup of the sample is the number of observations. To get around that problem, we reestimate our regression and measure all variables as deviations from their industry-specific average, divided by the industry-specific standard deviation, in each particular year. The results show a highly significant relation between age and profitability across all age intervals (not shown).

6. Interpretation: corporate aging

Overall, we find a significant and robust negative relation between firm age and profitability. The question we want to pursue is what that relation means. We therefore inquire into the possible economics of why age could harm performance, in spite of the possible learning effects of older age. We offer two nonexclusive hypotheses of why that could happen, namely organizational rigidities and rent seeking.[4]

6.1. Organizational rigidities

Age can have adverse effects on performance because of the organizational rigidities and inertia it brings about (Carroll, 1983; Hannan and Freeman, 1984; Leonard-Barton, 1992; Barron, West, and Hannan, 1994), a phenomenon that also impairs a firm's ability to perceive valuable signals (Kiesler and Sproull, 1982; Tripsas and Gavetti, 2000). The root of the problem could be the tendency of firms to codify their success with organizational measures, rules of conduct, and best practice. This behavior helps firms focus on their core competences and raise reliability and accountability. Stressing the good to prevent the bad, however, can also make it hard to recognize, accept, and implement change when doing so would be appropriate. Codification is a slow process. The older the firm, the more capillary and suffocating the codification can be. If

[4] There are other possible hypotheses we don't consider. One of them is the proliferation of seniority rules and privileges in the organization over time. Seniority rules can provide inadequate incentives for managers to perform and make it more difficult for organizations to function.

so, age will reduce flexibility and discourage change.[5] At the same time, whatever learning benefits the firm captures in its established lines of business probably decline over time (Agarwal and Gort,1996 and 2002). If so, older firms should tend to ossify and lose their competitive edge.[6]

If organizational rigidities make it hard for firms to keep up with the competition, we would expect a decrease in productive efficiency in older firms. If so, variable costs and overhead expenses should increase with age. At the same time, market share should decline, which means sales growth should lag behind that of the competition. Finally, if older firms are truly unwilling to innovate, they should eventually engage in less research activities and invest less. By implication, older firms should also tend to have antiquated machines, plants, and equipment.

To find out, we estimate individual panel regressions of costs, sales growth, R&D, and asset age on firm age. The control variables and the estimation technique are those used in Table 5. All dependent variables are measured as deviations from the median industry value in any given year. To save space, we show only the coefficients of the age covariates and their significance levels.

The results are shown in Table 9. The evidence is consistent with our predictions. Sales growth slows as firms grow older. Moreover, cost of goods sold (COGS) and overhead expenses go up. Finally, R&D and investment activities decline, and fixed assets become outdated. In the

5 There is a vast literature on organizational inertia. See, among others, Tripsas and Gavetti (2000) and the literature cited therein.

6 Foster and Kaplan (2001) make a somewhat related argument based on the fear of making mistakes. They contend that as corporations grow, they become weighted down by rules and procedures. Fear of cannibalizing their own products, competing with their customers, and diluting earnings through acquisitions result in cultural lock-in. Decision-making abilities, control systems, and mental models ossify, discourage innovation, and dampen the ability to shed uninteresting operations.

case of sales growth, the extant literature reports consistent results (see, for example, Evans, 1987; Caves, 1998; Chun et al., 2008).

The coefficients we compute are economically meaningful. For example, if we keep all covariates at their median value and allow only age to vary, the numbers imply that a newly listed firm's sales growth exceeds that of the industry by 16.9 percentage points. After nine years, growth falls below the industry median. The marginal effect of age is zero past age 30. This latter result should be interpreted with care, since fewer than 10 percent of the firms live longer than 30 years after their IPO. Hence, there are relatively few observations of comparatively old firms, and the coefficient estimates we obtain are more easily affected by outliers.

To assess the economic significance of the results, we can also compare each dependent variable of interest at age 30 and age 5, keeping all the control variables at their median value. The associated numbers are in the last column of Table 9. All differences are highly significant and almost all of them are economically tangible. For example, old firms have a ratio of cost-of-goods-sold to sales that is 4% higher than what we observe in young firms; given a sample average of 65.6%, the difference would seem to be sizable. Similarly, the difference in overhead as a ratio of firm value is a considerable 9.3% (the sample average ratio is 30.2%), that in sales growth is 11.4% lower (the sample average ratio is 8.73%), and that in research and development outlays as fraction of sales is 1.4% higher (compared to a sample average ratio of 5.3%). Also the investment outlays are substantially lower in older firms; as a fraction of assets, they are 11.2% lower (the average fraction in the sample is 8.1%). Finally, firms tend to have older assets, but not by much (only 0.2 years).

We also examine whether aging is more pronounced in high-tech than in low-tech industries and replicate Table 5 for these two industry groups separately (not shown). High-tech firms might age faster because they are more exposed to competitive threats. To identify high- and low-tech industries, we sort the 2-digit SIC industries according to their average R&D-to-assets ratio across all sample years. Low-tech industries are those with relatively low R&D-expenses, i.e., in the first tercile of that distribution. In contrast, we consider all industries in the third tercile as high-tech. The last two rows of the table compare ROA across the two subsamples. Aging is similar in the two groups. The same conclusion follows when examining Tobin's Q. Alternative definitions of high- and low-tech industries, including the classification in Francis and Schipper (1999) and Fama and French (1997), yield the same conclusions. High-tech firms might indeed be exposed to a higher risk of obsolescence, but they might also be comparatively better at dealing with frequent technological changes.

6.2. Rent-seeking hypothesis

An alternative, nonexclusive, hypothesis draws on Olson (1982) and his theory of collective action[7] and can be summarized as follows. Collective action in society is difficult to come about because it is costly. Moreover, the longer the time horizon, the more frequent the opportunities for special interest groups, especially small ones, to come together. These organizations for collective action often survive even if the good they once provided is no longer needed. Hence, "stable societies with unchanged boundaries tend to accumulate more collusions and organizations for collective action over time" (p. 41). The great majority of these special-interest

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[7] We are grateful to Michael Brennan for pointing out this possibility.

groups choose to redistribute income rather than to create it, as they bear the full cost of making society more efficient, but get only a small fraction of the resulting gains.[8] In comparison, redistributive efforts are more beneficial even though they can make society as a whole worse off—distributional coalitions do not bear the full costs of getting a larger slice of the social pie, but they can claim the full benefit.

Olson's logic can be extended to firms. Special-interest groups and coalitions are possible in firms as well. Unless these groups are provided the proper incentives by effective corporate governance, they are formally in the same situation as distributional coalitions in society are. Organizing a collective good that benefits the whole firm is often less beneficial than appropriating income and resources—including the pursuit of a quiet life (Bertrand and Mullainathan, 2003). The older the firm, the greater are the chances that these coalitions have formed. If distributional coalitions survive, rent-seeking behavior will be more widespread in older firms.

Some of the testable propositions that follow from the rent-seeking hypothesis are the same as those that follow from the organizational-rigidities hypothesis—the two hypotheses are not mutually exclusive. For example, Bertrand and Mullainathan (2003) show that poorly governed managers strive to avoid difficult restructuring and expansion decisions. Consequently, lower R&D expenses and investment outlays in older firms are consistent with the rent-seeking hypothesis as well, simply because they involve effort and risk. The hypothesis, however, implies a number of additional testable propositions.

8 Grossman and Hart (1980) make a similar argument to explain minority shareholders' reluctance to monitor management.

Specifically, if rent seeking is more pervasive in older firms, it must be because corporate governance allows it. If we look at the governance index from Gompers, Ishii, and Metrick (2003), we consequently expect the scores of older firms to be higher (high index values reflect poorer governance). Moreover, we would expect larger boards in older firms, since the literature suggests that larger boards reflect poorer governance (Yermack, 1996; Eisenberg, 1998). Larger boards could either favor rent seeking or be one of the ways quasi-rents are dissipated. Furthermore, if corporate governance is weaker in older firms, then managers should take advantage of it. We therefore investigate whether CEO pay is higher in older firms. Finally, we test whether the managers of older firms slow the growth in the labor force, possibly to make the existing jobs safer. Bertrand and Mullainathan (2003) suggest that managers care more about workers to buy peace with them.

Table 10 examines these predictions. As before, all dependent variables are measured as deviations from their industry median. For example, *G-Index* equals the actual Gompers, Ishii, and Metrick (2003) index value for the firm minus the median index value in the company's two-digit SIC industry. To avoid clutter, the table lists only the coefficients of the age covariates and their significance levels.

The evidence is consistent with the rent-seeking hypothesis. The corporate governance index worsens significantly with age, and board size increases,[9] in agreement with an environment conducive to agency problems in older firms. Field and Karpoff's (2002) results that large seasoned corporations deploy defenses at a higher rate than IPO firms would seem to be congruent.

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9 The literature has investigated the relation between age and board size in IPO firms with mixed results (Boone, Field, Karpoff, and Raheja, 2007; see, however, also Link, Netter, and Yang, 2008).

The evidence also confirms the existence of apparent agency problems: all other things being equal, total CEO compensation in real 1978 dollars goes up with age. The annual increase is limited, but it accumulates to a sizable number. For example, the first five years after the IPO add $9,000 to the CEO pay every year, and the next five add another $7,000. Ignoring time value of money, this means that the CEO of a firm at the end of its tenth year of listing makes $80,000 in real terms more than his peers in the industry. This result is robust to the inclusion of CEO age and tenure as additional controls in the regression (not shown). Hence, even though performance slows, CEOs end up making more money as firms grow older. The age effect in CEO compensation becomes even stronger when we control for profitability (not shown). In that case, compared to the CEO of a newly listed firm, the CEO of a ten-year old company earns approximately $120,000 more. Given that the median CEO pay in the sample is $328,000 in 1978 dollars, this age effect seems quite substantial.

We also find that employment grows more slowly in older firms. Combined with the evidence of lower R&D and investment efforts we just saw, this could reflect the quieter life that the managers of older firms might strive for—or their inability to keep pace with the competition. We should stress that we are controlling for firm size. Hence, the result is not the reflection of diminishing economies of scale.

As before, we can gauge the economic importance of the results by comparing 30-year old firms with 5-year old ones. The last column in Table 10 performs that comparison. Governance quality has about two index points more in older firms. Since the median index value in the sample is 9 and the minimum is 5, the difference would seem to be economically substantial. With almost three additional directors, board size is also larger in older firms—according to Table 2, the median board size is 9 and the minimum is 5. Please remember again that these findings are conditional on firm size. Similarly, CEO pay is almost 64 thousand real 1978 dollars higher and employment growth 11.7 percent lower.

On the whole, the evidence supports the existence of a corporate aging phenomenon along the economic logic we suggested. We should stress that, under both hypotheses, there is a causal relation between firm age and poorer performance. Under the organizational-rigidities hypothesis, it is time itself that enables a capillary codification of processes and ideas, leads to ossification, and progressively weakens the ability of the firm to respond to competitive threats. Similarly, under the rent-seeking hypothesis, it is time that enables the coalescing of an increasing number of interest groups and factions within the firm.

7. Alternative hypotheses

There are several alternative hypotheses that could explain our findings. What follows examines a number that were suggested to us. We therefore inquire whether our findings are driven by firms in the early years after their IPO, investor uncertainty, ownership structure, industry age, age of management, and sample selection. We focus our discussion on profitability.

7.1. Is the age effect a reincarnation of post-IPO regularities?

Jain and Kini (1994) and Fama and French (2004) report that operating profitability deteriorates after the IPO. Conceivably, firms list when they think they are at the peak of performance (see, among others, Pagano, Panetta, and Zingales, 1998; Chemmanur, He, and Nandy, 2008). If so, it should not be surprising that profitability deteriorates after the IPO. It's unclear, however, how optimal timing can explain a negative piecewise relation between age and profitability as many as 20 years after the IPO. Moreover, the same results obtain when we measure age from the date of incorporation rather than that of listing. We are not claiming that there is no IPO timing. All we are saying is that there is more than simply IPO timing to the data, and that the evidence is consistent with a phenomenon of corporate aging. In fact, the IPO effect could be an aging effect.

7.2. Is the age effect a manifestation of declining uncertainty?

Pástor and Veronesi (2003) argue that uncertainty about a firm's average future profitability should decline over time as investors learn more about the firm. Consistent with the model, and using firm age as a proxy for learning, the paper finds that younger firms have higher M/B ratios. At least two observations, however, cast doubts on a pure uncertainty interpretation of the age effect we observe. First, the age effect is not limited to a valuation multiple but extends, as we have seen, to other profitability measures (ROA and margins), sales growth, cost structures, and investment outlays, among others. Resolution of investor uncertainty cannot explain these findings. Second, the age effect in our Tobin's Q regressions does not disappear even though we control for stock-return volatility in our standard regression. This suggests that there is more to the age effect than investor learning.

7.3. Is the age effect a manifestation of declining ownership concentration?

The empirical literature finds a negative relation between ownership concentration and firm age. At the same time, ownership could correlate positively with profitability. Conceivably, increasing age could simply be a proxy for declining ownership concentration.

To find out whether this is so, we use blockholder data from Dlugosz et al. (2006) for the years 1996 to 2001. There are matching data for 1,180 firms (3,992 firm-years). Consistent with previous studies, we find that ownership concentration is lower in older firms (Panel A of Table 11). We then replicate the analysis in Table 5, extending the standard regression specification with the cumulative fraction of shares controlled by the firm's officers and directors (*Inside ownership*) and its squared value. The coefficients of the age covariates remain generally negative (regression 1 of Table 11B). The same conclusion follows when we control for the stake of the largest shareholder, the blockholders as a group, and the outside shareholders (not shown). Overall, therefore, it is difficult to claim that firm age is a surrogate for ownership concentration. At the same time, these results suggest that the decline in the quality of corporate governance we have observed above is a phenomenon that cannot be explained by declining ownership concentration alone.

We repeat the analysis by excluding closely held firms, namely those where *Inside ownership* is larger than 20 or, alternatively, 30 percent. This procedure should filter out a large proportion of family firms. The results are unaffected, which suggests that the age-profitability relation is not tied to a loosening of family control over time, either (not shown). Consistent with this argument, Anderson and Reeb (2003) find that the log of firm age (measured since inception) in family firms is also negatively related to profitability.

In this context, we should mention the monitoring model by Clementi, Cooley, and Di Giannatale (2009). The model predicts a decline in the value of entrepreneurial firms after they are started. Yet the model does not seem to apply to listed firms and their performance after listing.

7.4. Industry age

One could argue that older firms are more likely to operate in relatively old and unattractive industries. Therefore, the relation between firm age and performance could simply reflect a negative link between industry age and performance. Yet our performance measures are industry-adjusted, so industry age cannot explain our results.

7.5. Is the age effect a manifestation of older people in the organization?

Faleye (2007) observes a negative relation between director age and Tobin's Q. If older firms are managed by older people, firm age could be a proxy for the age of managers and directors. To find out whether it is the age of the organization or that of its people that impairs profitability, we collect age and tenure data for the sample firms' CEOs and directors. The information is from *RiskMetrics* and *ExecuComp*, respectively. We find matching data for 1,830 CEOs (11,447 firm-years) in 1992–2004 and for 1,896 boards (8,176 firm-years) in 1996–2004.

Panel A of Table 11 shows that the CEOs and the directors of older firms are indeed older themselves, although only marginally so; moreover, they have been with the company a bit longer. For example, the CEO of firms older than the median is 56, on average; in younger firms, he is 53. Similarly, directors of older firms are 59, on average, whereas in younger firms they are 56. We stress that these differences are fairly small. Not surprisingly, when we include these variables in our standard regression from Table 5, the results do not change. The analysis covers a subsample of 806 firms (2,134 firm-years) during the years 1998 to 2001. There is a negative relation between director tenure and performance, but we still find an overall negative relation between firm age and Tobin's Q (regressions 2, 3, and 4 of Table 11B). The same conclusions follow when measuring performance with ROA (not shown). The results remain the same also when adding the squared value of the CEO's and the directors' age, as well as the squared value of their tenure (not shown).

In a related test, we wanted to know whether young CEOs are able to turn things around in older firms. Hence, we repeated the standard regression in Table 5 and focused on firms where the CEO's tenure is shorter than 4 years. The results do not change. Young CEOs alone are apparently unable to solve the corporate aging problem.

7.6. Is the age effect an expression of sample selection?

Survival bias could also explain our results.[10] Let us illustrate this interpretation with an analogy. Firms can be thought of as antelopes. In our story, the M&A market plays the role of lions that feed on antelopes. We can assume that young antelopes taste better than old ones. Suppose now the agility of antelopes is a random variable independent of age. If so, the young antelopes that survive will tend to be more agile than the old survivors, simply because the weak among them, especially the young ones, will be caught and eaten by the lions. Natural selection

[10] We are indebted to Yakov Amihud for suggesting this interpretation.

will therefore induce a negative relation between agility and the age of the antelopes. The same happens in the M&A market, since poor performers are less likely to survive and since young firms seem to be more attractive takeover targets (Loderer, Neusser, and Waelchli, 2009). This more radical weeding out of poor performers in the cohort of young firms could therefore induce the negative relation between profitability and firm age we observe, even if unconditional firm profitability is unrelated to firm age.

To discriminate between this lion hypothesis (a sample-selection hypothesis) and our claim that it is age itself that reduces profitability, we replicate our regressions for the firms in the sample with superior profitability (i.e., above the industry median in any given year). Since lions supposedly feed on the weaker antelopes, they should have no or a significantly weaker effect on the observed mean agility of the faster antelopes. By analogy, natural selection in the market for corporate control should have no direct effect on the observed mean profitability of the better firms. As it turns out, our results are unchanged: there is still a strong negative relation between (incorporation and listing) age and performance. Even the better among the older firms fail to keep up with the competition (Panel C of Table 11).

8. Conclusions

In life, almost everything gets old and obsolete. This paper asks whether firms suffer the same fate and become inefficient as time goes by. A priori, it's unclear what one should expect. If anything, aging should decrease costs because of various learning effects within the firm and learning spillovers from other firms in the same or in other industries. We start by looking for a correlation between firm age and profitability. What we find is a highly significant negative relation, which is quite robust with respect to different estimation techniques, regression specifications, and the way we measure firm age. In the second part of the investigation, we look into the economics of aging and offer two nonexclusive hypotheses why firms could age, namely organizational rigidities and rent seeking.

The evidence is consistent with both rationales. COGS and overhead expenses go up, growth slows down, and R&D expenses and capital expenditures fall behind the industry median, which is consistent with the existence of organizational rigidities. Also, as predicted by the rent-seeking hypothesis, corporate governance worsens, boards grow, and CEO pay goes up. These results cannot be explained with alternative interpretations of the data. In particular, corporate aging is distinct from factors such as concave investment opportunity sets, uncertainty, ownership structure, age of officers and directors, and industry age.

Taken together, these findings are consistent with the existence of a real corporate aging problem. As far as we know, this is the first large-scale study to address the issue of corporate aging in its various performance-related dimensions, and the first such study to relate that phenomenon to organizational rigidities and rent seeking. Corporate aging raises many fascinating questions we have to leave for future research. One avenue of further inquiry is a better understanding of why corporate governance is apparently unable to deal with this problem. A second question is what happens to obsolete firms and their resources: do they waste away or does the market for corporate control dispose of them (Jensen, 2000)? Finally, a third area of interest is the possible existence and the determinants of a lifecycle of the corporation.

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Table 1

Firm age

The table shows descriptive statistics for the age of our sample firms. Panel A reports listing age by sample years. Panel B reports descriptive statistics for incorporation age.

Sample year	Mean	Median	p25	p75	Max	Stdev	N
			Panel A: Listing age by sample year				
1978 – 2004	14.14	10.00	5.00	19.00	80.00	13.79	82,845
1978	14.51	9.00	7.00	17.00	54.00	12.92	2,285
1980	15.78	10.00	9.00	19.00	56.00	13.09	2,277
1985	15.47	14.00	5.00	19.00	61.00	13.76	2,589
1990	14.96	10.00	5.00	19.00	66.00	13.90	2,808
1995	12.92	8.00	3.00	20.00	71.00	13.88	4,097
2000	12.27	7.00	4.00	15.00	76.00	13.41	3,523
2004	15.91	11.00	6.00	20.00	80.00	14.42	2,923
			Panel B: Incorporation age				
1978 – 2004	32.06	23.00	12.00	45.00	280.00	27.36	40,400
Age at listing	15.32	8.00	4.00	18.00	274	19.20	5,051

Table 2

Descriptive statistics

This table shows descriptive statistics for the performance measures and the control variables. We exclude here firms that operate in the financial sector (SIC 6000–6999) to make our data more comparable with those of other studies. All variables are winsorized at the 5th and 95th percentile of their pooled distribution across all firm-years (Campbell, Hilscher, and Szilagyi, 2008). Total assets and capital expenditures (net of depreciation) are in constant 1978 dollars. Variable definitions are shown in Table 12. The sample period is 1978 – 2004.

Variable	Mean	Median	Min	Max	Stdev	N
Panel A: Profitability measures						
Unadjusted Gross margin	34.383	31.376	7.647	73.565	18.125	76,188
Unadjusted ROA	12.211	12.509	–8.274	29.325	9.286	74,747
Unadjusted Tobin's Q	1.591	1.270	0.780	4.050	0.858	75,344
Panel B: Control variables (full sample)						
KZ index	–2.449	–0.403	–20.158	2.870	5.711	61,397
Volatility	0.643	0.564	0.238	1.435	0.326	73,271
Focus	0.848	1.000	0.113	1.000	0.237	76,201
Size	–10.530	–10.578	–14.436	–6.303	1.737	75,364
Capex	–0.030	–0.025	–0.233	0.140	0.093	72,081
Total assets	562.621	76.719	0.317	127,064.0	2,664.286	76,199
Capital expenditures	14.221	1.447	–15.822	120.330	32.338	71,370
Panel C: Control variables (reduced sample)						
CEO age	55.211	55.000	43.000	68.000	6.864	10,601
CEO tenure	7.663	6.000	1.000	23.000	6.045	9,979
Director age	58.440	58.778	50.500	65.167	3.927	7,589
Director tenure	9.265	8.833	3.600	17.300	3.745	5,837
Inside ownership	3.423	0.000	0.000	24.500	6.942	3,958
Panel D: Variables to investigate organizational rigidities and the rent-seeking						
Asset age	4.691	4.124	1.015	10.871	2.728	59,298
Board size	8.836	9.000	5.000	13.000	2.278	7,589
CEO pay	414.846	329.073	105.279	1,133.230	278.586	11,021
COGS	0.656	0.686	0.264	0.924	0.181	76,188
Employment growth	0.065	0.027	-0.275	0.591	0.205	61,561
G-Index	9.065	9.000	5.000	14.000	2.582	11,835
Investment outlays	0.081	0.057	-0.130	0.393	0.126	62,558
Overhead	0.302	0.188	0.000	1.226	0.332	75,377
Sales growth (%)	8.732	4.980	-25.974	63.258	21.669	64,581
Sales-to-assets	1.271	1.162	0.216	3.011	0.749	76,199
R&D expenses	0.053	0.020	0.000	0.245	0.070	39,125

Table 3

Correlation coefficients between regression arguments

The table shows Pearson correlation coefficients between pairs of regression arguments. The sample period is 1978 – 2004.

	Age	Age_{inc}	KZ index	Vola.	Focus	Size	Capex	CEO age	CEO tenure	Dir. age	Dir. tenure
Age_{inc}	0.734										
KZ index	–0.026	–0.009									
Volatility	–0.388	–0.425	–0.021								
Focus	–0.331	–0.291	–0.023	0.211							
Size	0.281	0.166	–0.109	–0.293	–0.152						
Capex	0.130	0.141	0.377	–0.199	0.062	–0.096					
CEO age	0.187	0.158	0.026	–0.171	–0.079	0.040	0.057				
CEO tenure	–0.102	–0.094	–0.033	–0.012	0.010	–0.009	0.024	0.369			
Director age	0.337	0.292	0.032	–0.239	–0.154	0.056	0.153	0.408	0.084		
Director ten.	0.184	0.220	–0.041	–0.167	–0.063	–0.002	0.008	0.198	0.350	0.404	
Inside own.	–0.208	–0.172	–0.009	0.008	0.119	–0.211	–0.010	0.037	0.251	–0.090	0.207

Table 4

Firm age and profitability

The table investigates the relation between listing age and firm profitability. Variable definitions are in Table 12. Profitability is measured with gross margin, return on assets (ROA), and Tobin's Q. All measures are adjusted for industry effects by subtracting the profitability of the median firm in the industry, defined with two-digit SIC codes. We use panel regressions with fixed effects and robust standard errors. The overall state of the economy is captured with period fixed effects (year dummies). Regressions (1) to (3) are estimated for the full sample. Regressions (4), to (6) exclude financials (SIC codes 6000–6999). Robust standard errors are reported in parentheses. The symbols ***, **, and * indicate statistical significance with confidence 0.99, 0.95, and 0.90, respectively. The years under investigation are 1978 to 2004.

	Full sample			Nonfinancial firms		
	Gross margin	ROA (1)	Tobin's Q (2)	Gross margin	ROA (3)	Tobin's Q (4)
Age	–0.196 ***	–0.114 ***	–0.015 ***	–0.204 ***	–0.115 ***	–0.015 ***
	(0.018)	(0.012)	(0.001)	(0.019)	(0.013)	(0.001)
Age^2 / 100	0.055 *	0.028	0.005 **	0.057 *	0.033 *	0.005 ***
	(0.028)	(0.019)	(0.002)	(0.030)	(0.020)	(0.002)
KZ index	–0.183 ***	–0.314 ***	–0.015 ***	–0.178 ***	–0.309 ***	–0.015 ***
	(0.014)	(0.012)	(0.001)	(0.014)	(0.013)	(0.001)
Volatility	–2.273 ***	–4.382 ***	–0.314 ***	–2.311 ***	–4.384 ***	–0.308 ***
	(0.209)	(0.179)	(0.015)	(0.222)	(0.187)	(0.016)
Focus	1.542 ***	0.381 *	0.050 **	1.619 ***	0.374	0.046 **
	(0.334)	(0.224)	(0.020)	(0.348)	(0.233)	(0.021)
$Size_{t-1}$	–0.162 **	–0.588 ***	–0.141 ***	–0.174 ***	–0.590 ***	–0.140 ***
	(0.064)	(0.049)	(0.005)	(0.067)	(0.051)	(0.006)
Capex	–5.994 ***	–9.943 ***	–1.066 ***	–6.149 ***	–9.761 ***	–1.067 ***
	(0.694)	(0.565)	(0.056)	(0.733)	(0.591)	(0.057)
$Gross\ margin_{t-1}$	0.525 ***			0.522 ***		
	(0.011)			(0.012)		
ROA_{t-1}		0.413 ***			0.411 ***	
		(0.007)			(0.007)	
$Tobin's\ Q_{t-1}$			0.517 ***			0.517 ***
			(0.008)			(0.008)
Constant	0.885	–3.662 ***	–1.140 ***	0.868	–3.634 ***	–1.122 ***
	(0.738)	(0.538)	(0.057)	(0.772)	(0.560)	(0.059)
Year dummies		Yes	Yes		Yes	Yes
Observations	64,724	64,662	64,740	59,769	59,704	59,768
R^2	0.330	0.259	0.287	0.327	0.256	0.290
F-Test	193.79 ***	292.69 ***	215.54 ***	169.63 ***	260.05 ***	199.79 ***
Hausmann test (χ^2)	10,894 ***	10,312 ***	7,038 ***	10,084 ***	9,419 ***	6,630 ***

Table 5

Piecewise linear regressions

The table inquires into the shape of the age-profitability relation with piecewise linear regressions. Panel A measures age since listing. The age covariates are *Age.1to5*, *Age.6to10*, *Age.11to20*, *Age.21to30*, and *Age.over30*. Firm age of 18 years, for example, implies that *Age.1to5*=5; *Age.6to10*=5; *Age.11to20*=8; *Age.21to30*=0; *Age.over30*=0. Panel B looks at incorporation age, where the age covariates are Age_{inc}*.1to12*, Age_{inc}*.13to23*, Age_{inc}*.24to45*, Age_{inc}*.46to88*, and Age_{inc}*.over88*, respectively. The control variables and the estimation techniques are those from Table 5. To save space, we report only the coefficients of the age variables and the associated significance levels. Robust standard errors are reported in parentheses. The dependent variables are Gross margin (regression 1), *ROA* (regression 2), and *Tobin's Q* (regression 3). All are measured as deviations from the industry median. The symbols ***, **, and * indicate statistical significance with confidence 0.99, 0.95, and 0.90, respectively. The sample period is 1978 – 2004.

Panel A: Age = Listing age

	Age.1to5	*Age.6to10*	*Age.11to20*	*Age.21to30*	*Age.over30*
(1) *Gross margin (%)*	–0.203 ***	–0.220 ***	–0.174 ***	–0.157 ***	–0.142 ***
	(0.052)	(0.032)	(0.020)	(0.023)	(0.020)
(2) *ROA (%)*	–0.141 ***	–0.153 ***	–0.080 ***	–0.106 ***	–0.087 ***
	(0.045)	(0.027)	(0.017)	(0.019)	(0.014)
(3) *Tobin's Q*	–0.024 ***	–0.021 ***	–0.007 ***	–0.016 ***	–0.010 ***
	(0.004)	(0.003)	(0.001)	(0.002)	(0.001)

Panel B: Age = Incorporation age

	Age_{inc}*.1to12*	Age_{inc}*.13to23*	Age_{inc}*.24to45*	Age_{inc}*.46to88*	Age_{inc}*.over88*
(1) *Gross margin (%)*	–0.198 ***	–0.186 ***	–0.150 ***	–0.119 ***	–0.143 ***
	(0.053)	(0.036)	(0.025)	(0.022)	(0.034)
(2) *ROA (%)*	–0.146 ***	–0.095 ***	–0.110 ***	–0.090 ***	–0.100 ***
	(0.045)	(0.031)	(0.021)	(0.019)	(0.026)
(3) *Tobin's Q*	–0.019 ***	–0.015 ***	–0.012 ***	–0.012 ***	–0.011 ***
	(0.004)	(0.003)	(0.002)	(0.002)	(0.001)

Table 6

Alternative estimation techniques

The tables presents the coefficient estimates of the age covariates in a piecewise linear context and various estimation techniques. The basic regression specification is our standard one from Table 5. Robust standard errors are reported in parentheses. The dependent variables are *ROA* (Panel A) and *Tobin's Q* (Panel B). All are measured as deviations from the industry median. The symbols ***, **, and * indicate statistical significance with confidence 0.99, 0.95, and 0.90, respectively. The sample period is 1978 – 2004.

Panel A: Dependent variable: *ROA*

	Age.1to5	*Age.6to10*	*Age.11to20*	*Age.21to30*	*Age.over30*
Logged ROA (industry-adjusted)	–0.135 *** (0.043)	–0.145 *** (0.026)	–0.071 *** (0.016)	–0.098 *** (0.018)	–0.079 *** (0.013)
Panel regressions with two lagged dependent variables	–0.190 *** (0.067)	–0.163 *** (0.030)	–0.081 *** (0.018)	–0.102 *** (0.020)	–0.088 *** (0.015)
Arellano-Bond estimation (two lags)	–0.372 *** (0.082)	–0.384 *** (0.046)	–0.190 *** (0.031)	–0.180 *** (0.034)	–0.267 *** (0.029)
Panel regressions with with Driscoll-Kraay standard errors	–0.271 *** (0.051)	–0.282 *** (0.024)	–0.210 *** (0.028)	–0.236 *** (0.033)	–0.217 *** (0.038)

Panel B: Dependent variable: *Tobin's Q*

	Age.1to5	*Age.6to10*	*Age.11to20*	*Age.21to30*	*Age.over30*
Logged Tobin's Q (industry-adjusted)	–0.014 *** (0.002)	–0.011 *** (0.001)	–0.006 *** (0.001)	–0.010 *** (0.001)	–0.007 *** (0.001)
Panel regressions with two lagged dependent variables	–0.019 *** (0.007)	–0.021 *** (0.003)	–0.010 *** (0.002)	–0.018 *** (0.002)	–0.013 *** (0.001)
Arellano-Bond estimation (two lags)	–0.024*** (0.008)	–0.033 *** (0.005)	–0.009 *** (0.003)	–0.026 *** (0.003)	–0.037 *** (0.003)
Panel regressions with with Driscoll-Kraay standard errors	–0.064 *** (0.010)	–0.061 *** (0.006)	–0.047 *** (0.005)	–0.056 *** (0.005)	–0.050 *** (0.006)

Table 7

Robustness check of the relation between firm age and profitability

The table replicates the regressions of Table 5 for subperiods of the sample years, when focusing on the firms in the S&P 500 index, and when focusing on firms that have been incorporated for at least five years before listing. For brevity, we report only the coefficients of the age covariates and the associated significance levels. The dependent variables are *ROA* (Panel A) and *Tobin's Q* (Panel B). All are measured as deviations from the industry median. The symbols ***, **, and * indicate statistical significance with confidence 0.99, 0.95, and 0.90, respectively. The sample period is 1978 – 2004.

Panel A: Dependent variable: *ROA*

	Age.1to5	*Age.6to10*	*Age.11to20*	*Age.21to30*	*Age.over30*
1978–1985	–0.498 ***	–0.302 ***	–0.172 ***	–0.090	0.038
	(0.043)	(0.026)	(0.016)	(0.018)	(0.013)
1986–1995	0.191 ***	0.004	–0.005	–0.026 ***	0.001
	(0.031)	(0.017)	(0.009)	(0.010)	(0.004)
1996–2004	–0.138 *	–0.281 ***	–0.171 ***	–0.362 ***	–0.272 ***
	(0.082)	(0.053)	(0.050)	(0.066)	(0.048)
S&P 500	–0.598 *	–0.243	–0.191 ***	–0.030	–0.026
	(0.082)	(0.046)	(0.031)	(0.034)	(0.029)

Panel B: Dependent variable: *Tobin's Q*

	Age.1to5	*Age.6to10*	*Age.11to20*	*Age.21to30*	*Age.over30*
1978–1985	–0.096 ***	–0.039 ***	–0.003	–0.009 *	–0.010 ***
	(0.013)	(0.008)	(0.003)	(0.005)	(0.003)
1986–1995	–0.014 **	–0.003	0.002	–0.012 ***	–0.011 ***
	(0.013)	(0.008)	(0.003)	(0.005)	(0.003)
1996–2004	–0.069 ***	–0.042 ***	–0.013 ***	–0.034 ***	–0.033 ***
	(0.009)	(0.005)	(0.005)	(0.006)	(0.004)
S&P 500	–0.103 **	–0.005	–0.029 ***	–0.014 ***	–0.014 ***
	(0.043)	(0.018)	(0.005)	(0.004)	(0.002)

Table 8

The relation between age and profitability across industries

The table replicates the regressions of Table 5 with Driscoll and Kraay (1998) standard errors for individual industries. We group the sample firms into the ten Fama-French (1997) industries. In addition, we examine *Financials* (SIC 6000–6999). For brevity, we report only the coefficients of the age covariates and the associated significance levels. The dependent variables are *ROA* (Panel A) and *Tobin's Q* (Panel B). The symbols ***, **, and * indicate statistical significance with confidence 0.99, 0.95, and 0.90, respectively. The sample period is 1978 – 2004.

Panel A: Dependent variable: *ROA*

Industry	*Age.1to5*	*Age.6to10*	*Age.11to20*	*Age.21to30*	*Age.over30*
Consumer nondurables	–0.357 ***	–0.136	–0.010	–0.005	–0.095
Consumer durables	–0.385 *	0.098	–0.249 **	–0.027	–0.147
Manufacturing	–0.057	0.014	0.102	0.044	0.070
Energy	–0.283 *	0.204	0.052	0.186	0.053
High tech	–0.194 **	–0.364 ***	–0.222 ***	–0.311 ***	–0.179 ***
Telecom	0.002	–0.354 *	–0.206 *	–0.311 **	–0.217 **
Shops	–0.133	–0.011	0.071	0.031	–0.007
Healthcare	–0.629 ***	–0.348 ***	–0.214 **	0.005	–0.176 ***
Utilities	–0.265	0.483 ***	0.094	0.251 **	0.255 ***
Others	0.043	–0.118	–0.012	0.073	0.026
Financials	–0.213	–0.303 ***	–0.156 ***	–0.223 ***	–0.210 **

Panel B: Dependent variable: *Tobin's Q*

Industry	*Age.1to5*	*Age.6to10*	*Age.11to20*	*Age.21to30*	*Age.over30*
Consumer nondurables	–0.047 ***	–0.009	–0.011	–0.013 **	–0.009
Consumer durables	–0.066 ***	–0.019	–0.009	–0.004	–0.013
Manufacturing	–0.049 ***	–0.018 **	–0.013	–0.022 ***	–0.014 *
Energy	–0.075 ***	–0.049 ***	–0.008	–0.040 **	–0.009
High tech	–0.024 *	–0.011	0.001	–0.011 ***	0.003
Telecom	0.016	–0.023	0.012	–0.016 *	–0.016 ***
Shops	–0.056 ***	–0.059 ***	–0.027 ***	–0.031 ***	–0.031 ***
Healthcare	–0.065 ***	–0.004	0.009 *	–0.002	0.016 **
Utilities	0.016	–0.016	0.004	–0.003	–0.003
Others	–0.054 ***	–0.035 ***	–0.018 **	–0.026 ***	–0.025 ***
Financials	–0.001	–0.009	0.009 ***	–0.019 ***	–0.007

Table 9

Organizational rigidities

The table tests the organizational rigidities hypothesis of corporate aging. The control variables and the estimation techniques are those from Table 5. To save space, we report only the coefficients of the age covariates and the associated significance levels. The dependent variables are *COGS* (regression 1), *Overhead* (regression 2), *Sales growth* (regression 3), *R&D expenses* (regression 4), *Investment outlays* (regression 5), *Asset age* (regression 6), *ROA of high-tech firms* (regression 7), and *ROA of low-tech firms* (regression 8), respectively. All these variables are defined in Table 12 and expressed as deviations from the industry median. The last column in the table performs a comparison of the various dependent variables in 30-year versus 5-year firms, keeping the control variables at their industry median. The symbols ***, **, and * indicate statistical significance with confidence 0.99, 0.95, and 0.90, respectively. The sample period is 1978 – 2004.

	Age.1to5	*Age.6to10*	*Age.11to20*	*Age.21to30*	*Age.over30*	*Marginal effect*
(1) *COGS* [a)]	0.191 ***	0.190 ***	0.165 ***	0.147 ***	0.135 ***	4.070
	(0.051)	(0.032)	(0.020)	(0.022)	(0.019)	
(2) *Overhead* [a)]	1.056 ***	0.632 ***	0.248 ***	0.366 ***	0.250 ***	9.300
	(0.125)	(0.082)	(0.050)	(0.059)	(0.046)	
(3) *Sales growth (%)*	–3.083 ***	–1.180 ***	–0.324 ***	–0.230 ***	–0.041	–11.440
	(0.255)	(0.100)	(0.051)	(0.055)	(0.045)	
(4) *R&D expenses* [a)]	–0.084 ***	–0.044 **	–0.031 ***	–0.040 ***	–0.031 ***	–0.930
	(0.029)	(0.018)	(0.011)	(0.012)	(0.012)	
(5) *Investment outlays* [a)]	–1.423 ***	–0.603 ***	–0.126 ***	0.024	0.179 ***	–4.035
	(0.137)	(0.057)	(0.033)	(0.037)	(0.028)	
(6) *Asset age*	0.032 **	–0.006	0.013 **	0.011 *	0.017 ***	0.210
	(0.016)	(0.009)	(0.005)	(0.006)	(0.006)	
(7) *ROA high-tech firms* (%)	–0.067	–0.125 *	–0.172 ***	–0.042	–0.112 **	–2.765
	(0.100)	(0.069)	(0.043)	(0.054)	(0.050)	
(8) *ROA low-tech firms* (%)	–0.239 **	–0.106 *	–0.083 **	–0.141 ***	–0.107 ***	–2.770
	(0.095)	(0.060)	(0.037)	(0.037)	(0.029)	

a) For reading convenience, we multiply the coefficients and their standard errors by 100

Table 10

Rent seeking

The table tests the rent-seeking hypothesis of corporate aging. The control variables and the estimation techniques are those from Table 5. To save space, we report only the coefficients of the age covariates and the associated significance levels. The dependent variables are *G-Index* (regression 1), *Board size* (regression 2), *CEO pay* (regression 3), *Employment growth* (regression 4), respectively, all defined in Table 12 and expressed as deviations from the industry median. The last column in the table performs a comparison of the various dependent variables in 30-year versus 5-year firms, keeping the control variables at their industry median. The symbols ***, **, and * indicate statistical significance with confidence 0.99, 0.95, and 0.90, respectively. The sample period is 1978 – 2004.

	Age.1to5	*Age.6to10*	*Age.11to20*	*Age.21to30*	*Age.over30*	*Marginal effect*
(1) *G-Index*	0.027	0.088 ***	0.078 ***	0.060 ***	0.054 ***	1.820
	(0.069)	(0.016)	(0.010)	(0.008)	(0.008)	
(2) *Board size*	0.175	0.138 ***	0.123 ***	0.076 ***	0.006	2.680
	(0.136)	(0.032)	(0.022)	(0.028)	(0.018)	
(3) *CEO pay*	9.075 *	7.353 ***	3.399	–0.716	5.074 ***	63.595
	(4.969)	(2.793)	(2.098)	(2.471)	(1.910)	
(4) *Employment growth* (%)	–3.386 ***	–1.283 ***	–0.359 ***	–0.168 ***	0.003	–11.685
	(0.262)	(0.105)	(0.053)	(0.056)	(0.044)	

Table 11

Test of alternative interpretations

The table tests alternative interpretations of the observed relation between firm age and profitability. Variable definitions are in Table 12. Panel A displays descriptive statistics for the firms' ownership structure, the age and tenure of their CEOs and directors, and their score on the corporate governance index from Gompers, Ishii, and Metrick (2003). The first column shows average values of these new variables for the younger firms in the sample (listing age < industry median). The second column shows average values for the older firms (listing age > industry median). The third column tests for differences. Note that a high governance index value means weaker shareholder rights. Panel B tests whether ownership concentration and age or tenure of the firm's CEO (or those of its directors) drive the observed relation between firm age and profitability. The control variables and the estimation techniques are those from Table 5. The additional control variables are *Inside ownership*, *CEO age*, *CEO tenure*, *Director age*, and *Director tenure*. For brevity, we do not report the coefficients of the other control variables. Panel C tests the sample selection hypothesis by re-estimating our standard regression from Table 5 for firms with superior performance. In column (1) and (2), we include only firms with ROA above the industry median. Similarly, in columns (3) and (4) we include only firms with Tobin's Q above the industry median. We report only the coefficients of the age covariates. The symbols ***, **, and * indicate statistical significance with confidence 0.99, 0.95, and 0.90, respectively. The sample period is 1978 – 2004.

Panel A: Ownership structure and CEO and director age

	Listing Age < Industry Median	Listing Age > Industry Median	t-Test
Inside ownership	4.368	3.304	–3.838 ***
CEO age	52.71	56.42	–23.729 ***
CEO tenure	7.35	8.52	–7.501 ***
Director age	55.98	59.24	–30.726 ***
Director tenure	8.59	10.77	–2.546 **

Table 11—Continued

Panel B: Test of the importance of the ownership structure and the age of people in the organization
Dependent variable: Tobin's Q

	(1)	(2)	(3)	(4)
Age.1to5	–0.107	-0.123	-0.119	–0.135
	(0.125)	(0.126)	(0.127)	(0.128)
Age.6to10	–0.071***	-0.072***	-0.083***	–0.082***
	(0.026)	(0.026)	(0.028)	(0.027)
Age.11to20	–0.052*	-0.050*	-0.058**	–0.057*
	(0.03)	(0.030)	(0.030)	(0.03)
Age.21to30	–0.055**	-0.052*	-0.051*	–0.051*
	(0.028)	(0.028)	(0.029)	(0.029)
Age.over30	–0.086***	-0.085***	-0.085***	–0.084***
	(0.019)	(0.018)	(0.019)	(0.018)
Inside ownership		0.010	0.008	0.011
		(0.013)	(0.013)	(0.013)
Inside ownership^2		-0.0004	-0.0003	–0.001
		(0.001)	(0.001)	(0.001)
CEO age		-0.005		–0.007 ^{t}
		(0.005)		(0.005)
CEO tenure		0.018***		0.019***
		(0.007)		(0.007)
Director age			0.015	0.019
			(0.016)	(0.016)
Director tenure			0.01	0.004
			(0.017)	(0.017)
Remaining control variables	Included	Included	Included	Included
Number of firm-years	2,134	2,134	2,134	2,134

Panel C: Test of sample selection

	Age = Listing age			Age = Incorporation age	
	ROA (%)	Tobin's Q		*ROA (%)*	Tobin's Q
	(1)	(2)		(3)	(4)
Age.1to5	–0.201 ***	–0.034 ***	Age_{inc}*.1to12*	–0.170 ***	–0.017 ***
	(0.041)	(0.007)		(0.039)	(0.006)
Age.6to10	–0.076 ***	–0.013 ***	Age_{inc}*.13to23*	–0.080 ***	–0.010 **
	(0.027)	(0.004)		(0.027)	(0.004)
Age.11to20	–0.064 ***	0.001	Age_{inc}*.24to45*	–0.075 ***	–0.004
	(0.016)	(0.002)		(0.019)	(0.003)
Age.21to30	–0.086 ***	–0.011 ***	Age_{inc}*.46to88*	–0.088 ***	–0.006 **
	(0.018)	(0.003)		(0.017)	(0.003)
Age.over30	–0.060 ***	–0.002	Age_{inc}*.over88*	–0.077 ***	–0.009 ***
	(0.015)	(0.003)		(0.021)	(0.003)

Table 12

Variable definitions

Variable	Definition
Age	Age is computed as one plus the difference between the year under investigation and the firm's year of birth. The year of birth is computed as the minimum value of: (a) the first year the firm appears on the CRSP tapes; (b) the first year the firm appears on the COMPUSTAT tapes; and (c) the first year for which we find a link between the CRSP and the COMPUSTAT tapes (based on COMPUSTAT data item LINKDT). For a subsample of randomly selected firms, we also compute age as the number of years (plus one) since incorporation. This information is from Mergent Webreports.
Asset age	We follow Chun et al. (2008) and approximate the age of the firm's assets as the ratio of aggregate depreciation in the balance sheet (DATA7 – DATA8) divided by the item "depreciation and amortization" in the income statement (DATA14). To account for industry-specific effects, we measure asset age as the absolute deviation from the industry median (based on two-digit SIC codes) in any given year. The data are from COMPUSTAT.
Board size	The number of directors who serve on the firm's board. To account for industry-specific effects, we measure *Board size* as the deviation from the industry median (based on two-digit SIC codes) in any given year. The data are from *Risk Metrics*.
Capex	The ratio of capital expenses (DATA178) net of depreciation and amortization charges (DATA14) to the market value of assets. The market value of the assets is approximated by the book value of assets (DATA6) minus the book value of common equity (DATA60) plus the market value of common equity (DATA25×DATA199). The data are from COMPUSTAT.
CEO age	The age of the firm's CEO, measured in years. The information is from *RiskMetrics* for a subsample of 1,830 firms for the years 1992 to 2004 (11,447 firm-years).
CEO pay	The CEO's total compensation, measured in thousands of 1978 U.S. dollars. The data are from the annual files of COMPUSTAT Executive Compensation.
CEO tenure	The number of years the CEO has been in office. The information is from *RiskMetrics* for a subsample of 1,830 firms for the years 1992 to 2004 (11,447 firm-years).
COGS	The firm's COGS-to-sales ratio, defined as the cost of goods sold (DATA41) divided by net sales (DATA12). To account for industry-specific effects, we measure *COGS* as the deviation from the industry median (based on two-digit SIC codes) in any given year. The data are from COMPUSTAT.
Director age	The average age of the firm's directors, measured in years. The information is from *ExecuComp* for a subsample of 1,896 firms for the years 1996 to 2004 (8,176 firm-years).
Director tenure	The average tenure of the firm's directors, measured in years. The information is from *ExecuComp* for a subsample of 1,896 firms for the years 1996 to 2004 (8,176 firm-years).
Employment growth	The change in the number of employees (DATA29) in relation to the previous year. To account for industry-specific effects, we measure employment growth as the absolute deviation from the industry median (based on two-digit SIC codes) in any given year. The data are from COMPUSTAT.
Focus	The Herfindahl index, H_E, captures the degree of specialization based on the sales in the firm's different segments, as reported on the COMPUSTAT Segment tapes: $H_E = \sum_{i=1}^{N} p_i^2$, where N is the number of segments, the subscript i identifies the segments, and p_i is the fraction of the firm's total sales in the segment in question.
G-Index	The firm's score on the governance index from Gompers, Ishii, and Metrick (2003). The index is provided on a bi- or triannual basis. To increase sample size, we interpolate the index for missing sample years. This yields a matching sample of 2,113 firms for the years 1990 to 2004 (12,690 firm-years).

Table 12—Continued

Variable	Definition
Gross margin	The gross profit margin, defined as net sales minus cost of goods sold (DATA12–DATA41), divided by net sales (DATA12). To account for industry-specific effects, we measure the gross margin as the deviation from the industry median (based on two-digit SIC codes) in any given year. The data are from COMPUSTAT.
Inside ownership	The cumulative fraction of shares controlled by the firm's officers and directors. This information is from Dlugosz et al. (2006) for a subsample of 1,242 firms for the years 1996 to 2001 (4,272 firm-years).
Investment outlays	The firm's investment (ΔDATA7+ΔDATA3) divided by the book value of assets at the end of the previous year ($DATA6_{-1}$). To account for industry-specific effects, we measure this investment-to-asset ratio as the deviation from the industry median (based on two-digit SIC codes) in any given year. The data are from COMPUSTAT.
KZ index	The Kaplan and Zingales (1997) index that measures a firm's level of financial constraints. We follow Lamont, Polk, and Saá-Requejo (2001, p. 552) and compute the KZ index as: –1.001909×[(DATA18+DATA14)/$DATA8_{t-1}$] + 0.2826389×[(DATA6+MV Equity–DATA60–DATA74)/DATA6] + 3.139193×[(DATA9+DATA34)/(DATA9+DATA34+DATA216)] – 39.3678×[(DATA21+DATA19)/$DATA8_{t-1}$] – 1.314759×[DATA1/$DATA8_{t-1}$].
Overhead	The firm's overhead expenses (DATA189), standardized by the market value of its assets. To account for industry-specific effects, we measure overhead as the deviation from the industry median (based on two-digit SIC codes) in any given year. The data are from COMPUSTAT.
R&D expenses	The firm's R&D expenses (DATA46) divided by its sales (DATA12). To account for industry-specific effects, we measure this ratio as the deviation from the industry median (based on two-digit SIC codes) in any given year. The data are from COMPUSTAT.
ROA	We follow Skinner (2008), among others, and measure return on assets as the ratio of the firm's operating income before depreciation (DATA13) divided by the book value of total assets (DATA6). To account for industry-specific effects, we measure ROA as the absolute deviation from the industry median (based on two-digit SIC codes) in any given year. The data are from COMPUSTAT.
Sales growth	The change in net sales (DATA12, expressed in constant 1978 USD) in relation to the previous year. To account for industry-specific effects, we measure sales growth as the absolute deviation from the industry median (based on two-digit SIC codes) in any given year. The data are from COMPUSTAT.
Sales-to-assets	The firm's sales-to-assets ratio (DATA12/DATA6). To account for industry-specific effects, we measure the sales-to-assets ratio as the deviation from the median industry value (based on two-digit SIC codes) in any given year. The data are from COMPUSTAT.
Size	The log of the ratio of the firm's market capitalization (DATA25× DATA199) to that of CRSP's NYSE/AMEX/Nasdaq equal-weighted index. The data are from CRSP and COMPUSTAT.
Tobin's Q	Tobin's Q, computed as the market value of the firm's assets divided by their book value. To account for industry-specific effects, we measure Tobin's Q as absolute deviation from the industry median (based on two-digit SIC codes) in any given year. The data are from COMPUSTAT.
Volatility	The annualized volatility of the firm's daily stock return. We calculate the volatility over a one-year window and include all firm-years with at least 100 daily returns. The data are from the daily CRSP tapes.