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Firm Rigidities and the Decline in Growth Opportunities

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As public firms exploit their growth opportunities following their initial public offering, their assets in place increase, and they organize themselves optimally to operate these assets efficiently, which requires a more formal and less flexible organization than to generate new growth opportunities. Our theory predicts that, as a result of these inflexibilities, firms fail to fully replace their growth opportunities, so that their Tobin's q falls with age and they invest less as they grow older. With our theory, competition in the market for corporate control and capital markets monitoring increase the rate of decrease in Tobin's q, while product and labor market competition slow it down. We find empirical support for these predictions. We also find evidence that the decline in q is related to firm rigidities.

Keywords: firm age; firm life cycle; firm rigidities; firm performance; corporate governance; competition
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1. Introduction

Life-cycle theories of the firm predict that firms invest in excess of their operating cash flow when young to take advantage of their growth opportunities, and as they get older, they invest less and pay out some of their cash flow in the form of dividends and stock repurchases (see, for instance, Fama and French 2001, Grullon et al. 2002, DeAngelo et al. 2006). These theories assume that firms do not renew their growth opportunities, so that their Tobin's q ratios decrease over time as they exercise their growth options. These theories do not explain why growth opportunities are not renewed eventually. In this paper, we show that part of the explanation for that phenomenon is that firms become optimally more rigid over time to focus on managing assets in place efficiently rather than on finding new growth opportunities. As firms innovate less, their Tobin's q falls.

A considerable literature motivates our hypothesis that firms optimally become more rigid over time. With this hypothesis, firms list to exploit existing ideas (Ferreira et al. 2014). As they exploit these ideas, their assets in place increase, so that they need a more hierarchical and formal organization to operate these assets efficiently and operating these assets becomes increasingly the focus of managers (Holmstrom 1989). Moreover, market scrutiny, career concerns, and takeover threats induce managers to favor activities that are more predictable and more easily communicated to investors (Holmstrom 1989, Bernstein 2015). Ownership dilution and cash-out incentives (Bernstein 2015) have the same effect. Firms therefore increasingly focus on exploiting their assets in place, which makes them better at creating incremental growth opportunities (Henderson 1993). Since they are specialized to a given set of core competences, these opportunities imply a decreasing marginal q. In their focusing effort, however, established firms optimally acquire organizational and operational rigidities that make it more difficult to create and exploit growth opportunities outside their core abilities. This idea goes back at least to Arrow (1974), and variations thereof have been offered by, among others, Holmstrom (1989), Nelson and Winter (2002), and, notably, Manso (2011).[1]

Any theory of Tobin's q that endows the firm with growth options that it exercises optimally over time concludes that Tobin's q falls as these growth options

[1] Rigidities can be project specific—a particular project, for example, might require tight quality control. Our argument, however, is that rigidities are tailored to the core abilities of firms. Hence, they cannot be turned on and off depending on the particular project on hand. A mechanical watch producer, for example, will choose the organizational form that allows him to optimally produce mechanical watches. The associated rigidities, however, will make it financially unattractive for this producer to manufacture cars or offer banking services.

are exercised. However, such a theory cannot explain why firms do not replace these growth options. Our theory explains why firms fail to replenish their growth opportunities. The reason is the various rigidities that firms adopt to optimally exploit their original investment opportunities. Consequently, the Tobin's q of firms will fall as they age irrespective of their industry. We study 15,420 listed firms with data on the Center for Research in Security Prices (CRSP) and COMPUSTAT between 1978 and 2013 (147,011 firm-years), excluding utilities and financial firms. As firms get older, their Tobin's q falls by roughly 1% per year five years after the initial public offering (IPO), and there is no major industry or state where Tobin's q increases. We obtain similar results with alternative measures of growth opportunities, including past and forward sales growth (see also Evans 1987, Caves 1998), market-to-book-equity, as well as capital expenditures and research and development (R&D)-to-sales ratios. The results are also robust to different measures of age, including the one proposed by Pástor and Veronesi (2003). Importantly, adjusting q for calendar-year and industry effects, only 30% of the sample firms ever exceed the maximum q they reached during the first four years after listing. The time window of the sample includes the dot-com boom of 1995–2001. The same results hold when we simply drop all firms that listed during those years.

Firm characteristics that are generally used to explain Tobin's q cannot explain the negative relation between Tobin's q and firm age we find. Our theory also has implications about operating efficiency and investment decisions. As firms focus more on assets in place as they age, we expect assets in place to be better managed at older firms. Moreover, as firms' ability to engage in radical (competence-destroying) innovation falls as they age (see also Henderson 1993, Acemoglu and Cao 2015), it becomes less advantageous for them to engage in such innovation. Hence, we expect older firms to invest less in R&D as their stock of growth opportunities declines over time. Less active engagement in radical innovation also implies that the probability of incurring a loss should decline with firm age. Furthermore, as firms become older, they will increasingly pay out their excess cash flows because they lack positive net present value projects. Our evidence supports these predictions as well. We find that firms do not become less efficient or more poorly managed as they age. Their productivity, as measured by their sales-to-assets ratio, actually increases, and their costs, as measured by the ratio of cost of goods sold (COGS) per employee, decline. Moreover, they spend less on R&D, invest less in capital expenditures, pay out more, and are less likely to have negative net income. Specific well-known older firms in our sample seem to be firms that fit our theory. For instance, in 2009, these firms included Alcoa, Hershey, and McDonald's. These firms are mature and focused, and they have comparatively lower growth opportunities.

Absent firm exit, age increases by one each year and would therefore seem to be unaffected by Tobin's q. Potential concerns about reverse causality could arise, however, if firms with low q ratios had lower exit rates and therefore a higher survival probability than firms with high q ratios. That would bring about the negative age–q relation we observe. Yet the extant literature is inconsistent with this possibility. Takeovers, the main exit risk of listed U.S. firms, are actually *more* likely for firms with low market-to-book ratios (see, among others, Loderer and Waelchli 2015). Moreover, there is no evidence that firms with low market-to-book ratios have lower financial failure risk (Loderer and Waelchli 2015).

Many papers before have discussed resource, organizational, and productive factors that limit the flexibility of firms to react to changes in their environment and which could therefore cause older firms to fall behind young ones in terms of growth and value creation. These factors fall roughly into two groups: those that are consistent with an interest alignment of ownership and management and those that are predicated on a misalignment. The first group includes the incompatibility of incentives for exploration and exploitation, as well as the difficulty of combining both sets of incentives in the same organization (Holmstrom 1989, Manso 2011, Kaplan and Henderson 2005); organizational inertia (Hannan and Freeman 1984, Holmstrom 1989, Leonard-Barton 1992, Tripsas and Gavetti 2000, Nelson and Winter 2002); incompatibility of new and old capital (Yorukoglu 1998, Jovanovic and Rousseau 2014, Henderson 1993); sticky incentive systems (Kaplan and Henderson 2005); short-termism induced by capital markets monitoring (Holmstrom 1989, He and Tian 2013, Asker et al. 2015); fear of cannibalizing the rents from existing products (Reinganum 1985); and bases of loyal customers and well-developed distribution networks that allow incumbent firms to fend off more innovative newcomers (Stein 1997). By contrast, the group of rigidities that are based on agency problems includes internal resistance to change (Schaefer 1998, Dow and Perotti 2013), progressive deterioration of corporate governance (Easterbrook and Fischel 1999), and career concerns (Stein 1989, Ferreira et al. 2014). Even though both sets of rigidities imply a decline of q ratios over time, the evidence we uncover is difficult to explain with agency problems alone.

Ultimately, our theory predicts that loss of flexibility helps explain the decay in Tobin's q. This prediction is difficult to test because flexibility is not directly observable. We therefore rely on various flexibility proxies—namely, how costs and investment react to shocks, product rigidities, and a measure of organizational rigidity. Data for these proxies come from Loderer and Waelchli (2015) and are only available for a comparatively small sample (47,660 firm-years, compared with 147,011 for the overall sample). When we use these variables jointly in our regression of q on firm age, the set of control variables typically used in the literature, and industry-year fixed effects, the magnitude of the age coefficient drops by almost 50% and loses some of its statistical significance, whereas all rigidity proxies are negative and significant at the 1% level. Hence, organizational and operational rigidities that firms optimally adopt or incur to focus on assets in place can indeed explain a sizable part of the decline of q over time. In our regressions, company age is therefore a proxy for the accumulation of these rigidities.

There are several other explanations for the age-related decline in Tobin's q ratios. Though these explanations help understand the decline in q, they fail to explain features of the decline in q that can be explained by the rigidity hypothesis. The first one claims that young firms start with relatively few assets in place and a number of new ideas in production, design, service, or marketing. They therefore start with high q ratios. These firms go public to exploit these opportunities. As these ideas are implemented, a higher fraction of the firms' assets is recognized on the firms' balance sheets, and q declines. While this explanation is a good description of how Tobin's q evolves as firms age, it assumes what we try to explain, which is that firms do not renew their growth opportunities as they age. If firms did so, Tobin's q would not fall over time. In this paper, we want to understand why firms do not do so.

A second hypothesis is the one by Pástor and Veronesi (2003) that centers on investor learning. With this hypothesis, a firm's valuation falls as uncertainty about its profitability decreases. Again, while this hypothesis produces a decrease in Tobin's q as firms age, it assumes the phenomenon we attempt to explain. If firms acquired new growth opportunities as they age, uncertainty would increase again as investors have to learn about the profitability of these opportunities. Moreover, we show that the decline in q ratios holds also when we restrict the sample to firms where learning would seem to be less important—namely, large firms and firms older than 5 or even older than 20 years. Similarly, when we estimate our regressions for the subsample of firms for which we have Institutional Brokers' Estimate System estimates, and add a measure of the dispersion of security analysts' profitability forecasts, the coefficient of age remains unaffected. This is inconsistent with the claim that age is a proxy for investor learning. One should add, however, that our hypothesis is not exclusive of but rather complementary to Pástor and Veronesi (2003). Their model assumes mean reversion in profitability and value, which is why investors can learn. In comparison, our hypothesis explains why firms are unable to avoid that mean reversion, on average.

A third explanation is that corporate aging merely reflects the post-IPO mean reversion in performance hypothesized by Pástor et al. (2009) and observed by various papers during the first years after the IPO, including Jain and Kini (1994), Mikkelson et al. (1997), Pagano et al. (1998), Fama and French (2004), and Chemmanur et al. (2010). Our analysis mostly examines firms older than five years of age. Hence, the decline in q we observe does not seem to be restricted to the first few years after the IPO.

A fourth and related explanation is that, partly because of competition, great ideas occur randomly with a low probability.[2] Because our sample is limited to listed firms, only firms that were lucky appear in our data. By self-selection, these firms have comparatively high initial Tobin's q values. As they exploit their projects, their asset base increases and Tobin's q drops. With this explanation, randomness in finding great ideas makes it very difficult for these firms to subsequently renew their growth opportunities and stop the decline in q. This hypothesis is not inconsistent with ours since competition is what forces firms to focus on their core competences to begin with. We contend, however, that the inability to renew growth opportunities is more than the result of competition—namely, the result of endogenous rigidities that firms assume to optimally exploit the available growth opportunities. Randomness alone cannot explain why established firms are unable to offset the decline in q by buying small firms lucky enough to have come across potentially great ideas or by simply imitating and improving on what other firms do. We contend that rigidities make these strategies economically unattractive, on average. Perhaps more important, randomness cannot explain why increased competition in the goods and services markets actually slows down the decline of q with firm age, and not the opposite. Moreover, randomness cannot explain the evidence we find that the decline in question is in fact related to the presence of rigidities.

A fifth possible explanation is that young firms could be credit constrained. For a credit-constrained firm, marginal q will be high. As the firm becomes less credit constrained, its marginal q falls. If marginal q is a declining function of the level of total past capital expenditures, we expect average q to exceed marginal q and to also decline. Hence, old firms that are not constrained will have lower Tobin's q ratios. As it turns out, credit constraints cannot explain the evidence. In particular, they fail to explain why firms that pay out cash to their shareholders (via dividends or share

[2] We are grateful to the associate editor for pointing out this hypothesis.

buybacks) experience the same decline in their Tobin's q ratio over time as firms that do not.

Finally, if management were more entrenched in older firms, we would expect these firms to have lower Tobin's q ratios. With this explanation, management consumes more private benefits in older firms. Even though executive stock ownership is lower in older firms, and boards are larger, we find little evidence to support management entrenchment. Among other things, the results do not change when controlling for various governance indices as well as for the age and tenure of the management team. Moreover, management does not have higher compensation in older firms. Further, older firms have greater payouts on average. Finally, the agency explanation cannot explain why firms that face less competition in the market for corporate control see their q ratios fall less quickly, why firms that are more closely monitored by the capital markets experience a more rapid decline in q ratios, or why technical efficiency increases over time. Still, we cannot exclude the entrenchment hypothesis completely.

Our theory also predicts that the relation between q and firm age is a function of how competitive the environment is that the firm operates in. Competition in the market for corporate control means that management has to focus even more on efficiently operating assets in place since poor performance of assets in place is readily observable, whereas the performance of management in developing growth opportunities is much harder to assess. Therefore, we would expect firms' Tobin's q to fall faster with age if there is more competition in the market for corporate control. Note that this argument is consistent with informationally efficient capital markets. Various theories predict managerial short-termism in rational markets. Myopic behavior, for example, could be induced by risk aversion. Another possibility is incomplete information (see Asker et al. 2015 and the literature cited therein). For example, in Stein (1989), managers tempted to forsake good investments to boost current earnings are trapped by rational markets into that very behavior.

To test our prediction that competition in the market for corporate control affects how Tobin's q falls with firm age, our identification strategy exploits the quasi-natural experiment of legal changes. Using the state adoption of business combination laws that restrict competition in the market for corporate control, we show that Tobin's q falls more slowly with age for firms incorporated in states where such laws are put in place. Our tests follow the procedure suggested by Karpoff and Wittry (2015) to address the concern that these laws might be the result of political rent seeking by potential takeover targets, or that the impact of these laws might be confounded by preexisting laws, preexisting firm-level antitakeover defenses, and important court decisions. Since antitakeover laws decrease monitoring by capital markets and are associated with a slower decrease in Tobin's q, we would expect that increases in capital markets monitoring would have the opposite effect. He and Tian (2013) argue that higher analyst coverage discourages firms' investments in long-term innovation projects. The evidence is consistent with this prediction. Firms with greater analyst following experience a faster decrease in Tobin's q.

We also exploit product market competition. Competition decreases the rents from past innovation. To offset this effect of competition, firms can become more efficient, but eventually even greater efficiency may not be enough to assure their survival. Firms can slow down the decay in q ratios through innovation. We would therefore expect firms to be more likely to innovate if the value they create from their assets in place falls because of competition. This "escape competition" motive for innovation has been formalized in the Aghion et al. (2001) endogenous growth model, among others. It is also consistent with recent studies that find that competition spurs growth (Asker et al. 2015, Fogel et al. 2008) and innovation (Bernstein 2015). Thus, older firms in a competitive industry should be relatively more likely to create new growth opportunities than their peers in noncompetitive industries. To test this prediction, we look at industries that experience competitive shocks—namely, large reductions in import tariffs—during the sample period. Lower tariffs should intensify product market competition (see also Frésard and Valta 2016). In support of our prediction about product market competition, we find that Tobin's q falls less quickly with firm age after tariff reductions.

Variation in labor markets regulation provides a further test of our theory. Young firms are firms with more radical growth opportunities (Henderson 1993, Acemoglu and Cao 2015). They face the risk that employees will defect and take knowledge that is relevant to these growth opportunities with them. By contrast, old firms that have focused on assets in place and the associated incremental innovations will lack employees that could help them cope with radical innovation. If so, we would expect laws that restrict employee mobility to be valuable for young firms but to hurt old firms. Hence, we would expect Tobin's q of firms to fall more quickly with age in states where noncompetition agreements are more strongly enforced. We find that this is the case.

Our identification strategy for how competition affects the relation between firm age and Tobin's q hinges on the exogeneity assumption of business combination laws, analyst coverage, tariff reductions, and employment protection laws. We conduct a battery of tests to address possible violations of that assumption, especially the ones proposed by Karpoff and Wittry (2015) in the context of business combination laws.

Still, the possibility that the changes whose impact we analyze could be partly endogenous has to be taken into account when evaluating our results. More research is therefore needed to ensure that our results are robust to all possible types of endogeneity.

Our paper contributes to several literatures. First, and foremost, it adds to the literature on corporate life cycles. Product and industry life cycles have been fairly well researched in the literature. Theories about a corporate life cycle, however, are still in their infancy. Mueller (1972) seems to be one of the few. A number of papers that mention a corporate life cycle argue that it is caused by investment opportunities that are depleted over time (see, among others, Grullon et al. 2002, DeAngelo and DeAngelo 2006, DeAngelo et al. 2006). Yet, as mentioned above, they do not provide a rationale for that phenomenon. Second, the paper is of relevance to the literature that studies the determinants of the valuation of firms and shows that Tobin's q falls as firms age across industries. We show that this phenomenon is not only a post-IPO investor learning phenomenon, or a post-IPO reversion to mean profitability phenomenon. Third, the paper contributes to the literature on how firms innovate, as it helps to understand why firms innovate less as they grow older and why the intensity with which firms innovate as they age differs across firms. Fourth, it adds to the agency literature as it shows that the decline in Tobin's q with age cannot be fully explained by increased agency problems or poorer governance.

The rest of the paper proceeds as follows. In the next section, we discuss the data. In Section 3, we show that Tobin's q falls with age across industries, and firms are unlikely to ever again achieve the Tobin's q of their youth. In Section 4, we show that old firms are more efficient, invest less, pay out more, and are more focused. In Section 5, we show that proxies for firm rigidity largely explain the negative relation between q and firm age. In Section 6, we investigate whether the predictions of alternative theories of aging are supported by the evidence. The role of competition and capital markets monitoring in the decrease in Tobin's q with age is investigated in Section 7. We conclude in Section 8.

2. Data

2.1. Sample Description

The sample consists of all listed firms with data on CRSP and COMPUSTAT between 1978 and 2013. The first year covered by the COMPUSTAT segment tapes is 1978. We exclude regulated utilities (Standard Industrial Classification (SIC) codes 4900–4999) as well as firms with business segments in the financial sector (SIC codes 6000–6999). Similarly, we ignore firms with negative total assets, negative sales, or missing data to compute the market capitalization of equity. Since very young firms might drive the results (Fama and French 2004), we generally omit all firms under five years since the IPO. Exceptions will be pointed out explicitly. This omission does not change our conclusions. The final sample consists of 15,420 firms and 147,011 firm-years. We start with 3,297 firms in 1978 and end with 2,849 firms in 2013. Turnover is remarkably high: 12,123 firms enter and 12,571 firms leave between 1978 and 2013. Some of the firms that drop from the exchanges in going-private transactions may list again years later, for example in a reverse LBO. Cao and Lerner (2009) identify 526 such transactions between 1981 and 2003. Firms that relist are typically treated as separate firms in the literature, but this practice does not seem to bias our results, since the same results obtain when we measure age from the date of incorporation rather than listing. We use COMPUSTAT's unique identifier (gvkey) to track companies over time in spite of name or ticker changes.

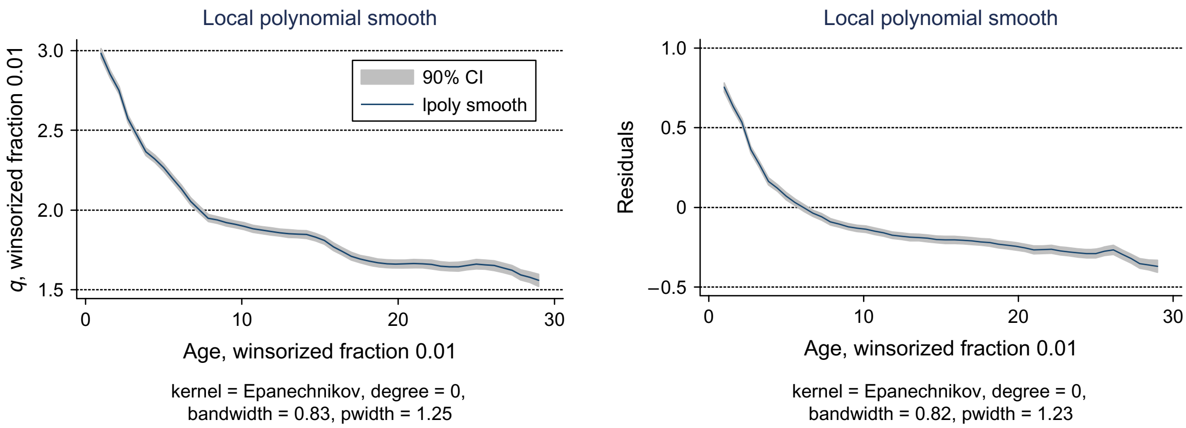
2.2. Firm Age

We follow Fama and French (2001) and Pástor and Veronesi (2003) and assume that firms are "born" in the year of their first appearance on the CRSP tapes. Most studies that look at firm age use the same definition. We refer to this variable as the firm's *listing age*. Shumway (2001) argues that listing age is the economically most meaningful measure of firm age, since listing is a defining moment in a company's life—it affects ownership and capital structure, multiplies growth opportunities, increases media exposure, and demands different corporate governance structures (Loderer and Waelchli 2010). 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 to 89 years at its end, in 2013. Alternatively, we compute the number of years (plus 1) elapsed since the year of incorporation and denote this variable as the firm's *incorporation age*. This information is hand-collected from *Mergent Webreports* as well as from Jay Ritter's website (Ritter 2015). On average, the listing age is 19 years; the median is 14. The distribution remains fairly stable over the sample period. Incorporation age has an average value of 37 and a median value of 27.

2.3. Control Variables

All definitions of the control variables are in the appendix of the paper. Table A1 of the Internet appendix (available as supplemental material at http://dx.doi.org/10.1287/mnsc.2016.2478) reports descriptive statistics for all the variables in the analysis. To reduce the influence of outliers, we winsorize all variables at the 1st and the 99th percentiles of their pooled distribution. The results, however, do not depend on this winsorization. Ownership structure and corporate governance data are available for only a limited subsample of firms. Most pairwise correlation coefficients

Figure 1 Firm Age and Tobin's q



(a) Unconditional (listing age; full sample)

(b) Conditional (listing age; full sample)

Notes. The figure shows the relation between Tobin's q and company age implied by nonparametric regressions. The solid lines in the panels are obtained from local polynomial regressions of Tobin's q ratios on firm age using an Epanechnikov kernel function with a rule-of-thumb bandwidth estimator and local-mean smoothing. The shaded area shows the 90% confidence interval (CI). Panel (a) shows the unconditional relation and measures age since listing. To obtain panel (b), we first estimate an OLS regression with industry-year fixed effects of Tobin's q on *Capex*, *R&D*, *Focus*, *KZ-index*, *Leverage*, *Size*, *Volatility*, and *ROA* and store the residuals. We then perform nonparametric regressions of these residuals on listing age. Listing age is restricted to between 1 and 30 years. The sample period is 1978–2013.

between regressors are fairly low (not tabulated) such that there is no concern about multicollinearity.

3. Firm Age and Growth Opportunities

Our theory predicts that, since managers of listed firms focus on exploiting their assets in place and the associated incremental growth opportunities, their ability to engage in radical innovation is limited. Since, at the same time, the valuable incremental growth opportunities available at the time of listing will be used up eventually, the stock of growth opportunities is expected to decrease as a firm ages. We test this prediction in this section.

3.1. Decline in Tobin's q Ratios Over Time

We approximate Tobin's q by the ratio of the market value of assets to the book value of assets. We follow Cronqvist and Fahlenbach (2009), among others, and define the market value of assets as the book value of assets minus the book value of equity plus the market value of equity minus deferred taxes. Figure 1 shows the relation between Tobin's q and company age implied by estimating local polynomial regressions of Tobin's q on firm age using an Epanechnikov kernel function with a "rule-of-thumb" bandwidth estimator and local-mean smoothing. The advantage of this approach is that we do not impose a functional form for how Tobin's q changes with age. Panel (a) shows this unconditional relation. Consistent with the hypothesis, the relation is negative. We explore next whether the relation between Tobin's q and age holds if we control for firm characteristics. We first estimate an ordinary least squares (OLS) regression with industry-year fixed effects of Tobin's q on *Capex*, *R&D*, *Focus*, *KZ-index*, *Leverage*, *Size*, *Volatility*, and *ROA* and store the residuals. We define industries at the three-digit SIC code level. Then, we perform nonparametric regressions of these residuals on firm age. The resulting conditional relation between company age and Tobin's q is negative as well, as shown in panel (b) of Figure 1.[3]

For a formal test of the relation between age and Tobin's q, we estimate OLS panel regressions with industry-year fixed effects and firm-clustered standard errors. This approach enables us to separate out industry life-cycle effects from firm life-cycle effects. The results are qualitatively the same when we run separate cross-sectional regressions for each year as in Pástor and Veronesi (2003) (not tabulated). Note that, in our main regressions, we do not add firm fixed effects because age would be collinear with year and firm fixed effects (age grows by one each year). In untabulated robustness tests, we drop the year fixed effects and add firm fixed effects instead. The results of these regressions are qualitatively the same.

The results are reported in Table 1. Regressions (1)–(3) use the full sample. As expected, the coefficient of firm age is negative and significant. In regression (1), the age measure is the one proposed by Pástor and Veronesi (2003), namely, $-1/(1+\textit{Listing age})$. This age measure best fits the nonparametric relation from Figure 1, which is why most of our analysis will be conducted with this measure. For brevity, we will refer to it as *Age*. Regressions (2) and (3) show that alternative age

[3] Figure A1 of the Internet appendix replicates the analysis with incorporation instead of listing age. The results are the same.

Table 1 Firm Age and Growth Opportunities

	Dependent variable: *Tobin's q*						
	Full sample			Subsample with listing age > 4			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	−2.026*** (0.146)			−2.519*** (0.233)			−2.289*** (0.259)
ln(*Listing age*)		−0.189*** (0.013)			−0.181*** (0.015)		
Old dummy			−0.204*** (0.019)			−0.181*** (0.018)	
$-1/(1+Age_{\text{inc}}$ *at listing*)							−0.672*** (0.117)
ROA	−0.008*** (0.001)	−0.008*** (0.001)	−0.008*** (0.001)	−0.005*** (0.001)	−0.005*** (0.001)	−0.005*** (0.001)	−0.005*** (0.001)
Capex	0.172*** (0.037)	0.172*** (0.037)	0.186*** (0.037)	0.227*** (0.049)	0.224*** (0.049)	0.230*** (0.048)	0.255*** (0.057)
R&D	0.204*** (0.024)	0.202*** (0.024)	0.205*** (0.024)	0.233*** (0.030)	0.232*** (0.030)	0.234*** (0.030)	0.215*** (0.031)
Focus	0.343*** (0.031)	0.320*** (0.031)	0.361*** (0.031)	0.316*** (0.032)	0.301*** (0.032)	0.326*** (0.032)	0.286*** (0.036)
KZ-index	−0.002 (0.001)	−0.002 (0.001)	−0.002 (0.001)	−0.004** (0.002)	−0.004** (0.002)	−0.003** (0.002)	−0.003* (0.002)
Leverage	−2.741*** (0.053)	−2.752*** (0.053)	−2.759*** (0.053)	−2.532*** (0.057)	−2.537*** (0.057)	−2.541*** (0.057)	−2.631*** (0.063)
Size	0.172*** (0.006)	0.179*** (0.006)	0.169*** (0.006)	0.167*** (0.006)	0.173*** (0.006)	0.165*** (0.006)	0.185*** (0.007)
Volatility	4.085*** (0.192)	4.021*** (0.192)	4.218*** (0.192)	4.354*** (0.211)	4.334*** (0.211)	4.459*** (0.209)	4.118*** (0.235)
Constant	1.111*** (0.044)	1.800*** (0.058)	1.392*** (0.046)	0.977*** (0.047)	1.666*** (0.066)	1.236*** (0.048)	1.885*** (0.080)
Industry-year FE	Included	Included	Included	Included	Included	Included	Included
Observations	114,771	114,771	114,771	99,188	99,188	99,188	82,528
Adjusted R^2	0.289	0.290	0.287	0.291	0.292	0.290	0.287

Notes. The table investigates the relation between company age and Tobin's *q* using OLS panel regressions with industry-year fixed effects (FE) and firm-clustered standard errors. Regressions (1)–(3) use the full sample of firms. Regressions (4)–(7) exclude firms with listing age younger than five. Variable definitions are in the appendix. The sample period is 1978–2013.

***, **, and * indicate statistical significance in two-sided tests with confidence levels of 0.99, 0.95, and 0.90, respectively.

measures, namely, the natural logarithm of listing age, ln(*Listing age*), as well as a binary variable *Old dummy*, which identifies firms older than the sample median in any given year, yield consistent results. The results are the same when we omit firms younger than five years (regressions (4)–(6)) or when we measure age with piecewise linear functions (not tabulated).

Older firms do not have lower q ratios because they are larger. Since we are controlling for firm size, our findings do not reflect declining returns to scale. Consistent with this, the age coefficient remains negative and significant, and essentially unchanged, when we estimate separate regressions for large and small firms (not tabulated). We also investigate whether the significance of the age coefficient depends on the definition of size. The measure we use in the regressions is the market value of the assets. The age coefficient, however, remains negative and significant if we use the logarithm of book assets, book assets and the square of book assets, the logarithm of sales, and the number of employees.[4]

Tobin's q has measurement error. One type of measurement error is related to the theory we test. Suppose a firm acquires growth opportunities through an acquisition where purchase accounting applies. If the acquired firm has valuable growth opportunities, they will be accounted for as goodwill by the acquiring firm. Hence, the value of assets in place after the acquisition will reflect acquired growth opportunities. To examine the importance of these considerations, we follow Custódio (2014) and adjust Tobin's q for goodwill. We find that doing so has no impact on our results. Data

[4] In untabulated regressions, we also used different functional forms for the relation between size and Tobin's q. These choices do not affect the age effect we find.

on goodwill are available on COMPUSTAT starting in 1988. When we adjust Tobin's q for goodwill, the coefficient on *Age* is −2.296 instead of −2.113, and the significance is the same.

If listing makes it optimal for management to devote more effort to assets in place over time, the age effect we document should be distinct from a possible age effect the company might have experienced before listing. To test this proposition, we extend regression (4) with a variable that measures incorporation age at the time of listing ($-1/(1+Age_{\text{inc}}$*at listing*)). Previous work shows that incorporation age at listing varies substantially over time (Jovanovic and Rousseau 2001, Fink et al. 2010). Regression (7) shows the results. The coefficient of incorporation age at listing is negative and significant, indicating that firms that list at a later stage of their life cycle have fewer growth opportunities. More importantly, however, *Age* maintains its negative and significant coefficient. We conclude that the listing age effect is a phenomenon that differs from or is incremental to that associated with the firm's age prior to listing.

The coefficients of the control variables are mostly in line with the extant literature across regression specifications. Capital expenditures, R&D outlays, focus, and volatility are associated with larger Tobin's q ratios (the latter result is consistent, in particular, with Pástor and Veronesi 2003). To assess financial constraints, we follow Lamont et al. (2001), among others, and estimate the Kaplan and Zingales (1997) index (*KZ-index*). The results do not change when we replace that index with alternative measures, such as a binary variable that identifies dividend payers. The effect of financial frictions seems to be immaterial. We also find that return on assets (ROA) has a negative coefficient, possibly because a high ROA increases the opportunity cost of looking for growth opportunities, at least those of the competence-destroying kind. Table 1 also shows that financial leverage has a negative coefficient. In unreported regressions, we also added the square of volatility. The coefficient of *Age* is not affected.

We can assess the economic significance of the relation between Tobin's q and firm age using the estimates of regression (1) (full sample). Firms in the 25th percentile of the full sample have a listing age of 4, whereas firms in the 75th percentile have a listing age of 19. Thus, the difference in q predicted by regression (1) is $-2.026 \times [-1/(1+19)+1/(1+4)] = -0.30$. When each right-hand-side variable takes the median value, the predicted value of q is 1.87. Thus, the percentage difference in q predicted by regression (1) due to an increase in listing age from the 25th percentile to the 75th percentile is $-0.30/1.87 = 16\%$.

We investigated whether these findings could be explained by survivorship bias. The concern is that the fact that firms drop out of the sample might explain the relation between Tobin's q and age. For that purpose, we reestimated regression (1) of Table 1 using a sample of firms that live for 25 years or more. With this sample, the coefficient on *Age* is −5.40, which is very similar but larger in absolute value to the coefficient of −2.03 when the whole sample is used. It is therefore implausible that survivorship bias explains our result.

The results are also robust to the measurement of growth opportunities. In Table A2 of the Internet appendix, we measure these opportunities with the variables suggested by Billett et al. (2007) and Adam and Goyal (2008) as alternatives to market-to-book assets—namely, the past as well as the forward rates of sales growth, R&D-to-sales, market-to-book-equity, earnings-to-price, and capex-to-PPE (property, plant, and equipment). In these regressions, the coefficient of age remains negative and significant.

3.2. Decline in Tobin's q Ratios Across Industries

It is well known that there is an industry life cycle (Gort and Klepper 1982, Maksimovic and Phillips 2008). Perhaps more directly, industries tend to go through periods where firms adopt new technologies. We would expect the Tobin's q of firms within an industry to vary in a predictable way as a technology is adopted by the industry (Jovanovic and MacDonald 1994). Therefore, a concern with our results is that they might just reflect that life cycle. A simple approach to separate the industry life cycle from the firm life cycle is to estimate our regressions for each industry separately. We use the 48 industries identified by Fama and French (1997) to perform this analysis. The results are in Table 2. The regression specification is the same as that in column (4) of Table 1, except that, since we work with industry-specific subsamples, the only fixed effects we include are year fixed effects.[5] Standard errors are clustered at the firm level. For simplicity, we report only the coefficient of *Age*. In the table, we use that coefficient to compute the impact on Tobin's q of a change in listing age from the 25th to the 75th percentile of the pooled distribution of age in the industry. This effect is measured relative to the average Tobin's q in the industry and is shown only for statistically significant age coefficients.

The relation between age and Tobin's q is negative and significant at least at the 5% level for 31 of the 42 industries we report, and it is negative and significant at the 1% level in 24 of these 31 cases. The marginal impact of age is similar across industries, and it goes from about −3.4% (petroleum and natural gas) to −20.3% (nonmetallic and industrial metal mining). We obtain very similar results when measuring

[5] The results are not different if we include three-digit SIC code fixed effects.

Table 2 Age and Tobin's q: Industry-Specific Regressions

	Firm-years	Listing age (avg.)	Average q	Coefficient of *Age*	Marginal impact (%)
Agriculture	384	14.8	1.90	−0.478	
Food products	2,095	24.7	1.55	−0.760	
Candy and soda	401	39.8	2.08	5.491***	12.6
Beer and liquor	398	21.2	1.38	−1.515	
Tobacco products	194	45.4	2.42	24.747***	27.1
Recreation	1,173	18.1	1.43	−3.154***	−12.8
Entertainment	1,477	13.3	1.71	−2.896***	−11.8
Printing and publishing	1,461	19.2	1.73	−2.900***	−8.8
Consumer goods	2,709	23.9	1.53	−3.120***	−10.6
Apparel	1,764	23.3	1.36	−2.548***	−8.4
Healthcare	2,085	12.5	1.99	−0.099	
Medical equipment	3,381	15.1	2.73	−4.131***	−9.3
Pharmaceutical products	4,488	15.2	3.55	0.040	
Chemicals	2,437	25.5	1.71	−4.805***	−15.6
Rubber and plastic products	1,093	18.5	1.46	−1.729**	−7.1
Textiles	941	21.4	1.06	−1.051**	−4.6
Construction materials	3,452	22.7	1.29	−2.004***	−7.8
Construction	1,379	17.5	1.26	−0.736	
Steel works, etc.	1,905	27.6	1.21	−1.335***	−5.9
Fabricated products	495	19.4	1.24	−1.607**	−6.6
Machinery	4,612	23.8	1.52	−2.426***	−8.3
Electrical equipment	3,067	16.3	1.96	0.118	
Automobiles and trucks	1,770	27.8	1.35	−1.258**	−4.8
Aircraft	655	30.9	1.35	−1.680***	−6.2
Shipbuilding, railroad equipment	211	35.5	1.23	−1.186	
Defense	259	27.8	1.65	−3.828***	−14.3
Precious metals	405	20.8	2.52	−4.107*	−11.8
Nonmetallic	598	22.5	1.93	−5.887***	−20.3
Coal	257	22.6	1.54	−2.313*	−10.1
Petroleum and natural gas	5,517	19.1	1.62	−0.775**	−3.4
Communication	2,418	15.2	1.78	−2.360***	−9.6
Personal services	1,261	14.3	1.84	−5.545***	−17.7
Business services	11,212	13.4	2.23	−2.289***	−6.8
Computers	4,031	15.6	2.02	−2.947***	−8.9
Electronic equipment	6,667	17.7	1.92	−2.325***	−7.1
Measuring and control equipment	2,757	17.2	1.82	−5.613***	−17.5
Business supplies	1,446	25.5	1.36	−1.487***	−6.1
Shipping containers	641	24.8	1.34	−0.825	
Transportation	2,788	20.6	1.33	−3.309***	−16.0
Wholesale	5,124	16.8	1.48	−1.910***	−8.5
Retail	6,512	19.1	1.53	−2.025***	−7.7
Restaurants, hotels, motels	2,751	16.1	1.55	−3.152***	−12.9

Notes. The table estimates separate regressions for each of the 48 industries identified by Fama and French (1997). We exclude industries with an insufficient number of observations. For each industry, the first three columns show the number of observations, the average firm age, and the average Tobin's q value, respectively. In the fourth column, we report the coefficient of *Age*, which we obtain from the same regression specification as that in column (4) of Table 1, except we only have year fixed effects. Standard errors are clustered at the firm level. The column labeled "Marginal impact (%)" computes the change in q if listing age goes from the 25th to the 75th percentile of the pooled age distribution in the industry. The impact is measured relative to the average q in the industry and is shown only for statistically significant age coefficients. The sample period is 1978–2013.

***, **, and * indicate statistical significance in two-sided tests with confidence levels of 0.99, 0.95, and 0.90, respectively.

age since incorporation. Only two industries have a positive and significant coefficient: candy and soda, and tobacco products. However, there are only 37 candy and soda producers and 21 tobacco companies in the sample. A closer inspection of the two industries reveals that the positive age coefficients are driven by merely one outlier in each case (National Beverage Corporation in the candy and soda industry and Rock Creek Pharmaceuticals in the tobacco industry). When we exclude the two firms from the analysis, the age effects become statistically zero.

3.3. Decline in Tobin's q Ratios Across Headquarter States

Table A3 of the Internet appendix replicates the analysis at the state level. The rationale is that there is considerable heterogeneity across states with respect to dimensions that affect the firms' ability to generate growth opportunities such as the cost of doing business, innovation friendliness, takeover regulation, and labor market regulation. We focus on headquarter states because more than half of the sample firms are incorporated in Delaware. The results are qualitatively the same when we estimate regressions by incorporation state. The regression specification is the same as in Table 2, except that we include both industry and year fixed effects. The relation between age and Tobin's q is negative and significant in 37 states. Only one state, New Mexico, yields a positive and significant age coefficient. There are only 14 firms headquartered in New Mexico that meet our sample criteria. As it turns out, the positive coefficient is driven by one single firm, Santa Fe Gold Corp., which is in the sample for two years. When we exclude that firm, the age coefficient becomes negative but statistically insignificant. We conclude that the negative age dependence of Tobin's q is a phenomenon that applies to industries and states at large.

3.4. Inability to Revert to the Initial Success

The puzzling aspect of the relation between age and Tobin's q is that firms are unable to renew their success, in spite of the fact that they can learn and that they can buy into new technologies and markets. Table 3 documents this phenomenon from a slightly different perspective. Panel A performs an unconditional analysis of the 8,949 firms with the necessary number of observations by comparing the maximum Tobin's q ratios observed during the first four years after listing (denoted with q^*) with the maximum ratios observed thereafter. Consistent with the inability to renew growth opportunities, these maximum ratios have a median value of 2.5 in younger firms compared with 2.1 in older firms. The difference is statistically significant at the 99% confidence level.

Following a similar logic, Figure 2 illustrates how likely it is that a firm will be able to exceed q^* as a function of age. In this analysis, we filter out common effects. We therefore measure q as the residual from a pooled OLS regression of Tobin's q on industry and year fixed effects. The figure shows that very few firms manage to exceed their q^* after year 4. At age 5, for example, only 8.4% of the sample firms have a q larger than q^*. This fraction declines to 3.9% at age 25. Moreover, we find that only 33% of the firms *ever* beat their q^* (not tabulated).

Panel B of Table 3 conducts an analysis of the ability to exceed q^* with conditional logit regressions, industry-year fixed effects, and robust standard errors. The binary dependent variable equals 1 if the Tobin's q of the firm in question increases beyond q^* in any given year, and it equals 0 otherwise. We test whether the probability of that event, among firms that are below q^*, declines with age. The control variables are those of the regression specifications in Table 1. The evidence is consistent with this prediction. The coefficients on our measures of age, *Age* and *Old dummy*, are both negative and significant.

Table 3 Firms' Ability to Return to the Initial Success

Panel A: Univariate analysis

	Maximum Tobin's q	
	Listing age 1–4	Listing age 5 and older
Mean	3.53	3.10
p50	2.50	2.08
Min	0.95	1.02
Max	11.09	11.16
SD	2.79	2.61
N	8,949	8,949
Mean comparison t-test	3.705***	

Panel B: Switching probability from below to above the maximum initial q

	Dependent variable: Dummy for firms that switch from below to above the maximum initial q			
	(1)	(2)	(3)	(4)
Age	−1.496***	−1.661***		
	(0.397)	(0.402)		
Age × *R&D*		0.517**		
		(0.215)		
Old dummy			−0.164***	−0.186***
			(0.056)	(0.056)
Old dummy × *R&D*				0.083***
				(0.030)
Control variables	Included	Included	Included	Included
Industry-year FE	Included	Included	Included	Included
Observations	43,333	43,333	43,333	43,333
Adjusted R^2	0.213	0.213	0.213	0.213

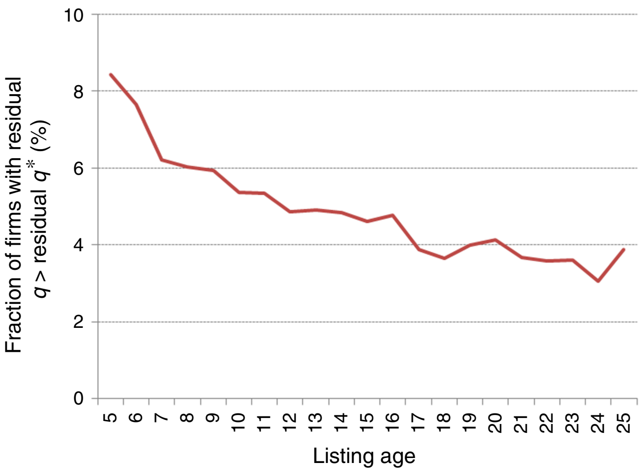
Notes. This table investigates whether mature firms are able to replicate their initial growth opportunities. For the 8,079 firms with sufficient data in our data set, panel A reports descriptive statistics for the maximum value of Tobin's q before and after listing age 5, respectively (winsorized at the 5th and the 95th percentiles of the pooled distribution). Panel B asks whether the firms' probability of exceeding the maximum initial q measured during the first four years of listing age is a function of age. The dependent variable is a binary variable that identifies firms that switch from below the maximum initial q to above the maximum initial q. The firms we analyze are those with a Tobin's q below the maximum initial q. We estimate conditional logit regressions with industry-year fixed effects (FE) and robust standard errors. The control variables are the same as in Table 1. All control variables are lagged by one year. Variable definitions are in the appendix. The sample period is 1978–2013.

***, **, and * indicate statistical significance in two-sided tests with confidence levels of 0.99, 0.95, and 0.90, respectively.

4. Managerial Effort Allocation and Strategic Focus in Older Firms

With our theory, as a firm gets older, it focuses more on managing assets in place because that is what it is best at. Therefore, we expect older firms to be more efficient in managing assets in place. In addition, having devoted less effort to the generation of growth opportunities early on, older firms should also increasingly lose the skills to generate such opportunities. Barring agency problems, older companies should therefore reduce their investment outlays, especially for R&D. We test these predictions in this section.

Figure 2 (Color online) Probability of Regenerating Growth Opportunities in Early Years



Notes. The figure shows the fraction of firms with $q > q^*$, sorted by age cohort; q^* is the maximum q ratio observed during the first four years after listing. To adjust for common effects, the q ratios we use are the residuals from a pooled OLS regression of q on industry and year fixed effects. The sample period is 1978–2013.

4.1. Increased Technical Efficiency

We argue that firms dedicate themselves to exploiting their earnings potential, to making their products and services more attractive, and to lowering costs. What follows tests whether this effort pays off and allows older firms to become technically more efficient. We examine three different measures of technical efficiency: a sales/book-value-of-assets ratio, a sales/assets-in-place ratio, and the ratio of cost of goods sold (COGS) per number of employees. The evidence in panel A of Table 4 is in line with the predicted increase in technical efficiency in older firms. Keeping everything else the same, older firms generate significantly more sales per dollar of assets invested, regardless of whether we use a book measure of those assets or Richardson's (2006) measure of assets in place. Companies also achieve significantly lower COGS per employee over time. We also find that the probability of losses drops with age (regression (5)), which is consistent with increased technical efficiency.

4.2. Age and Profitability

If age reduces the ability to renew the firm's growth opportunities, it should also eventually reduce profitability. As shown in regression (4) (see Table 4, panel A), ROA drops with age. The results are similar for other profitability measures.

4.3. Age and Investment Policy

We argued that, as firms focus more on assets in place, their ability to innovate falls. Hence, barring agency problems, we expect older firms to invest less to generate new growth opportunities. Their capital expenditures should be comparatively lower, and they should engage less actively in R&D activities.

Panel B of Table 4 investigates different measures of investment outlays and tests whether they grow with company age. We consider capital expenditures and R&D expenditures. These investment measures are standardized with sales and regressed on listing age and the usual set of control variables using OLS with industry-year fixed effects and firm-clustered standard errors. The coefficients on our age measures, however, are all negative and significant.

5. Firm Age, Loss of Flexibility, and Tobin's q

Our theory predicts that the ability to replace growth opportunities declines with firm age because firms optimally become less flexible. Age is a proxy for the loss of flexibility over time. This section tests this prediction. We first investigate whether firms become more rigid as they get older and then ask whether the accumulation of such rigidities helps explain why Tobin's q drops with age. The power of this test might be limited by the fact that rigidity data are available only for a subset of the sample firms.

5.1. Firm Age and Loss of Flexibility

The rigidity proxies we consider relate to the firm's cost structure, investment policy, product portfolio, and organizational dispersion and are defined as follows (see also Loderer and Waelchli 2015):

(a) Firms with inflexible cost structures are unable to temporarily cut costs as much as the average firm does when demand declines. Therefore, the proxy for cost rigidities is a binary variable that identifies firms that adjust their overhead expenses disproportionately less in reaction to a decrease in sales (*Rigid costs dummy*).

(b) A rigid investment policy implies that firms fail to respond to a positive investment signal (*Rigid investments dummy*). We assume a positive investment signal materializes if the growth rate of the median Tobin's q of a related industry exceeds that of the firm's main industry by more than 20 percentage points. Related industries are three-digit SIC industries within the same SIC division as the firm's main industry.[6] Failure to respond to such a signal means that the firm's investment intensity (*Capex* + *R&D*, divided by lagged book assets) falls behind the average investment intensity of all other firms within the same main industry[7]

[6] For example, for a firm that operates in "engines and turbines" (three-digit SIC code 351), related industries are all other three-digit industries within the same SIC "manufacturing" division (three-digit SIC codes 200–399).

[7] For example, if the industry "engines and turbines" receives a positive investment signal from a related industry, we measure the average investment intensity within "engines and turbines" in reaction to that signal and conclude that firms with a below-average investment intensity have a comparatively rigid investment policy.

Table 4 Firm Age, Technical Efficiency, and Investment Activities

Panel A: Firm age and technical efficiency

	Sales/Assets (1)	*Sales/VAIP* (2)	*COGS/Employee* (3)	*ROA* (4)	*Negative NI dummy* (5)
Age	1.087***	1.019***	−120.624***	−18.182***	−1.102***
	(0.139)	(0.158)	(36.046)	(2.759)	(0.320)
Controls	Included	Included	Included	Included	Included
Industry-year FE	Included	Included	Included	Included	Included
Observations	99,194	99,194	97,431	99,194	99,008
Adjusted/pseudo R^2	0.479	0.319	0.385	0.414	0.247

Panel B: Firm age and investment activities

	Capex		*R&D*	
	(1)	(2)	(3)	(4)
Age	−0.177***		−0.717***	
	(0.032)		(0.120)	
Old dummy		−0.012***		−0.052***
		(0.003)		(0.011)
Capex			0.124**	0.125**
			(0.054)	(0.054)
R&D	0.013**	0.013**		
	(0.006)	(0.006)		
Controls	Included	Included	Included	Included
Industry-year FE	Included	Included	Included	Included
N	99,185	99,185	99,185	99,185
Adjusted R^2	0.115	0.115	0.335	0.335

Notes. Panel A shows the relation between firm age and technical efficiency. We estimate OLS regressions with industry-year fixed effects (FE) and firm-clustered standard errors. In regression (1), the dependent variable is *Sales/Asset*. Regression (2) standardizes sales with the value of the assets in place (*VAIP*) instead of book assets. Regression (3) looks at the firm's COGS per employee (*COGS/Employee*). Regression (4) looks at *ROA*. Finally, regression (5) estimates a conditional logit model with a binary variable that identifies firm-years with negative net income. Panel B presents regressions of *Capex* and *R&D* on firm characteristics. The regressions are OLS regressions with industry-year fixed effects (FE) and firm-clustered standard errors. The control variables are the same as in Table 1. All investment measures are standardized with sales. Variable definitions are in the appendix. The sample period is 1978–2013.

***, **, and * indicate statistical significance in two-sided tests with confidence levels of 0.99, 0.95, and 0.90, respectively.

(c) The proxy for product rigidities (*Rigid products*) is the negative value of the fluidity measure provided by Hoberg et al. (2014).

(d) Finally, geographically dispersed organizations are more complex and therefore more structured and consequently more resistant to change (Denis et al. 2002). Therefore, the proxy for organizational rigidity is a binary variable (*Multinational dummy*) that identifies firms with nonzero pretax income from foreign operations.

The rigidity measures are available for only a small subsample of firms. When we focus on the firms with listing age larger than 4, the number of observations drops from 99,188 to 38,678.

Panel A of Table 5 shows that old firms score significantly higher on the four rigidity proxies. We regress each proxy on firm age, the standard set of control variables, as well as industry-year fixed effects. In the case of the binary rigidity measures, *Rigid costs dummy* and *Rigid investments dummy*, as well as in the case of the *Multinational dummy*, the model is implemented with conditional logistic regressions with robust standard errors. For the continuous product rigidity measure, we estimate an OLS regression with firm-clustered standard errors. Regardless of the rigidity proxy, the coefficient of firm age is positive and highly significant. Consequently, rigidities accumulate over time.

5.2. Firm Age, Rigidities, and Tobin's *q*

Panel B of Table 5 investigates whether the accumulation of rigidities is, at least in part, responsible for the age effect we observe. To find out, we add the four rigidity proxies to our standard regression (4) from Table 1. Because the subsample of firms with matching data is much smaller and therefore possibly different, regression (1) simply replicates the original regression and shows that firm age maintains its negative and significant coefficient also in this subsample. Regressions (2)–(5) then add the rigidity proxies individually. In each regression, the rigidity proxy is negative and significant. Less flexible firms therefore have fewer growth opportunities. However, the individual rigidity

Table 5 **Firm Aging, Loss of Flexibility, and Tobin's *q***

Panel A: Firm age and rigidities

	Rigidity proxies			
	Rigid costs dummy (1)	*Rigid investments dummy* (2)	*Rigid products* (3)	*Multinational dummy* (4)
Age	3.738***	2.416***	10.602***	2.283***
	(0.389)	(0.401)	(0.669)	(0.441)
Controls	Included	Included	Included	Included
Industry-year FE	Included	Included	Included	Included
Observations	34,735	32,621	38,678	35,443

Panel B: Firm age, rigidities, and Tobin's *q*

	Dependent variable: *Tobin's q*					
	(1)	(2)	(3)	(4)	(5)	(6)
Age	−1.474***	−1.286***	−1.245***	−1.169***	−1.384***	−0.801**
	(0.330)	(0.329)	(0.326)	(0.331)	(0.329)	(0.326)
Rigid costs dummy		−0.311***				−0.283***
		(0.021)				(0.021)
Rigid investments dummy			−0.414***			−0.396***
			(0.027)			(0.027)
Rigid products				−0.029***		−0.018***
				(0.006)		(0.006)
Multinational dummy					−0.234***	−0.228***
					(0.032)	(0.031)
Controls	Included	Included	Included	Included	Included	Included
Industry-year FE	Included	Included	Included	Included	Included	Included
Number of observations	38,678	38,678	38,678	38,678	38,678	38,678
Adjusted R^2	0.259	0.266	0.273	0.261	0.263	0.284

Notes. The table investigates whether rigidities can explain the decay in Tobin's *q*. Panel A asks whether age is positively associated with the presence of rigidities in the firm's cost structure, investment policy, product portfolio, and organizational structure. We regress the rigidity measure in question on firm age, the standard set of control variables, as well as industry-year fixed effects (FE). For the binary rigidity measures *Rigid costs dummy* (regression (1)) and *Rigid investments dummy* (regression (2)), and *Multinational dummy* (regression (4)), we estimate conditional logistic regressions with robust standard errors. For the continuous rigidity measure *Rigid products* (regression (3)), we estimate a pooled OLS regression and firm-clustered standard errors. Panel B tests whether the addition of our rigidity proxies to our standard regression (4) from Table 1 can explain the negative age dependence of *q*. Variable definitions are in the appendix.

***, **, and * indicate statistical significance in two-sided tests with confidence levels of 0.99, 0.95, and 0.90, respectively.

types cannot explain the age effect, as the coefficient of firm age falls slightly and remains significant. This changes in regression (6), where we combine all rigidity proxies in the same regression. In that regression, the coefficient of age gets cut almost in half (compared with regression (1)) and loses part of its statistical significance, whereas the coefficient of the four rigidity proxies remains negative and significant at the 1% level. The standard error of the age coefficient and the magnitude of the rigidity coefficients remain unchanged. Therefore, the loss in significance of the age coefficient does not appear to result from multicollinearity problems. When we compute variance-inflation factors, none of them exceeds a value of 2 (the critical value is 10).

We conclude that it is the accumulation of rigidities over time that probably hampers the ability of mature firms to innovate. Firm age is simply a proxy for the loss of operational flexibility induced by the rigid corporate structures, incentive systems, and best practices that mature firms choose to optimally focus on assets in place.

6. Alternative Hypotheses

As predicted by our theory, we find a negative relation between company age and growth opportunities. The relation is highly significant and quite robust with respect to different estimation techniques, regression specifications, and the way we measure firm age. In this section, we investigate a number of competing explanations. According to these explanations, the negative age relation between age and Tobin's *q* could be the result of increased managerial agency problems in older firms, the consequence of the relaxation of financial constraints over time, a manifestation of the difficulty of finding positive net present value (NPV) projects, or simply a reflection of the post-IPO decay reported, in particular, by Jain and Kini (1994).

6.1. Post-IPO Evolution

Several alternative explanations view the decline in q as the natural evolution of firms after their IPO. The first of these explanations is the theory of Pástor and Veronesi (2003) that investors learn about firms after the IPO. The second explanation is simply that after the IPO growth, options are exercised so that assets grow and growth opportunities fall. The third explanation is that performance reverts to the mean after the IPO (Jain and Kini 1994, Pástor et al. 2009). These post-IPO explanations assuredly help explain the decrease in Tobin's q as firms age. However, most of our regressions exclude firms that are less than five years from the IPO, so that the evolution of firms immediately after the IPO cannot explain our results. Furthermore, in unreported tests, we find that the results hold if we restrict the sample to firms older than 20 years. The post-IPO alternative explanations also seem to be less relevant for large firms. For instance, Pástor and Veronesi (2003) explicitly say that their theory explains better the evolution of market-to-book of smaller firms. Yet when we estimate our regression for small and large firms separately, we do not find a difference in the age coefficient. The results also hold if we exclude the firms that listed during the dot-com boom of 1995–2001, which are years where the uncertainty theory of Pástor and Veronesi (2003) would be most relevant. Finally, and perhaps most importantly, the results hold when we control for dispersion of analyst forecasts (see Section 3 of the Internet appendix).

6.2. Random Ideas

A second explanation holds that finding growth opportunities is not easy. Because our sample is limited to listed firms, only firms that were lucky and succeeded appear in our data. By self-selection, these firms have comparatively high initial Tobin's q ratios. As they exploit their projects, their asset base increases and Tobin's q drops. Finding subsequent ideas that yield significant positive NPV projects is a random, low probability event. Existing firms are sometimes lucky (e.g., Microsoft hit it big with Windows, then Office, then Xbox) and find such projects. Yet the average firm is not lucky, which is why, according to the hypothesis, the average Tobin's q gradually drops over time down to 1.

The contention that great ideas are random is fully consistent with our hypothesis. One cause of randomness is competition, since there is generally an advantage to be first. Hence, the random idea hypothesis is closely related to the claim that Tobin's q declines as a result of competition, a claim that implicitly goes back at least to Stigler (1963, p. 54), who noted that "there is no more important proposition in economic theory than that, under competition, the rate of return on investment tends toward equality in all industries." Yet, as pointed out in the introduction, the puzzle is not so much that there are forces that pull Tobin's q ratios toward 1 but rather the fact that established firms are unable to resist that pull.

Established firms do not need to have new great ideas themselves to offset their q decline. Conceivably, they could also buy out lucky start-ups or their patents. In fact, the typical mature firm in our sample could simply improve on what other firms do, in and outside its industry. There is nothing under the random ideas hypothesis that would prevent it from successfully pursuing these activities. By contrast, we argue that it is rigidities that make many of these strategies economically unattractive because they lie outside the firm's core abilities. It is because of these rigidities that the slide of Tobin's q ratios toward 1 cannot be halted, on average.

More important, there is evidence that cannot be explained by the random idea hypothesis. First, we just showed that the decline in q is in fact at least partly related to the presence of rigidities. Second, as reported further down, product market competition actually slows down the time-related decline in q. Competition per se should have the opposite effect, because it reduces the probability of finding profitable investment projects.

6.3. Financial Constraints and the Relation Between Tobin's q and Firm Age

Over time, investors learn more about firms and their business models, and not surprisingly, investor uncertainty declines. This loosens the financial constraints of firms over time and improves their access to capital markets. Consistent with these predictions, Hadlock and Pierce (2010) find that company age is a particularly useful predictor of financial constraints. Neoclassical theory predicts that firms with limited capital and a given set of investment opportunities undertake the most profitable investments first (Cooley and Quadrini 2001). If so, it is not surprising to observe that older firms have lower Tobin's q ratios—although the puzzling observation of their inability to regenerate their investment opportunity set remains. Section 2 of the Internet appendix tests whether financial constraints are indeed responsible for at least part of the aging effect we uncover. We find that not to be the case.

6.4. Agency Problems in Older Firms

Finally, the decrease in Tobin's q with firm age could reflect agency problems between managers and firm owners that intensify as time goes by. Managers could have a preference for a quiet life and therefore decide to work less, steer away from risky investment and R&D projects, and simply milk the available lines of business. This quiet-life hypothesis (Hicks 1935, Bertrand and Mullainathan 2003, Giroud and Mueller

2010) could explain some of our results, such as the decline in Tobin's q, the reduction in investment and R&D activities, and the impact of competition. Yet it cannot explain why technical efficiency increases over time or why, as discussed further down, enhanced capital markets monitoring contributes to an acceleration of the decline in Tobin's q. A quiet life, however, is only one possible manifestation of managerial conflicts of interest. In Section 2 of the Internet appendix, we therefore test whether older firms are more likely to have principal–agent problems in general and whether that explains the impact of company age on Tobin's q. As explained in detail in the Internet appendix, we find that the age effect is robust to the inclusion of a broad set of variables typically used as proxies for potential agency problems, including various corporate governance indices, board size, inside ownership, as well as the age and tenure of the chief executive officer (CEO) and the directors.

Moreover, since older firms invest less, we examine whether there is any evidence of poor use of the cash they generate. We therefore investigate whether the compensation of CEOs in older firms is higher and whether older firms are reluctant to return cash to shareholders. We also ask whether they end up accumulating larger cash balances. The evidence in Section 2 of the Internet appendix rejects these predictions. In sum, we find that old firms make higher payouts to shareholders and hold smaller cash balances, on average. Moreover, CEO compensation is lower in old firms. We therefore conclude that there is no evidence that older firms have lower q ratios because of greater agency problems.

7. Competition, Capital Markets Monitoring, and the Evolution of Tobin's q with Age

Our theory predicts that the relation between age and Tobin's q should be more negative when competition forces management to devote more effort to assets in place and flatter when it makes it more advantageous for management to devote more effort to generating growth opportunities. As discussed in the introduction, management optimally devotes more effort to assets in place when there is more competition in the market for corporate control. That makes the slope of the relation between Tobin's q and age more negative. Greater monitoring by the capital markets has a similar effect. By contrast, greater competition in the goods market increases the value to management from devoting more effort to generating growth opportunities. This makes the relation between age and Tobin's q flatter. Finally, if the firm can more easily hire people who have the ability to generate growth opportunities, the expected gain to management from devoting effort to generating growth opportunities is higher, so that the relation between age and Tobin's q is less negative. This section tests these predictions. Note, however, that all our predictions are about the impact of competition on the relation between Tobin's q and firm age. They are distinct and independent from predictions about the impact of competition on the level of Tobin's q itself.

7.1. Competition in the Market for Corporate Control

We test the prediction that the relation between Tobin's q and age is more negative if competition in the market for corporate control is stronger using the introduction of business combination laws as a source of variation in corporate control regimes. Business combination laws deter corporate control transactions by imposing a moratorium on transactions, such as mergers, between a large shareholder and the firm incorporated in a particular state as soon as the shareholder's stake exceeds a given size. Delaware, for example, enacted these statutes during the 1980s to deter hostile leveraged takeovers. These laws might reduce the short-termism induced by capital markets monitoring (Holmstrom 1989, He and Tian 2013, Asker et al. 2015), or they might take some of the pressure off management to make an efficient use of their assets to avoid a takeover (Bertrand and Mullainathan 2003). Under these laws, we would therefore expect management to focus less on the performance of assets in place and to devote more effort to generate growth opportunities, which would imply a less significant decline in Tobin's q over time.

Table 6 shows that older firms incorporated in states with business combination statutes in place experience the predicted less rapid decline in Tobin's q ratios over time. Specifically, in column (1), we estimate our standard regression specification with the addition of *BC*, a binary variable equal to 1 if the firm is incorporated in a state that has a business combination statute in place in a particular year and equal to 0 otherwise. We also include an interaction term that combines *Age* and *BC*. To account for the fact that the errors in our regressions are likely correlated at the state level, we cluster the standard errors at the state of incorporation level. The coefficient of *Age* remains negative and significant. Moreover, the existence of a business combination law per se does not contribute to a lower Tobin's q. However, the interaction of age and business combination statutes appears to slow down the decline of Tobin's q over time. Hence, as predicted, business combination laws seem to protect firms and give their managers more time to develop growth opportunities. Numerically, these estimates imply that, in a state without BC, old age is associated with a Tobin's q lower by 0.28; in comparison, the effect of old age on q in BC states is less than half as much, namely, 0.11.

Table 6 Firm Aging and Competition in the Market for Corporate Control

Dependent variable: *Tobin's q*				
	Full sample (1)	Excluding DE (2)	Full sample (3)	Full sample (4)
Age	−4.589***	−4.235***	−4.136***	−4.134***
	(0.456)	(0.556)	(0.464)	(0.465)
Business combination law (BC)	−0.025	−0.059*	0.009	0.026
	(0.029)	(0.033)	(0.054)	(0.050)
Age × BC	2.787***	1.815**	0.021	0.260
	(0.697)	(0.731)	(0.646)	(0.569)
BC × Amanda decision			0.151***	0.133***
			(0.043)	(0.046)
Age × BC × Amanda decision			2.629***	2.379***
			(0.295)	(0.326)
First-generation law (FG)			−0.221***	−0.222***
			(0.051)	(0.051)
Age × FG			−2.131***	−2.133***
			(0.620)	(0.618)
Poison pill law (PP)			0.014	−0.082
			(0.083)	(0.072)
Age × PP			0.670	−1.071*
			(0.752)	(0.632)
Paramount × PP				0.102**
				(0.049)
Paramount × PP × Age				1.854***
				(0.659)
Control share acquisition law (CS)			0.079	0.094
			(0.087)	(0.084)
Age × CS			0.686	0.904
			(0.686)	(0.615)
CS × CTS			−0.118	−0.133
			(0.085)	(0.083)
Age × CS × CTS			−2.020**	−2.249***
			(0.867)	(0.836)
Directors' duty law (DD)			−0.074	−0.074
			(0.064)	(0.063)
Age × DD			−0.427	−0.418
			(0.818)	(0.808)
Fair price law (FP)			0.038	0.034
			(0.043)	(0.044)
Age × FP			0.266	0.211
			(0.584)	(0.585)
Motivating firm (MF)			−0.177	−0.177
			(0.259)	(0.258)
Age × MF			1.212	1.213
			(3.655)	(3.647)
BC × MF			0.212	0.210
			(0.232)	(0.231)
Age × BC × MF			6.105	6.074
			(3.858)	(3.853)
Controls, industry-year FE	Included	Included	Included	Included
Number of observations	95,177	40,693	95,177	95,177
Adjusted R^2	0.286	0.276	0.287	0.287

Notes. The table investigates how the existence of business combination laws in the state of incorporation affects the relation between listing age and Tobin's *q*. The states passed these laws during the sample period. The control variables are the same as in Table 1 and the regressions include industry-year fixed effects (FE). Regression (1) is estimated for the full sample of firms with listing age greater than 4. Regression (2) excludes firms incorporated in Delaware (DE). Regressions (3) and (4) are estimated for the full sample of firms and include the additional control variables suggested by Karpoff and Wittry (2015). Standard errors are clustered at the state of incorporation level. Variable definitions are in the appendix. The sample period is 1978–2013.

***, **, and * indicate statistical significance in two-sided tests with confidence levels of 0.99, 0.95, and 0.90, respectively.

We obtain similar results when measuring firm age with the binary variable *Old dummy* (not shown). Since Delaware is the state of incorporation of choice, it is possible that the results reflect a Delaware-specific effect. Column (2) therefore replicates the estimation while omitting firms incorporated in Delaware. The results, however, remain the same.

Karpoff and Wittry (2015) raise concerns about the approach used in regressions (1) and (2) that is common in the literature. They question whether the BC laws are exogenous and show that the impact of such laws depends on the type of BC law, on the coverage by first-generation and other second-generation state antitakeover laws, on the legal regime as reflected in important court decisions, and on preexisting firm-level takeover defenses. They provide relevant information on first-generation laws as well as important other second- and third-generation state antitakeover laws. Moreover, they have a list of firms that lobbied for the passage of these laws. Finally, they identify important court decisions that changed the legal regime.

In regression (3), we add control variables that capture the issues raised by Karpoff and Wittry (2015) as well as interaction terms of these control variables with firm age. Consistent with Karpoff and Wittry (2015), we find that the effect we document is particularly strong after the *Amanda Acquisition Corp. v. Universal Foods Corp.* decision in 1989 (877 F.2d 496 (7th Cir. 1989)), which affirmed the constitutionality of business combination laws. Karpoff and Wittry (2015) point out, however, that this business combination law effect could be spurious because a nearly contemporaneous court decision, *Paramount Communications, Inc. v. Time, Inc.* (571 A.2d 1140 (Del. Supr. 1989)), also strengthened a firm's use of poison pills. To address this concern, regression (4) augments the specification with a variable that identifies firms incorporated in states that are covered by poison pill laws after the *Paramount Communications, Inc. v. Time, Inc.* decision (*Paramount* × *PP*) as well as an interaction term of that variable with firm age (*Paramount* × *PP* × *Age*). The inclusion of the two variables does not affect the business combination law effect we document. However, both additional variables have positive and significant coefficients, consistent with the view that poison pills are the most formidable defense against takeover (Coates 2000). By contrast, control share acquisition laws that were in place after the 1987 court decision in *CTS Corp. v. Dynamics Corp. of America* (481 U.S. 69 (1987)), which confirmed the legality of such laws, significantly accelerate the age-related decrease in Tobin's q. Also the presence of first-generation laws appears to accelerate that effect. Note, however, that first-generation laws were ruled unconstitutional in 1982 (see the *Edgar v. MITE Corp.* decision of the U.S. Supreme Court (457 U.S. 624 (1982))), which is why, following Karpoff and Wittry (2015), we set the value of the first-generation law dummy equal to 0 for all firms from 1982 onward. In our sample, less than 6% of the observations occur before 1982. Finally, there is no effect for fair-price laws and directors' duty laws and also the firms that lobbied for business combination laws do not appear to be different. Overall, our conclusions remain unchanged. Increased competition in the market for corporate control slows down the age-related decline in q.

7.2. Capital Markets Monitoring

We also investigate whether close monitoring by the capital markets accelerates that negative relation. The details of this analysis are reported in Section 3 of the Internet appendix. We assume that capital markets monitoring is stricter if a firm is followed by a comparatively larger number of financial analysts. Consistent with the hypothesis that capital markets monitoring accelerates the decay in Tobin's q, we find that firms with high analyst coverage age more quickly. We conduct several additional tests to address the potential endogeneity of analyst coverage, including the instrumental-variable approach suggested by Yu (2008) as well as the procedure of Chang et al. (2006), who lag analyst coverage by three years. When we do that, our results remain the same.

7.3. Product Market Competition

Section 4 of the Internet appendix reports tests of the hypothesis that the relation between age and Tobin's q is less negative when product market competition is more intense. We follow Frésard and Valta (2016), among others, and assume that import tariff reductions should increase product market competition. Consistent with our prediction, we find that stronger competition significantly slows down the age-related decay in Tobin's q. The validity of this result hinges on the exogeneity assumption of tariff reductions. We conduct tests to address potential endogeneity concerns. They leave our conclusion unchanged. Questions about endogeneity, however, undoubtedly remain.

7.4. Labor Market Competition

Cross-sectional variation in the competitive structure of labor markets should have an effect on the relation between company age and growth opportunities as well. Non-compete clauses in employment contracts limit the ability of employees to pursue own ventures or join firms in activities related to those of their employers. These clauses are not enforced uniformly across states in the United States. Vigorous enforcement will help young firms because they prevent employees from leaving their employer to cash in on their knowledge and ideas. By contrast, they make it difficult for older firms to find creative employees. Hence, companies located in states that allow and enforce non-compete clauses in employment agreements should experience a quicker decline in Tobin's q ratios over time. We test this prediction in Section 5 of the Internet appendix and find supporting evidence.

8. Conclusions

This paper investigates why older firms have fewer growth opportunities. A simple answer to this question is that young firms exercise growth options, so their Tobin's q falls. This simple answer begs the question of why firms do not acquire new growth options in such a way that their Tobin's q does not fall. We show that the failure of firms to acquire new growth options to an extent sufficient to prevent Tobin's q from falling cannot be understood without taking into account the fact that firms optimally become more rigid as they age. As a result, their ability to innovate deteriorates, and hence they find it increasingly more difficult to replenish their growth opportunities. Using measures of corporate rigidity, we find that these measures help understand the decrease in Tobin's q with age. Moreover, we find indirect support for the role of increasing rigidity with age by showing that the rate at which growth opportunities decline for firms is affected positively by capital markets monitoring and by a more active market for corporate control. This is because firms focus more on observable and quantifiable performance metrics when there is more capital markets monitoring and a more active market for corporate control. By contrast, we show that greater goods competition and greater labor market competition lead to a slower rate of decay of growth opportunities because greater goods competition makes it harder for firms to thrive without innovation and greater labor competition makes it easier for older firms to hire employees with innovation skills.

We show that other explanations for the decay of growth opportunities cannot explain all of the evidence we present. For instance, hypotheses that stress the role of the decrease in uncertainty about firms' growth prospects may help explain some of the decrease in the market-to-book ratio as firms age, but we find that this decrease holds controlling for analysts' uncertainty about a firm's prospects and holds regardless of firm size. Similarly, we provide evidence that the lower Tobin's q of older firms cannot be fully explained by greater agency problems.

Supplemental Material

Supplemental material to this paper is available at http://dx.doi.org/10.1287/mnsc.2016.2478.

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Appendix. Variable Definitions

Variable	Definition
	Panel A: Firm age
Age	The age measure proposed by Pástor and Veronesi (2003), namely, $-1/(1 + \textit{Listing age})$. *Listing age* is computed as one plus the difference between the year under investigation and the first year the firm appears on the CRSP tapes.
Age_{inc}	We also compute age as the number of years (plus one) since incorporation. This information is from Jay Ritter's website as well as from Mergent Webreports.
Age_{inc} *at listing*	The firm's incorporation age (Age_{inc}) at the time of listing.
Old dummy	Binary variable equal to 1 if the firm in question is older (in terms of listing age) than the sample median in any given year, and equal to 0 otherwise.
	Panel B: Profitability, productivity, and growth opportunities
COGS/Employee	The firm's COGS (cogs) divided by the number of employees (variable emp in COMPUSTAT).
Negative NI dummy	Binary variable equal to 1 if the firm's net income (NI, variable ni in COMPUSTAT) is negative.
ROA	Return on assets is the ratio of the firm's operating income before depreciation (variable oibdp in COMPUSTAT) divided by the lagged book value of total assets (at).
Sales/Assets	The firm's sales (variable sale in COMPUSTAT) divided by the book value of assets at the beginning of the year (variable at in COMPUSTAT).
Sales/VAIP	The firm's sales (variable sale in COMPUSTAT) divided by the value of the assets in place. *VAIP* is the value of the assets in place, as defined in Richardson (2006): $VAIP = (1 - AR)BV + A(1 + R)X - ARD$, where BV is the book value of common equity (variable ceq in COMPUSTAT), X is earnings (variable oiadp in COMPUSTAT), D is dividends (variable dvc in COMPUSTAT), R is the discount rate (12%), and A is $W/(1 + R - W)$; W is a fixed persistence parameter with a value of 0.62, as reported in Dechow et al. (1999).
Tobin's q	Tobin's q, computed as the market value of the firm's assets (variable size in COMPUSTAT) divided by their book value (variable at in COMPUSTAT).

Appendix. (Continued)

Variable	Definition
	Panel C: Other firm-specific variables
Capex	The ratio of capital expenses (variable capx in COMPUSTAT) net of depreciation and amortization charges (variable dp in COMPUSTAT) to sales (variable sale in 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.
KZ-index	The Kaplan and Zingales (1997) index that measures a firm's level of financial constraints. We follow Lamont et al. (2001, p. 552) and compute the KZ-index as $-1.001909 \times$ [(ib + dp)/ppentt − 1] + $0.2826389 \times$ [(*Size*)/at] + $3.139193 \times$ [(dltt + dlc)/(dltt + dlc + seq)] − $39.3678 \times$ [(dvc + dvp)/ppentt − 1] − $1.314759 \times$ [che/att − 1]. With the exception of *Size*, the variable names in the equation refer to COMPUSTAT.
Leverage	Leverage is the firm's long- and short-term debt (variables dltt + dlc in COMPUSTAT) divided by the market value of assets (*Size*).
Multinational dummy	Binary variable that identifies firms with nonzero pretax income from foreign operations.
R&D	The firm's R&D expenses (variable xrd in COMPUSTAT) divided by its sales (variable sale in COMPUSTAT).
Rigid costs dummy	A firm has rigid costs if its overhead expenses (expressed in 2009 dollars) drop by less than 0.5% in reaction to a 1% decrease in real sales.
Rigid investments dummy	Binary variable that identifies firms that fail to respond to a positive investment signal to the industry. We assume a three-digit SIC industry i receives a positive signal if the median Tobin's q of another industry j within the same SIC division increases by more than 20 percentage points relative to the median change in Tobin's q of industry i. Failure to respond to that signal means that the firm's investment intensity (*Capex* + *R&D*, normalized by lagged book assets), falls behind the industry average.
Rigid products	The negative value of the firm's fluidity measure according to Hoberg et al. (2014).
Size	The log of market value of the assets at the beginning of the year, approximated by the book value of assets (variable at in COMPUSTAT) minus the book value of common equity (ceq) plus the market value of common equity (csho × prcc_f) minus deferred taxes (txtb). Variable names in parentheses refer to COMPUSTAT.
Volatility	The volatility of the firm's monthly stock return. We calculate the volatility over a five-year window and include all firm-years with at least 24 monthly returns.
	Panel D: State antitakeover laws
Business combination law (*BC*)	Binary variable equal to 1 if the firm is incorporated in a state with a business combination law in place and equal to 0 otherwise. The data are from Table 2 of Karpoff and Wittry (2015).
First-generation law (*FG*)	Binary variable equal to 1 if the firm is incorporated in a state with first-generation antitakeover laws in place, according to Table 1 of Karpoff and Wittry (2015), and equal to 0 otherwise. As in Karpoff and Wittry (2015), the variable is flipped back to 0 in all firms in all states in 1982 and the subsequent years, i.e., after the U.S. Supreme Court ruled in *Edgar v. MITE Corp.* that the Illinois first-generation antitakeover law was unconstitutional.
Poison pill law (*PP*)	Binary variable equal to 1 if the firm is incorporated in a state with a poison pill law in place, according to Table 1 of Karpoff and Wittry (2015), and equal to 0 otherwise.
Paramount × *PP*	Binary variable that identifies firm-years 1989 and later of firms incorporated in a state with a poison pill law in place. In 1989, a Delaware Supreme Court decision strengthened the firms' ability to deploy poison pills.
Control share acquisition law (*CS*)	Binary variable equal to 1 if the firm is incorporated in a state with a control share acquisition law in place, according to Table 1 of Karpoff and Wittry (2015), and equal to 0 otherwise.
Directors' duties law (*DD*)	Binary variable equal to 1 if the firm is incorporated in a state with a directors' duties law in place, according to Table 1 of Karpoff and Wittry (2015), and equal to 0 otherwise.
Fair price law (*FP*)	Binary variable equal to 1 if the firm is incorporated in a state with a fair price law in place, according to Table 1 of Karpoff and Wittry (2015), and equal to 0 otherwise.
CS × *CTS*	Binary variable that identifies firm-years 1987 and later of firms incorporated in a state with a control share acquisition law in place. In 1987, the U.S. Supreme Court affirmed constitutionality of control share laws.
BC × *Amanda*	Binary variable that identifies firm-years 1989 and later of firms incorporated in a state with a business combination law in place. In 1989, the U.S. Court of Appeals, Seventh Circuit, affirmed constitutionality of business combination laws.
Motivating firm	Binary variable that identifies firms that lobbied for business combination laws, according to Table 3 of Karpoff and Wittry (2015).

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