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INVESTMENT-LESS GROWTH:
AN EMPIRICAL INVESTIGATION

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ABSTRACT

We analyze private fixed investment in the U.S. over the past 30 years. We show that investment is weak relative to measures of profitability and valuation – particularly Tobin's Q, and that this weakness starts in the early 2000's. There are two broad categories of explanations: theories that predict low investment because of low Q, and theories that predict low investment despite high Q. We argue that the data does not support the first category, and we focus on the second one. We use industry-level and firm-level data to test whether under-investment relative to Q is driven by (i) financial frictions,(ii) measurement error (due to the rise of intangibles, globalization, etc), (iii) decreased competition (due to technology or regulation), or (iv) tightened governance and/or increased short-termism. We do not find support for theories based on risk premia, financial constraints, or safe asset scarcity, and only weak support for regulatory constraints. Globalization and intangibles explain some of the trends at the industry level, but their explanatory power is quantitatively limited. On the other hand, we find fairly strong support for the competition and short-termism/governance hypotheses. Industries with less entry and more concentration invest less, even after controlling for current market conditions. Within each industry-year, the investment gap is driven by firms that are owned by quasi-indexers and located in industries with less entry/more concentration. These firms spend a disproportionate amount of free cash flows buying back their shares.

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In his March 2016 letter to the executives of S&P 500 firms, BlackRock's CEO Laurence Fink argues that, "*in the wake of the financial crisis, many companies have shied away from investing in the future growth of their companies. Too many companies have cut capital expenditure and even increased debt to boost dividends and increase share buybacks.*" The decline in investment has been discussed in policy papers [Furman, 2015], especially in the context of a perceived decrease in competition in the goods market [CEA, 2016]. There is little systematic evidence, however, on the extent of the investment puzzle and on the potential explanations.

This paper tries to (at least partially) fill that gap. We clarify some of the theory and the empirical evidence; and test whether alternate theories of under-investment are supported by the data. The main contributions of the paper are to show that: (i) the lack of investment represents a reluctance to invest despite high Tobin's Q; and (ii) this investment wedge appears to be linked to decreased competition and changes in governance that encourage shares buyback instead of investment. We address the issues of causality of competition and governance in a companion paper [Gutiérrez and Philippon, 2016].

It is useful, as a starting point, to distinguish two broad categories of explanations for low investment rates: theories that predict low investment *because* they predict low Tobin's Q and theories that predict low investment *despite* high Tobin's Q. The first category includes theories of increased risk aversion or decreases in expected growth. The standard Q-equation holds in these theories, so the only way they can explain low investment is by predicting low values of Q. The second category ranges from credit constraints to oligopolistic competition, and predicts *a gap* between Q and investment due to differences between average and marginal Q (e.g., market power, growth options) and/or differences between firm value and the manager's objective function (e.g., governance, short-termism).

We find that private fixed investment is weak relative to measures of profitability and valuation – particularly Tobin's Q. Time effects from industry- and firm-level panel regressions on Q are substantially lower since 2000. This is true controlling for firm age, size, and profitability; focusing on subsets of industries; and even considering tangible and intangible investment separately. Given these results, we discard theories that predict low investment *because* they predict low Q.

We therefore focus on theories that predict *a gap* between Q and investment; and we consider the following eight potential explanations, grouped into four broad categories. See Section 2 for a detailed discussion of these hypotheses.

- Financial frictions

  1. External finance
  2. Bank dependence
  3. Safe asset scarcity

- Measurement Error

  4. Intangibles

5. Globalization

- Competition

6. Regulation
7. Concentration due to other factors

- Governance

8. Ownership and Shareholder Activism

We emphasize that these hypotheses are not mutually exclusive. For instance, there is a large and growing literature that focuses precisely on the interaction between governance and competition (see, for example, Giroud and Mueller [2010, 2011]). Thus, our tests do not map one-to-one into hypotheses (1) to (8); some tests overlap two or more hypotheses (e.g., measures of firm ownership affect both short-termism and governance). We report the results of our tests and discuss their implications for the above hypotheses in Section 4.

Testing these hypotheses requires a lot of data, at different levels of aggregation. Some are industry-level theories (e.g., competition), some firm-level theories (e.g., ownership), and some theories that can be tested at the industry level and/or at the firm level. Unfortunately, firm- and industry-data are not readily comparable, because they differ in their definitions of investment and capital, and in their coverage. As a result, we must spend a fair amount of time simply reconciling the various data sources. Much of the work is explained in Section 3 and in the Appendix.

We gather industry investment data from the BEA and firm investment data from Compustat; as well as additional data needed to test each of the eight hypotheses. For instance, for Entry and Concentration, we obtain measures of firm entry, firm exit, and concentration (sales and market value Herfindahls, and concentration ratios, i.e., the share of sales and market value of the Top 4, 8, 20 and 50 firms in each industry). For governance and short-termism, we use measures of institutional ownership, including different ownership types following Brian Bushee's institutional investor classification.[1]

Competition and Governance We then analyze investment patterns at the industry- and firm-level. At the industry level, we find that industries with more quasi-indexer institutional ownership and less competition (as measured by changes in the number of firms, as well as sales and market value concentration) invest less. These results are robust to controlling for firm demographics (age and size) as well as Q. The decrease in competition is supported by a growing literature[2], though the

[1] The classification – described in Bushee [2001] – identifies Quasi-indexer, Transient and Dedicated institutional investors based on the turnover and diversification of their holdings. Dedicated institutions have large, long-term holdings in a small number of firms. Quasi-indexers have diversified holdings and low portfolio turnover – consistent with a passive, buy-and-hold strategy of investing portfolio funds in a broad set of firms. Transient owners have high diversification and high portfolio turnover. See Section 3 for additional details.

[2] For instance, the Council of Economic Advisers issued a 2016 issue brief that "*reviews three sets of trends that are broadly suggestive of a decline in competition: increasing industry concentration, increasing rents accruing to a few firms, and lower levels of firm entry and labor market mobility.*" (see also Decker et al. [2015]).

empirical implications for investment have not been recently studied (to our knowledge). Similarly, the mechanisms through which quasi-indexer institutional ownership impacts investment remain to be fully understood: while such ownership may improve governance (e.g., Appel et al. [2016a]), it may also increase short-termism (e.g., Asker et al. [2014], Bushee [1998]) – both of which could lead to higher buybacks and less investment. Industries with a higher share of intangibles exhibit lower investment and we find some weak evidence that industries with more regulation also invest less. Industries with higher foreign profits invest less in the US, as expected, but firm level investment does not depend on the share of foreign profits.

Firm-level results are consistent with industry-level results. They suggest that within each industry-year and controlling for Q, firms with higher quasi-indexer institutional ownership invest less; and firms in industries with less competition also invest less. None of the other theories appear to be supported by the data, and they often exhibit the 'wrong' and/or inconsistent signs; or are not statistically significant.

Safe Assets and Intangibles To better understand the implications of safe asset scarcity and the rise of intangibles, we discuss these hypotheses in greater detail. According to the safe asset scarcity hypothesis, the value of being able to issue safe assets has increased after the Great Recession. In that case, the valuation (and investment) of highly rated firms should increase relative to that of other firms. We regress the 2014 value on the 2006 value and an indicator for AA to AAA rated firms and find no support for the hypothesis. We also fail to observe higher investment for these firms in the cross-section.

The rise of intangibles may affect investment in several ways: first, intangible investment is difficult to measure and is therefore prone to measurement error. Under-estimation of I would lead to under-estimation of K, and therefore over-estimation of Q; and would translate to an 'observed' under-investment at industries with a higher share of intangibles. Alternatively, intangible assets might be more difficult to accumulate. A rise in the relative importance of intangible could then lead to a higher equilibrium value of Q even if intangibles are correctly measured. We find some support for these hypotheses but their impact does not seem to be quantitatively very large.

Other Papers Overall, our results are aligned with Lee et al. [2016] who find that industries that receive more funds have a higher industry Q until the mid-1990s, but not since then. The change in the allocation of capital is explained by a decrease in capital expenditures and an increase in stock repurchases by firms in high Q industries since the mid-1990s. Our results are also related to Alexander and Eberly [2016] who study the implications of the rise of intangibles on investment. Last, our results somewhat contrast with Bena et al. [2016], who study the relationship between foreign institutional ownership (proxied by additions to the MSCI World Index), investment and innovation across 30 countries. They find that foreign institutional ownership can increase long-term investment in fixed capital, innovation, and human capital. It will therefore be interesting, in future work, to understand if our results are specific to the United States. Finally, the above conclusions

Table 1: Current Account of Non financial Sector

Name	Notation	Value in 2014 ($ billions)		
		Corporate[1]	Non corporate[2]	Business[1+2]
Gross Value Added	$P_t Y_t$	$8,641	$3,147	$11,788
Net Fixed Capital at Rep. Cost	$P_t^k K_t$	$14,857	$6,126	$20,983
Consumption of Fixed Capital	$\delta_t P_t^k K_t$	$1,286	$297	$1,583
Net Operating Surplus	$P_t Y_t - W_t N_t - T_t^y - \delta_t P_t^k K_t$	$1,614	$1,697	$3,311
Gross Fixed Capital Formation	$P_t^k I_t$	$1,610	$354	$1,964
Net Fixed Capital Formation	$P_t^k (I_t - \delta_t K_t)$	$325	$56	$381

are based on simple regressions and therefore cannot establish causality between competition, governance and investment. In follow-up work [Gutiérrez and Philippon, 2016] we use a combination of instrumental variables and natural experiments to test the causality of our two main explanations, lack of competition and tight or short-termist governance.

The remainder of this paper is organized as follows. Section 1 presents five important facts about aggregate private fixed investment in recent years. Section 2 discusses the theories that may explain under-investment relative to Q and reviews the related literature. Section 3 describes the data used to test our eight hypotheses. Section 4 discusses the methodology and results of our analyses; and section 5 concludes.

1 Five Facts about US Non Financial Sector Investment

We present five important facts related to investment by the US non financial sector in recent years. We focus on the non financial sector for three main reasons. First, this sector is the main source of nonresidential investment. Second, we can roughly reconcile aggregate data from the Flow of Funds with industry-level investment data from the BEA (which includes residential and non residential investment, as well as investment in intellectual property). Last, we can use data on the market value of bonds and stocks for the non financial corporate sector to disentangle various theories of secular stagnation.

1.1 Fact 1: The Non financial Business Sector is Profitable but does not Invest

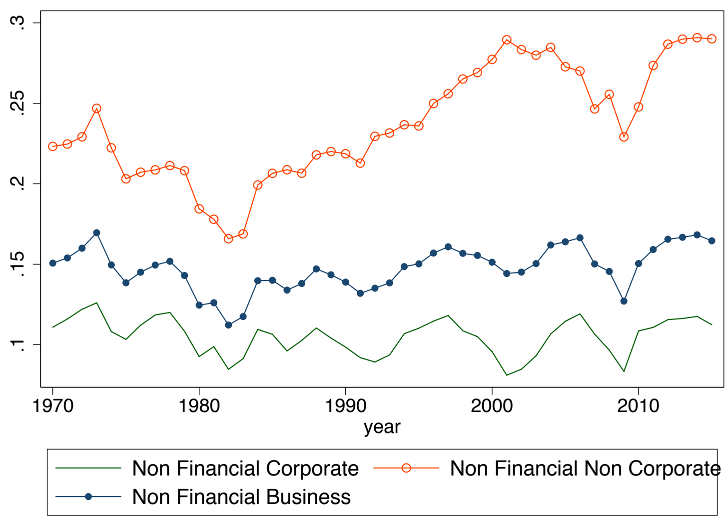
Table 1 summarizes some key facts about the balance sheet and current account of the non financial corporate, non financial non corporate and non financial business sectors.

One reason investment might be low is that profits might be low. This, however, is not the case. Figure 1 shows the operating return on capital of the non financial corporate, non financial non corporate and non financial business sector, defined as net operating surplus over the replacement cost of capital:

$$\text{Net Operating Return} = \frac{P_t Y_t - \delta_t P_t^k K_t - W_t N_t - T_t^y}{P_t^k K_t}$$

As shown, the operating return for corporates has been quite stable over time while the operating return of non corporates has increased substantially since 1990. For corporates, the yearly average from 1971 to 2014 is 10%, with a standard deviation of only one percentage point. The minimum is 8.1% and the maximum 12.6%. In 2014, the operating return was 11.3%, very close to the historical maximum. For non corporates, the yearly average from 1971 to 2014 is 24%, while the average since 2002 has been 27%. The maximum is 28.9%, equal to the operating return observed in 2012, 2013 and 2014. A striking feature is that the net operating margin was not severely affected by the Great Recession, and has been consistently near its highest value since 2010 for both Corporates and Non corporates.

Figure 1: Net Operating Return, by Sector



Note: Annual data, by Non financial Business sector.

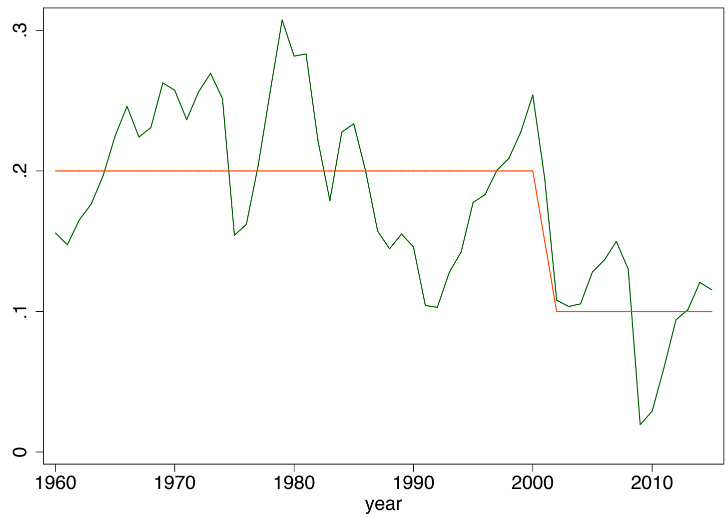
But firms do not invest the same fraction of their operating returns as they used to. Figure 2 shows the ratio of net investment to net operating surplus for the non financial business sector:

$$^{NI}/_{OS} = \frac{P_t^k \left(I_t - \delta_t K_t\right)}{P_t Y_t - \delta_t P_t^k K_t - W_t N_t - T_t^y}$$

The average of the ratio between 1959 and 2001 is 20%. The average of the ratio from 2002 to 2015 is only 10%.[3] Current investment is low relative to operating margins. Similar patterns are observed when separating corporates and non corporates.

[3]Note that 2002 is used for illustration purposes only. It was chosen based on graphically, not based on a formal statistical analysis.

Figure 2: Net Investment Relative to Net Operating Surplus



Note: Annual data for Non financial Businesses (Corporate and Non corporate).

1.2 Fact 2: Investment is low relative to Q

Of course, economic theory does not say that $^{NI}/_{OS}$ should be constant over time. Investment should depend on expected future operating surplus, on the capital stock, and the cost of funding new investment; it should rely on a comparison of expected returns on capital and funding costs. The Q-theory of investment captures this trade-off.

Consider a firm that chooses a sequence of investment to maximize its value. Let K_t be capital available for production at the beginning of period t and let μ_t be the profit margin of the firm. The basic theory assumes perfect competition so the firm takes μ as given. In equilibrium, μ depends on productivity and production costs (wages, etc.). The firm's program is then

$$V_t\left(K_t\right) = \max_{I_t} \mu_t P_t K_t - P_t^k I_t - \frac{\gamma}{2} P_t^k K_t \left(\frac{I_t}{K_t} - \delta_t\right)^2 + \mathbb{E}_t\left[\Lambda_{t+1} V_{t+1}\left(K_{t+1}\right)\right],$$

where P_t^k is the price of investment goods. Given our homogeneity assumptions, it is easy to see that the value function is homogeneous in K. We can then define $\mathcal{V}_t \equiv \frac{V_t}{K_t}$ which solves

$$\mathcal{V}_t = \max_{x} \mu_t P_t - P_t^k\left(x_t + \delta_t\right) - \frac{\gamma}{2} P_t^k x^2 + (1+x)\,\mathbb{E}_t\left[\Lambda_{t+1}\mathcal{V}_{t+1}\right],$$

where $x_t \equiv \frac{I_t}{K_t} - \delta_t$ is the net investment rate. The first order condition for the net investment rate is

$$x_t = \frac{1}{\gamma}\left(Q_t - 1\right), \tag{1}$$

where

$$Q_t \equiv \frac{\mathbb{E}_t\left[\Lambda_{t+1}\mathcal{V}_{t+1}\right]}{P_t^k} = \frac{\mathbb{E}_t\left[\Lambda_{t+1}V_{t+1}\right]}{P_t^k K_{t+1}}. \tag{2}$$

Q is the ex-dividend market value of the firm divided by the replacement cost of its capital stock and γ controls adjustment costs. To build our empirical measures, we define

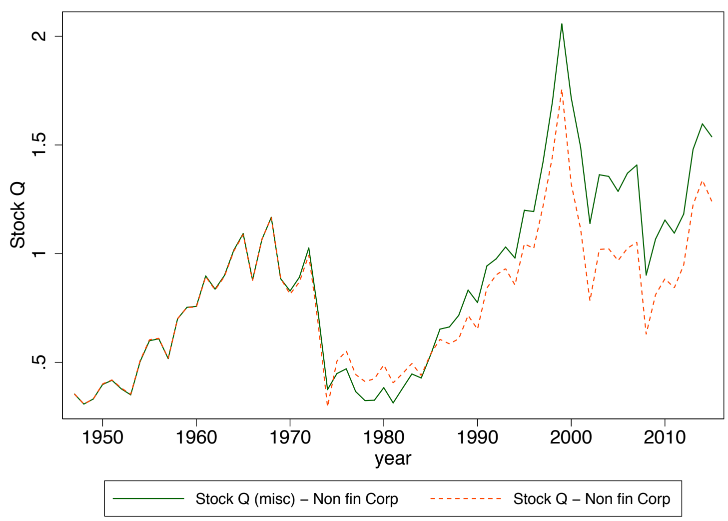
$$Q = \frac{V^e + (L - FA) - Inventories}{P_k K}$$

where V^e is the market value of equity, L are the liabilities (mostly measured at book values, but this is a rather small adjustment, see Hall [2001]), and FA are financial assets. Notice that the BEA measure of K now includes intangible assets (including software, R&D, and some intellectual property). As a result, our measure of Q is lower than in the previous literature. Because financial assets and liabilities contain large residuals, we also compute another measure of Q:

$$Q^{misc} = Q + \frac{A^{misc} - L^{misc}}{P_k K}$$

where A^{misc} and L^{misc} are the miscellaneous assets and liabilities recorded in the financial accounts. Since $A^{misc} > L^{misc}$, it follows that $Q^{misc} > Q$. It is unclear which measure is more appropriate. Figure 3 shows the evolution of Q for the non financial corporate sector. As shown, Q is high according to both measures, by historical standards.

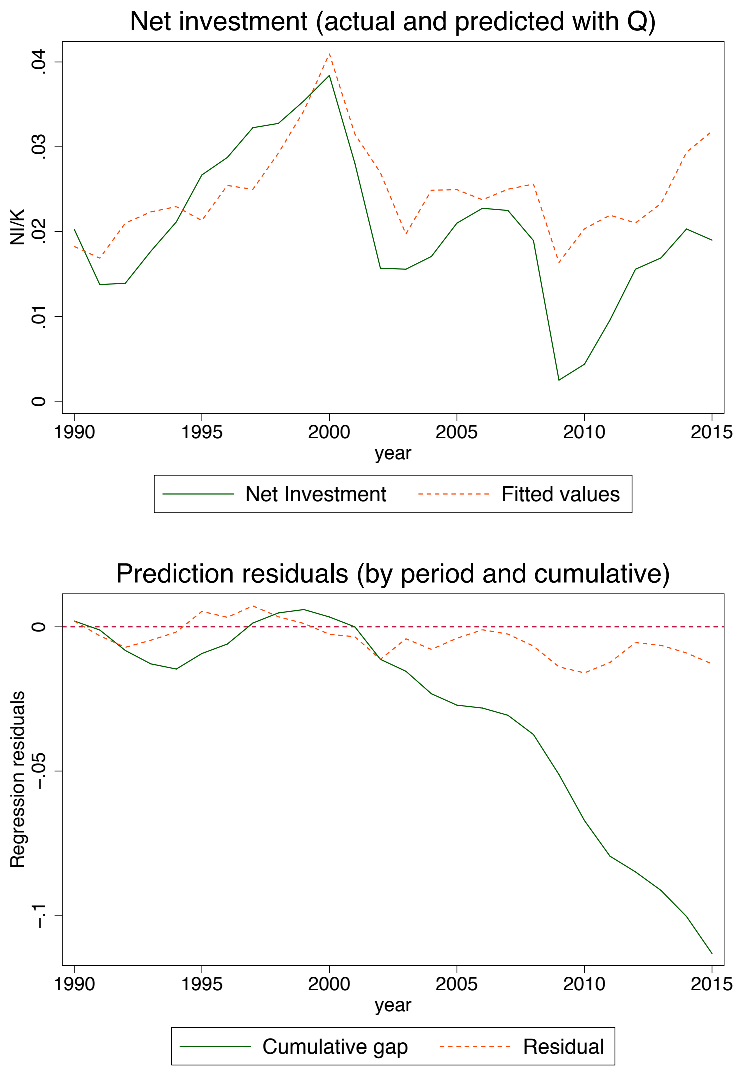
Figure 3: Two Measures of Q



Note: Annual data. Q for Non Financial Corporate sector (data for Non Corporate sector not available)

This leads us to our main conclusion: investment is low relative to Q. The top chart in Figure 4 shows the aggregate net investment rate for the non financial business sector along with the fitted

Figure 4: Net Investment vs. Q



Note: Annual data. Net investment for Non Financial Business sector.

value for a regression on (lagged) Q from 1990 to 2001. The bottom chart shows the regression residuals (for each period and cumulative) from 1990 to 2015. Both charts clearly show that investment has been low relative to Q since sometime in the early 2000's.[4] By 2015, the cumulative under-investment is more than 10% of capital.[5]

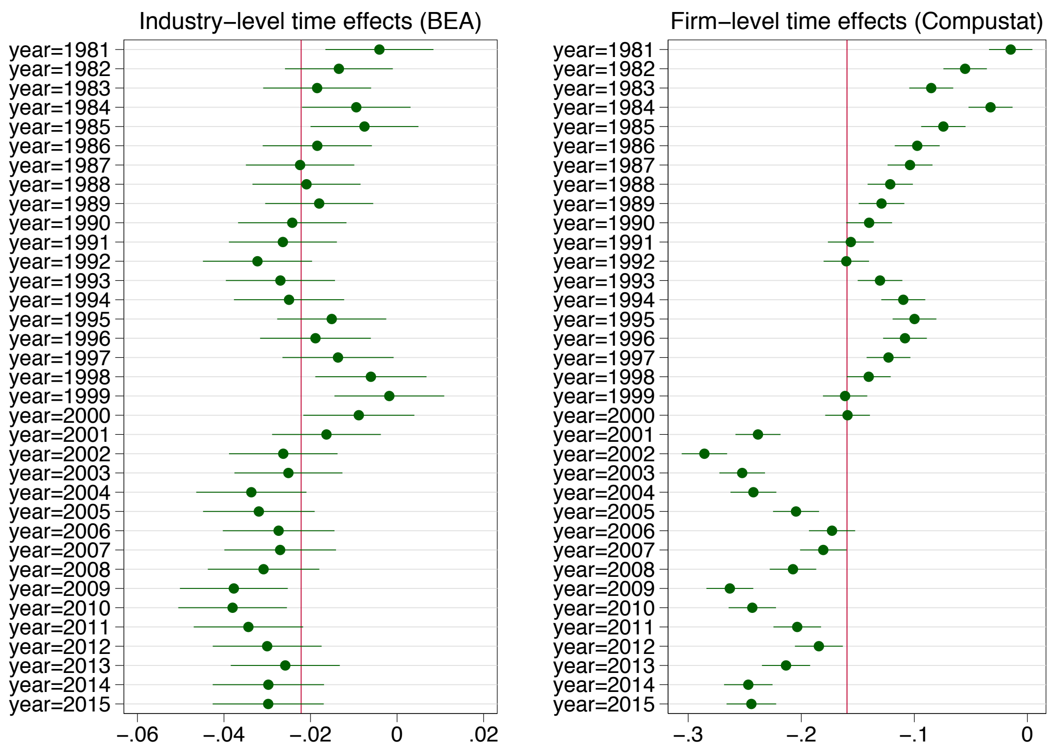
[4]By definition of OLS, the cumulative residual for 2002 is zero, but the underinvestment from then on is striking

[5]Note that we focus on the past 25 years because measures of Q based on equity are not always stable and therefore do not fit long time series. This is a well known fact that might be due to long run changes in technology and/or participation in equity markets that make it difficult to compare the 2000's with the 1960's. Even in shorter windows, van Binsbergen and Opp [2016] argue convincingly that asset pricing anomalies that affect Q can have material consequences for real investment – particularly for high Q firms. Q is therefore not a perfect benchmark, but it enables us to control for a wide range of factors and provides theoretical support for testing the remaining hypotheses.

The above regression focuses on aggregate investment. To study under-investment at a more granular level, we estimate panel regressions of industry- and firm-level investment on Q; and study the time effects. The details of the regression are discussed in Section 4.2.1. Figure 5 shows the results: time effects for the industry regression are shown on the left and for the firm regression on he right. The vertical line highlights the average time effect across all years for each regression[6]. As shown, the time-effects are substantially lower for both Industry- and Firm-level regressions from 2000 onward. In the industry regression, time effects were above average in most years from 1980 to 2000 but have been consistently below-average since. In the firm regression, time effects were fairly high in the 1980s and slightly high in the 1990s. They approach the average as early as 1999 and turn substantially negative thereafter. These results are robust to including additional measures of fundamentals such as cash flow; considering only a subset of industries; and even splitting tangible and intangible assets (see Figure 17). These results are consistent with those in Alexander and Eberly [2016], who consider firm-level gross investment, defined as the ratio of capital expenditures to assets. We conclude that investment has been low relative to Q since the early 2000's.

[6]Note that the time effects need not be zero, on average, given the impact of adjustment costs in Q theory and the inclusion of a constant in the regression.

Figure 5: Time effects from Industry and Firm-level regressions



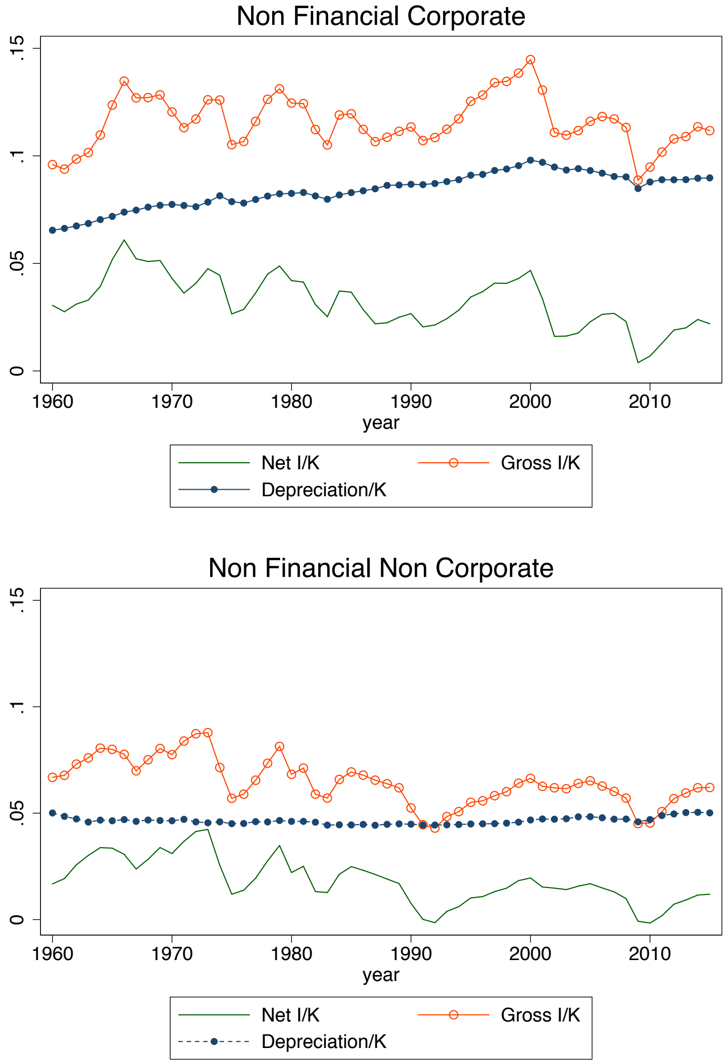
Note: Time fixed effects from industry- and firm-panel regressions of net investment on Q, with time as well as industry/firm fixed effects. Industry investment data from BEA; firm investment based on CAPX/Assets from Compustat.

1.3 Fact 3: Following a Secular Increase, Depreciation Has Remained Stable Since 2000

The decrease in net investment could be the result of changes in the depreciation rate. To test this, Figure 6 shows the gross investment rate, the net investment rate and the depreciation rate for the non financial corporate sector on the top, and the non financial non corporate sector on the bottom. Note that these series include residential structures, but their contribution is relatively small for non financial businesses. The gross investment rate is defined as the ratio of 'Gross fixed capital formation with equity REITs' to lagged capital. Depreciation rates are defined as the ratio of 'consumption of fixed capital, equipment, software, and structures, including equity REIT' to lagged capital; and net investment rates as the gross investment rate minus the depreciation rate.

In the non corporate sector, depreciation is stable and net investment follows gross investment. The evolution is more complex in the corporate sector. There was a secular increase in depreciation from 1960 until 2000, driven primarily by a shift in the composition of corporate investment (from structures and equipment to intangibles). As a result, the trend in net investment is significantly lower than the trend in gross investment from 1960 to 2000. Since 2000, however, the share of

Figure 6: Investment and Depreciation Rate for Non financial Business Sector



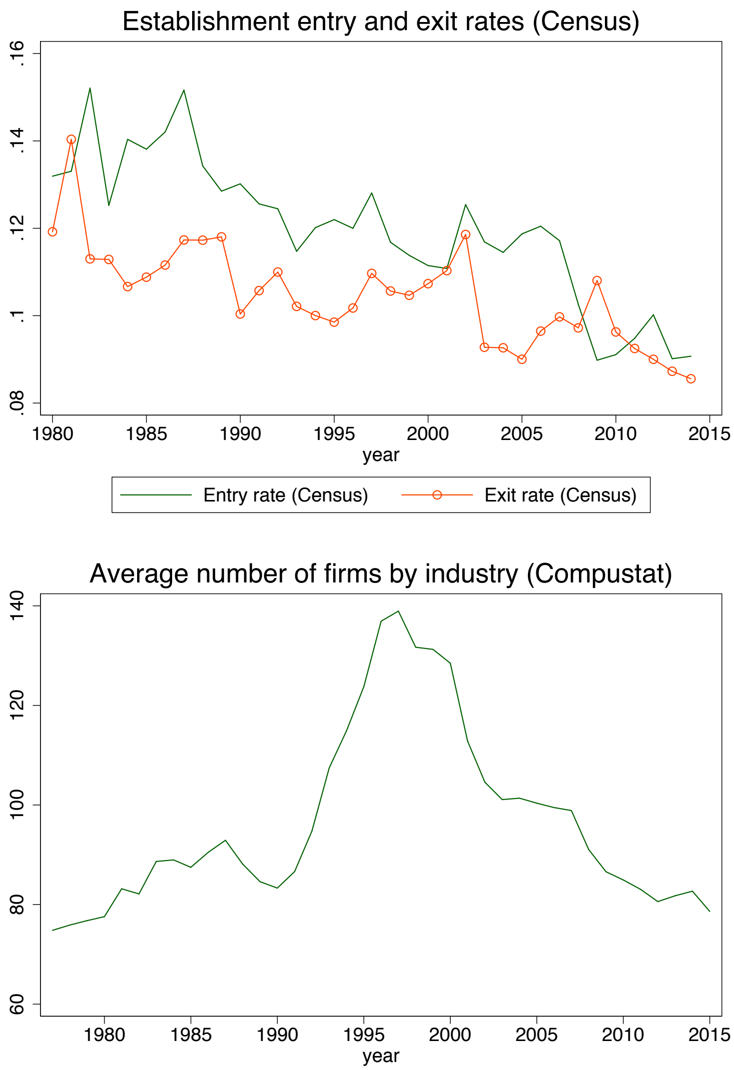
Note: Annual data. Non financial corporate sector on the top, non financial non corporate sector on the bottom.

intangible assets has remained flat such that depreciation has been more stable, and, if anything, it has decreased. The drop in net investment over the past 15 years is therefore due to a drop in gross investment, not a rise in depreciation. Because the corporate sector contributes the lion share of investment, the aggregate figure for the combined non-financial sector resembles the top panel (see Table 1).

1.4 Fact 4: Firm Entry has Decreased

Figure 7 shows two measures of firm entry: the establishment entry and exit rates as reported by the U.S. Census Bureau's Business Dynamics Statistics (BDS); and the average number of firms by industry in Compustat. In the early 1990s, we see a large increase in firms in Compustat, driven primarily by firms going public. Since then, both charts provide strong evidence of a decline in the number of firms. This downward trend in business dynamism has been highlighted by numerous papers (e.g., Decker et al. [2014]) but the trend has been particularly severe in recent years. In fact, Decker et al. [2015] argue that, whereas in the 1980s and 1990s declining dynamism was observed in selected sectors (notably retail), the decline was observed across all sectors in the 2000s, including the traditionally high-growth information technology sector.

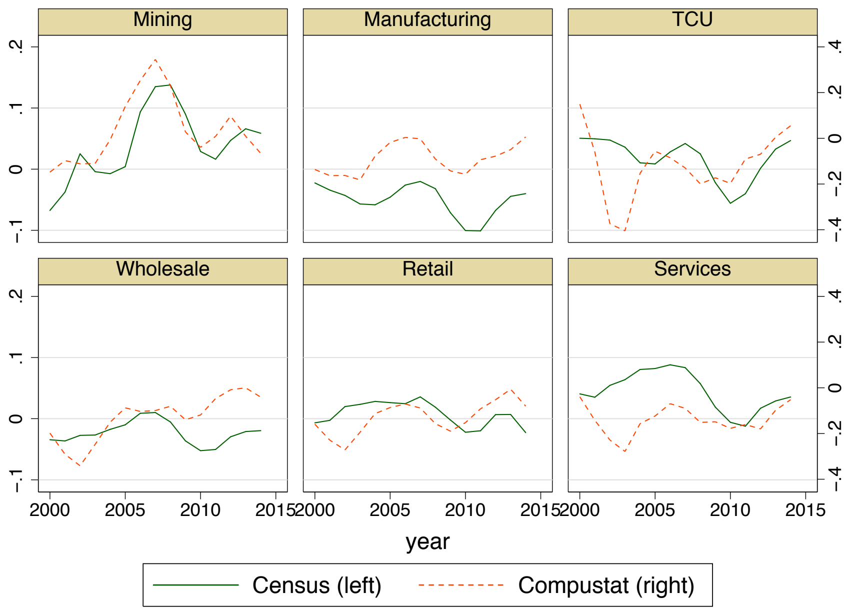
Figure 7: Firm entry, exit and number of firms



Note: Annual data.

The Compustat and Census patterns above appear quite different. However, focusing on the post-2000 period (the main period of interest) and the sectors for which Compustat provides good coverage, we find significant similarities. Figure 8 shows the 3-year log change in the number of firms based on Compustat and the number of establishments based on Census BDS data (excluding agriculture and construction for which Compustat provides limited coverage). As shown, changes in the number of firms are roughly similar across all sectors, including manufacturing, mining and retail which are the main contributors of investment.

Figure 8: Comparison of 3-Year log change in # of establishments (Census) and firms (Compustat), by SIC sector



Note: Annual data. Agriculture and construction omitted because Compustat provides limited coverage for these sectors

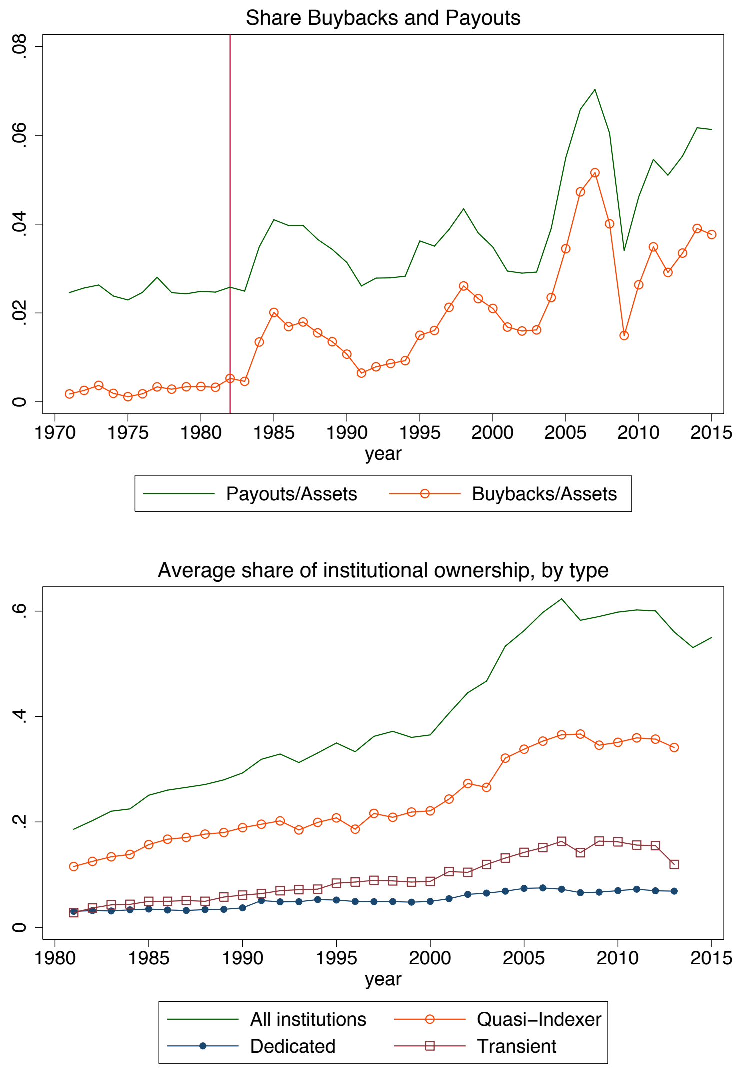
1.5 Fact 5: Institutional Ownership and Payouts Have Increased

The top graph of Figure 9 shows the total buybacks and payouts for all US-incorporated firms in Compustat. As shown, there has been a substantial increase in total payouts, primarily driven by an increase in share buybacks. The increase starts soon after 1982, when SEC Rule 10b-18 was instituted (noted by the vertical line). Rule 10b-18 allows companies to repurchase their shares on the open market without regulatory limits.

The bottom graph shows the average share of institutional ownership, by type. Again, we see a substantial increase in institutional ownership – particularly since 2000. The increase is primarily driven by growth in transient and quasi-indexer institutions. This is not shown in the figure, but the increase is particularly pronounced for smaller firms: since 2000, the dollar-weighted share of quasi-indexer institutional ownership increased from ~30% to ~45%, while the median share increased from ~15% to ~50%. That is, while the dollar-weighted quasi-indexer ownership increased by about 50%, it more than doubled for the median firm.

These two effects are remarkable, and closely match the timing of decreasing investments at the aggregate level.

Figure 9: Payouts and Institutional ownership



Notes: Annual data for all US incorporated firms in Compustat. Results are similar when including foreign-incorporated firms. The vertical line in the first graph highlights the passing of SEC rule 10b-18, which allows companies to repurchase their shares on the open market without regulatory limits.

2 What might explain the under-investment?

The basic Q-equation (1) says that Q should be a sufficient statistic for investment, while equation (2) equates Q with the average market to book value. This theory is based on the following assumptions [Hayashi, 1982]:

- no financial constraints;
- shareholder value maximization;
- constant returns to scale and perfect competition;

Low investment despite high levels of Q might be explained by a variety of theories – we consider the following eight (grouped into four broad categories)[7]:

- **Financial frictions**

  1. **External finance constraints**: A large literature has argued that frictions in financial markets can constrain investment decisions and force firms to rely on internal funds. See Fazzari et al. [1987], Gomes [2001], Moyen [2004], and Hennessy and Whited [2007].[8] Similarly, Rajan and Zingales [1998] show that industrial sectors that are relatively more in need of external financing develop disproportionately faster in countries with more developed financial markets. Thus, if certain sectors depend on external finance to invest and are unable to obtain the required funds, they may under-invest relative to Q.
  2. **Bank dependence**: Financial constraints may differ between bank-dependent firms and firms with access to the capital markets. As a result, we also test whether bank dependent firms are responsible for the under-investment (see, for instance, Alfaro et al. [2015]). This hypothesis is supported by recent papers such as Chen et al. [2016], which shows that reductions in small business lending has affected investment by smaller firms.[9]
  3. **Safe asset scarcity:** Safe asset scarcity and/or changes in the composition of assets may affect corporations' capital costs (see Caballero and Farhi [2014], for example). In their simple form, such variations would impact Q. They would not cause a gap between Q and investment. However, a gap may appear if safe firms are unable or unwilling to

[7] We also considered changes in R&D expenses as a proxy for lack of ideas (i.e., differences between *average and marginal* Q). Firms increasing R&D expenses are likely to have better ideas and therefore a higher marginal Q. So we test whether under-investing industries (and firms) exhibit a parallel decrease in R&D expense. We do not find support for this hypothesis, but this is inconclusive: under some theories, a rise in R&D may actually imply lower marginal Q (e.g., if ideas are harder to identify). We were unable to find a better measure for (lack of) ideas, so we cannot rule out this hypothesis.

[8] There is considerable controversy about the implications of financial frictions, of course, but this does not matter for our analysis because we are not interested in estimating elasticities. While financial frictions make internal funds relevant, it is not at all clear that they increase the sensitivity of investment to cash flows. [Kaplan and Zingales, 1997] and Gomes [2001] show that financial frictions might not decrease the fit of the Q equation much.

[9] We should say from the outset that our ability to test this hypothesis is rather limited. Our industry data includes all firms, but investment is skewed and tends to be dominated by relatively large firms. Our firm-level data does not cover small firms.

take full advantage of low funding cost (due to, for example, product market rents). See section 4.2.5 for additional discussion and results relevant to this hypothesis.

- **Measurement Error**

    4. **Intangibles:** The rise of intangibles may affect investment in several ways: first, intangible investment is difficult to measure and is therefore prone to measurement error. Under-estimation of I would lead to under-estimation of K, and therefore over-estimation of Q; and would translate to an 'observed' under-investment at industries with a higher share of intangibles. Alternatively, intangible assets might be more difficult to accumulate. A rise in the relative importance of intangibles could then lead to a higher equilibrium value of Q even if intangibles are correctly measured.[10]

    5. **Globalization**: official GDP statistics on private investment aim to capture investment that occurs physically in the US, regardless of where the firm making the investment is incorporated. For example, the investment series would include a manufacturing plant in Michigan built by a German company and exclude investment in China by a US Retail company. Thus, we may observe lower US private investment if US firms with foreign activities are investing more abroad, or foreign firms are investing less in the US. This would be pure measurement error: consolidated investment at the firm-level would still follow Q, but would not be included in US Financial Accounts.

- **Competition**

    6. **Regulations & uncertainty:** Regulation and regulatory uncertainty may affect investment in two ways. First, increased regulation may stifle competition by raising barriers to entry. Second, per the theory of investment under uncertainty, irreversible investment in an industry may decline if economic agents are uncertain about future payoffs (see, for example, Bernanke [1983]). Thus, increased regulation and the associated regulatory uncertainty may restrain investment.[11]

    7. **Concentration:** A large literature has studied the link between competition, investment, and innovation (see Aghion et al. [2014] for a discussion). From a theoretical perspective, we know that the relationship is non-monotonic because of a trade-off between average and marginal profits. For a large set of parameters, however, we can

[10] Intangibles can also interact with information technology and competition. For instance, Amazon does not need to open new stores to serve new customers; it simply needs to expand its distribution network. This may lead to a lower equilibrium level of tangible capital (e.g., structures and equipment), thus a lower investment level on tangible assets. But this would still be consistent with Q theory since the Q of incumbent would fall. On the other hand, Amazon should increase its investments in intangible assets. Whether the Q of Amazon remains large then depends mostly on competition. Finally, intangible assets can be used as a barrier to entry. For all these reasons, we think that it is important to consider intangible investment together with competition.

[11] Increases in firm-specific uncertainty may also lead to lower investment levels due to manager risk-aversion Panousi and Papanikolauo [2012] and/or irreversible investment [Pindyck, 1988, Dixit and Pindyck, 1994]. We test this hypothesis using stock market return and sales volatility and find some, albeit limited support for this hypothesis.

expect competition to increase innovation and investment. Firms in concentrated industries, aging industries and/or incumbents that do not face the threat of entry might have weak incentives to invest.[12] This hypothesis is supported by a growing literature that argues that competition may be decreasing in several economic sectors (see for example CEA [2016], Decker et al. [2015], Mongey [2016]). Similarly, Jovanovic and Rousseau [2014] highlights differences in the sensitivity of investment to Q between incumbents and new entrants. Blonigen and Pierce [2016] studies the impact of mergers and acquisitions (M&As) on productivity and market power, and finds that M&As are associated with increases in average markups. Given the rise in M&A over the past decades, this suggests a potential rise in market power.

- **Governance**

8. **Firm Ownership:** ownership can affect management incentives through governance and investment horizon. Regarding short-termism, some have argued that equity markets can put excessive emphasis on quarterly earnings, and that higher stock-based compensation incentivizes managers to focus on short term share prices rather than long term profits (see Martin [2015], Lazonick [2014], for example). Given the rise of institutional ownership, an increase in market-induced short-termism may lead firms to cut their long term investment expenditures.

   On the other hand, ownership may improve governance. A large literature following Jensen [1986] argues that conflicts of interest between managers and shareholders can lead firms to invest in ways that do not maximize shareholder value. [13] Harford et al. [2008] and Richardson [2006] find evidence that poor governance associates with greater industry-adjusted investment. Thus, improvements in governance driven by changes in ownership may lead to lower investment levels.

   Several recent papers study the implications of shareholder activism and institutional ownership on governance and payouts. Appel et al. [2016a] find that passive owners influence firms' governance choices (they lead to more independent directors, lower takeover defenses, and more equal voting rights; as well as more votes against management).[14] Appel et al. [2016b] find that larger ownership stakes of passive institutional investors make firms more susceptible to activist investors (increasing the ambitiousness of activist objectives as well as the rate of success); and Crane et al. [2016] show that higher (total and quasi-indexer) institutional ownership causes firms to increase their payouts.

   Together, this growing literature suggests that increases in passive institutional ownership

[12] We do not take a stand on the drivers of increased concentration; simply that it appears in the data.

[13] This does not necessarily imply that managers invest too much; they might invest in the wrong projects instead. The general view, however, is that managers are reluctant to return cash to shareholders, and that they might over-invest.

[14] Schmidt and Fahlenbrach [2016] find opposite effects for some governance measures (including the likelihood of CEO becoming chairman and appointment of new independent directors), though they focus on a smaller sample. They also find that higher passive ownership leads to more value-destructing M&A.

lead to tighter governance. However, it is unclear whether the increased susceptibility to activist investors and higher payouts are in fact evidence of tighter governance or increased short-termism. Some papers provide qualitative support for governance (e.g., Crane et al. [2016] refer to Chang et al. [2014] which argues that increasing passive institutional ownership leads to share price increases), but it is inconclusive. And other studies such as Asker et al. [2014] show that public firms invest substantially less and are less responsive to changes in investment opportunities than private firms.

In the end, although these two hypotheses impact investment through very different mechanisms,[15] differentiating between them is quite challenging. Improvements in governance reduce managerial entrenchment and require managers to continuously demonstrate strong performance, just as increased short-termism would. We are therefore unable to differentiate between these two hypotheses. We simply test whether increases in (passive) institutional ownership lead to higher payouts and lower investment.

3 Data

Testing the above theories requires the use of micro data. We gather and analyze a wide range of aggregate-, industry- and firm-level data. The data fields and data sources are summarized in Table 2. Sections 3.1 and 3.2 discuss the aggregate and industry datasets, respectively. Section 3.3 discusses the firm-level investment and Q datasets; and 3.4 discusses all other data sources, including the explanatory variables used to test each theory. We discuss data reconciliation and data validation results where appropriate.

3.1 Aggregate data

Aggregate data on funding costs, profitability, investment and market value for the US Economy and the non financial sector is gathered from the US Flow of Funds accounts through FRED. These data are used in the aggregate analyses discussed in Section 1; in the construction of aggregate Q; and to reconcile and ensure the accuracy of more granular data. In addition, data on aggregate firm entry and exit is gathered from the Census BDS; and used in the aggregate regressions reported in Section 4.

3.2 Industry investment data

3.2.1 Dataset

Industry-level investment and profitability data – including measures of private fixed assets (current-cost and chained values for the net stock of capital, depreciation and investment) and value added

[15] Improved governance aligns the (manager's) maximization problem with that of the shareholder's, thereby increasing the focus on long term value. Increased short-termism shifts the objective function of the maximization towards short-term value.

Table 2: Data sources

	Data fields	Source	Granularity
Primary datasets	Aggregate investment and Q	Flow of Funds	US
	Industry-level investment and operating surplus	BEA	~NAICS L3
	Firm-level financials	Compustat	Firm
Additional datasets	Sales and Market Value Concentration	Census	NAICS L3
	Entry/Exit; firm demographics	Census	SIC L2
	Occupational Licensing	PDII Survey	NAICS L3
	Regulation index	Mercatus	NAICS L3
	Industry-level spreads	Egon Zakrajsek	NAICS L3
	Institutional ownership	Thomson Reuters 13F	Firm
	Bushee's institutional investor classification	Brian Bushee's website	Institutional Investor

(gross operating surplus, compensation and taxes) – are gathered from the Bureau of Economic Analysis (BEA).

Fixed assets data is available in three categories: structures, equipment and intellectual property (which includes includes software, R&D and expenditures for entertainment, literary, and artistic originals, among others). This breakdown allows us to (i) study investment patterns for intellectual property separate from the more 'traditional' definitions of K (structures and equipment); and (ii) better capture total investment in aggregate regressions, as opposed to only capital expenditures.

Investment and profitability data are available at the sector (15 groups) and detailed industry (63 groups) level, in a similar categorization as the 2007 NAICS Level 3. We start with the 63 detailed industries and group them into 39 industry groupings that contribute a material share of investment (see Appendix I: Industry Investment Data for details on the investment dataset). We exclude Financials and Real Estate; and also exclude Utilities given the influence of government actions in their investment and their unique experience after the crisis (e.g., they exhibit decreasing operating surplus since 2000). This leaves 36 industry groupings for our analyses, whose total net investment since 2000 is summarized in Table 14 in the appendix. All other datasets are mapped into these 36 industry groupings using the NAICS Level 3 mapping provided by the BEA.

We define industry-level gross investment rates as the ratio of 'Investment in Private Fixed Assets' to lagged 'Current-Cost Net Stock of Private Fixed Assets'; depreciation rates as the ratio of 'Current-Cost Depreciation of Private Fixed Assets' to lagged 'Current-Cost Net Stock of Private Fixed Assets'; and net investment rates as the gross investment rate minus the depreciation rate. Investment rates are computed across all asset types, as well as separating intellectual property from structures and equipment.

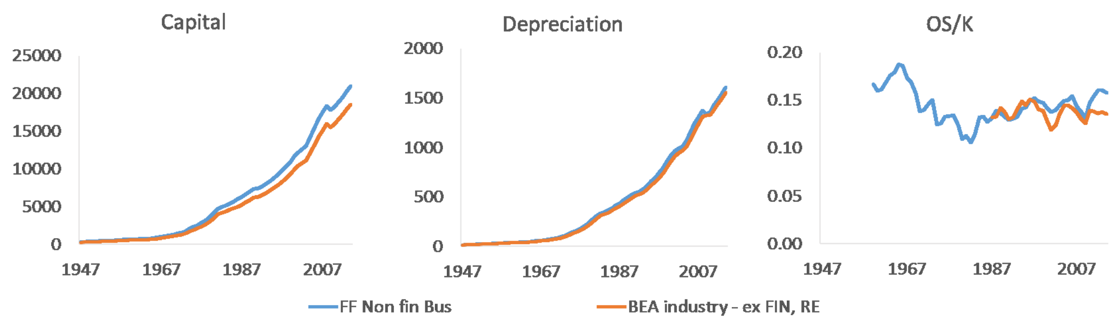
The Gross Operating Surplus is provided by the BEA, while the Net Operating Surplus is computed as the 'Gross Operating Surplus' minus 'Current-Cost Depreciation of Private Fixed

Assets'. OS/K is defined as the 'Net Operating Surplus' over the lagged 'Current-Cost Net Stock of Private Fixed Assets'.

3.2.2 Data validation

In order to ensure industry-level figures are consistent with aggregate data, we reconcile the two datasets. We first note that industry-level figures include all forms of organization (financials and non financials, as well as corporates, non corporates and non businesses). A breakdown between financials and non financials or corporates and non corporates by industry is not available. Thus, a full reconciliation can only be achieved at the aggregate level or considering pre-aggregated BEA series (such as non financial corporates). But these do not provide an industry breakdown. Instead, we note that aggregating capital, depreciation and operating surplus across all industries except Financials and Real Estate yields very similar series as the aggregated non financial business series sourced from the Flow of Funds (see Figure 10). The remaining differences appear to be explained by non-businesses (households and non profit organizations) but cannot be reconciled due to data availability. Regardless, the trends are sufficiently similar to suggest that conclusions based on industry data will be consistent with the aggregate-level under-investment discussed in Section 1.

Figure 10: Reconciliation of Flow of Funds and BEA industry datasets



Notes: Flow of Funds data for non financial business sector; BEA data for all industries except Finance and Real Estate. Remaining differences – particularly for OS/K – appear to be driven by non-businesses (households and non profit), which are included in the BEA series but not in the Flow of Funds series.

3.3 Firm-level investment and Q data

3.3.1 Dataset

Firm-level data is primarily sourced from Compustat, which includes all public firms in the US. Data is available from 1950 through 2016, but coverage is fairly thin until the 1970s. We exclude firm-year observations with assets under \$1 million; with negative book or market value; or with missing year, assets, Q, or book liabilities.[16] In order to more closely mirror the aggregate and industry figures, we exclude utilities (SIC codes 4900 through 4999), real estate (SIC codes 5300

[16] These exclusion rules are applied for all measures except firm age, which starts on the first year in which the firm appears in Compustat irrespective of data coverage

through 5399) and financial firms (SIC codes 6000 through 6999); and focus on US incorporated firms (see Section 3.3.2 for additional discussion).

Firms are mapped to BEA industry segments using 'Level 3' NAICS codes, as defined by the BEA. When NAICS codes are not available, firms are mapped to the most common NAICS category among those firms that share the same SIC code and have NAICS codes available. Firms with an 'other' SIC code (SIC codes 9000 to 9999) are excluded from industry-level analyses because they cannot be mapped to an industry.

Firm-level data is used for two purposes: first, we aggregate firm-level data into industry-level metrics and use the aggregated quantities to explain industry-level investment behavior (e.g., by computing industry-level Q). We consider the aggregate (i.e., weighted average), the mean and the median for all quantities, and use the specification that exhibits the highest statistical significance. Second, we use firm-level data to analyze the determinants of firm-level investment through panel regressions (see Section 4 for additional details).

3.3.2 Data validation

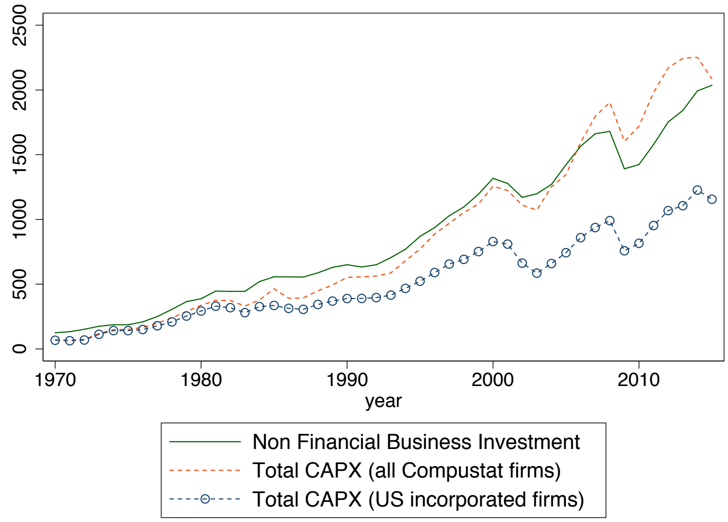
The sample of Compustat firms that we study represents a wide cross-section of firms in the US. Still, this set of firms may not be representative of aggregate and industry-level investment figures.

For instance, Compustat captures investment by US public firms, while official GDP statistics capture all investment that occurs physically in the US irrespective of the listing status or country of the firm making the investment. To address this issue, Figure 11 plots the gross fixed capital formation for non financial businesses (from the Flow of Funds) versus total capital expenditures (CAPX) for two sets of Compustat firms: all firms in Compustat, irrespective of country of incorporation, and all domestically incorporated firms. Simply summing up CAPX for all firms results in a series that roughly tracks, and sometimes exceeds, the official Flow of Funds estimates. However, this Compustat series exhibits a much stronger recovery after the Dotcom bubble and the Great Recession than the official estimates: total CAPX accounts for 85% of investment from 1980 to 2000, on average; but 117% from 2008 to 2015. Focusing on US incorporated firms largely resolves the differences: the new series accounts for 63% of investment from 1980 to 2000 and 59% from 2008 to 2015, on average. These results suggest that Foreign-incorporated firms are investing more than US-incorporated firms, but this investment is occurring outside the US.

In order to more closely mirror US aggregate figures, we restrict our sample to US incorporated firms for the remainder of our analyses. None of the qualitative conclusions in this paper are sensitive to the inclusion of all firms irrespective of country of incorporation.

We are interested in using Compustat firm-level data to reach conclusions about industry-level investment. Thus, we need to understand whether Compustat firms in a given industry provide a good representation of the industry as a whole. We define the following two measures of 'coverage': the ratio of Compustat total CAPX to BEA Investment by industry, and the ratio of Compustat total PP&E to BEA Capital. Table 14 in the Appendix shows the coverage for the 36 industries under consideration. As shown, our Compustat sample provides good coverage for the majority of

Figure 11: Comparison of Flow of Funds and Compustat CAPX ($B)



Note: Annual data. Note that all Compustat figures are before the application of our exclusion criteria (e.g., excluding Financials). The qualitative conclusions remain the same after applying our exclusion criteria.

material industries. In particular, Compustat provides at least 10% coverage across both metrics for 22 industries, which account for 54% of total net investment from 2000 to 2015. The most material sectors for which Compustat does not provide good coverage are Health Care, Professional Services and Wholesale Trade. Low coverage levels increase the noise in Compustat estimates, but are not expected to bias the results. We therefore include all industries in our analyses, and confirm that qualitative results remain stable when including only industries with >10% coverage across both metrics.

3.3.3 Investment definition

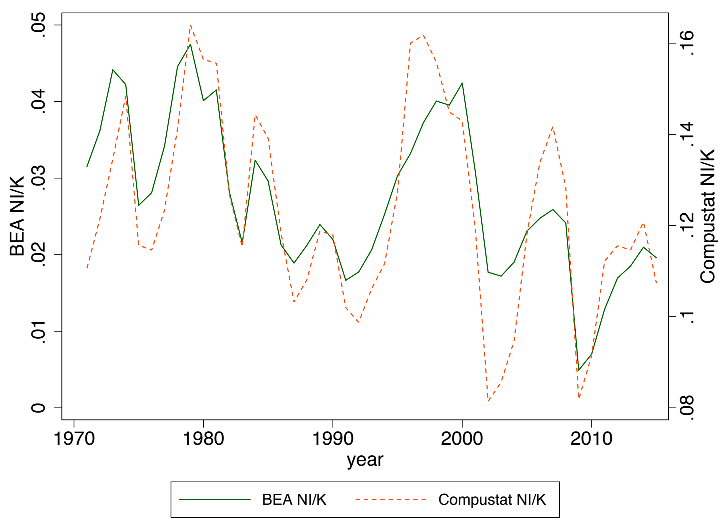
We consider two investment definitions. First, the 'traditional' gross investment rate is defined as in Rajan and Zingales [1998] – specifically, as capital expenditures (Compustat item CAPX) at time t scaled by net Property, Plant and Equipment (item PPENT) at time $t-1$. Net investment rate is calculated by imputing the industry-level depreciation rate from BEA figures. In particular, note that the depreciation figures available in Compustat include only the portion of depreciation that affects the income statement, and therefore exclude depreciation included as part of Cost of Goods Sold. For consistency, and because we are interested in aggregate quantities, we assume all firms in a given industry have the same depreciation rate, and compute the net investment rate as the gross investment rate minus the BEA-implied depreciation rate for structures and equipment within each industry. Second, we estimate investment in intangibles as the ratio of R&D expenses to assets (Compustat XRD / AT)[17]. We consider only the gross investment rate (i.e., do not subtract

[17] XRD set to zero if missing

depreciation) since a good proxy for depreciation for R&D is not available.[18]

The resulting firm-level net investment figures closely mirror the BEA official estimates. Figure 11 shows the BEA official net investment rate along with the aggregate net investment rate for our Compustat sample (adjusted to mirror the BEA industry mix). The Compustat series is higher because of the differences in definitions (e.g., PP&E covers only a portion of capital; the BEA includes all firms while Compustat includes only public firms), but the trends are very similar from each other.

Figure 12: Comparison of Compustat and BEA net investment rates



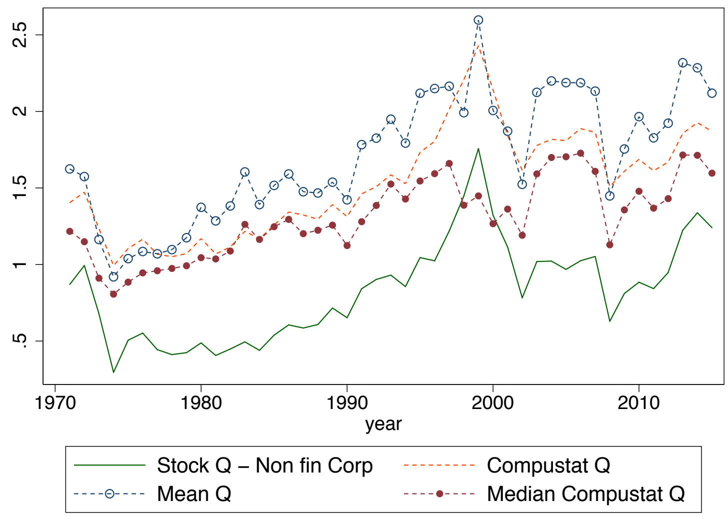
Note: Annual data. BEA and Compustat NI/K for selected sample.

3.3.4 Q definition

Firm-level stock Q is defined as the book value of total assets (AT) plus the market value of equity (ME) minus the book value of equity (computed as AT - LT - PSTK) scaled by the book value of total assets (AT). The market value of equity (ME) is defined as the total number of common shares outstanding (item CSHO) times the closing stock price at the end of the fiscal year (item PRCC_F). Figure 13 shows the aggregate, mean and median Q across all firms in our Compustat sample, along with the measure of Q constructed for non financial corporates using Flow of Funds data. As shown, the aggregate and mean Q from Compustat closely mirror the Flow of Funds series. The median Q is substantially lower in the early 2000s, because the corresponding increase in average Q was driven by a few firms concentrated in particular industries.

[18] In order to ensure robustness, we also test three alternate definitions: (i) capital expenditures plus R&D expense over total assets (Compustat (CAPX + XRD) / AT); (ii) a broader definition of investment constructed from the statement of cash flows (capital expenditures plus increase in investments minus sale of investments over the sum of PP&E, Investment and Advances (equity) and Investment and Advances (other) (Compustat (CAPX + IVCH - SIV)/(PPE+IVAEQ+IVAO); and (iii) investment over market value, in which case Q is omitted from the regression equations. Definitions (i) and (ii) aim to capture a broader set of long term investment activities than just capital expenditures. We use the total BEA-implied depreciation rate to compute net investment under all three alternate definitions. All qualitative conclusions are robust to using either of these broader definitions of investment.

Figure 13: Comparison of Compustat and Flow of Funds Q



Note: Annual data. Flow of Funds Q for Non Financial Corporate sector due to data availability. Compustat Q for selected sample.

3.4 Explanatory Variables

Last, a wide range of additional variables are gathered and/or computed to test our eight theories of under-investment.

3.4.1 Financial Frictions

External finance constraints. For external finance constraints, we are interested in the amount of investment that cannot be financed through internal sources, i.e., the cash flow generated by the business. We follow Rajan and Zingales [1998] and define a firm's dependence on external finance as the ratio of capital expenditures (item CAPX) minus cash flow from operations divided by capital expenditures. Cash flow from operations is defined as the sum of Compustat cash flow from operations (item FOPT) plus decreases in inventories (item INVCH), decreases in receivables (item RECCH), and increases in payables (item APALCH).[19] The dependence on external equity finance is defined as the ratio of the net amount of equity issues (item SSTK minus item PRSTKC) to capital expenditures; and the dependence on external debt finance as the ratio of the net amount of debt issues (item DLTIS minus item DLTR) to capital expenditures.[20] We use these metrics to test whether firms or industries with high dependence on external finance are under-investing.

Bank dependence. Since financial constraints may differ between bank-dependent firms and firms with access to capital markets, we follow Kashyap et al. [1994] (and others) and define a borrower as bank-dependent if it does not have a long-term issuer rating from S&P. Again, we

[19]This definition is used for cash flow statements with format codes 1, 2, or 3. For format code 7 we use the sum of the following items: ibc, dpc, txdc, esubc, sppiv and fopo

[20]Note that debt finance dependence is not computed by Rajan and Zingales

test whether bank-dependent firms or industries are under-investing. As explained earlier, however, one should bear in mind that one would need to over-sample small firms in order to test the bank dependence hypothesis.

Safe asset scarcity. For safe asset scarcity, we gather firm-level S&P corporate bond ratings (available in the CRSP-Compustat Merged database) and industry-level corporate bond spreads. The former is used for firm-level analyses, and aggregated to the industry level based on the share of firms rated AA to AAA. The latter was kindly provided by Egon Zakrajsek, and measures the simple average corporate bond spread across all bonds in a given NAICS Level 3 code. This dataset was used in Gilchrist and Zakrajsek [2011]. Not all industries are covered by the bond spread dataset.

3.4.2 Measurement Error

Intangibles. For Intangibles, we compute two types of metrics. First, we compute the investment rate for tangible and intangible assets separately (as described above) and use these to (i) test for under-investment in intangible assets and (ii) test whether the hypotheses supported for total investment also hold for intangible assets. Second, we compute the ratio of intangibles excluding goodwill to assets (Compustat (INTAN-GDWL)/AT); and use this ratio to test for measurement error in intangibles. See Section 4.2.6 for additional details. Goodwill is excluded because it primarily measures M&A activity, not formation of intangible capital.[21]

Globalization. For Globalization, we use Compustat item PRETAX INCOME - FOREIGN to identify industries and firms with substantial foreign activities. This field contains the income of a company's foreign operations before taxes. It is reported only by some firms[22], yet there are no other indicators of the extent of a firm's foreign operations available in Compustat (Foley et al. [2007]). For industry-level analyses, we compute the industry share of foreign income as the ratio of total PRETAX INCOME - FOREIGN to total PRETAX INCOME (i.e., across all firms in a given industry and year). For firm-level analyses, we consider three transformations of foreign activities given the potential for missing data: one omitting all firms with missing PRETAX INCOME - FOREIGN; one setting missing PRETAX INCOME - FOREIGN equal to zero, and one with an indicator for populated PRETAX INCOME - FOREIGN. We use these measures to test whether industries with substantial foreign activities are over-investing relative to Q.

3.4.3 Competition

Regulation and Uncertainty For regulation and uncertainty, we consider two measures.

As a measure of the amount and change in regulations affecting a particular industry, we gather the Regulation index published by the Mercatus Center at George Mason University. The index

[21] We also tested the ratio of intangibles to assets, but excluding goodwill is more appropriate and exhibits a stronger link to investment

[22] Security and Exchange Commission regulations stipulate that firms should report foreign activities separately in each year that foreign assets, revenues or income exceed 10% of total activities

relies on text analysis to count the number of relevant restrictions for each NAICS Level 3 industry from 1970 to 2014. Note that most, but not all industries are covered by the index. See Al-Ubaydli and McLaughlin [2015] for additional details. Second, as a proxy for barriers to entry, we gather the share of workers requiring Occupational Licensing in each NAICS Level 3 industry from the 2008 PDII.[23]

Concentration and demographics. For concentration and firm demographics we use two different sources: Compustat and the US Census Bureau.

From Compustat, we compute (i) the log-change in the number of firms in a given industry as a measure of entry and exit; (ii) sales and market value Herfindahls and (iii) the share of sales and market value held by the top 4, 8 and 20 firms in each industry as measures of concentration; and the (iv) age (from entrance into Compustat) and (v) size (log of total assets) as measures of firm demographics. We use Compustat item SALE for measures of sales concentration and market value as defined in the computation of Q above for measures of market value concentration.

We also gather industry-level establishment entry/exit rates and demographics (age and size) from the Census' BDS; and industry-level measures of sales and market value concentration from the Economic Census. The former are available for 9 broad sectors (SIC Level 2) since 1977. The latter include the share of sales/market value held by the top 4, 8, 20 and 50 firms in each industry; and are available for a subset of NAICS Level 3 industries for 1997, 2002, 2007 and 2012. We aggregate to our 36 industry groupings by taking the average across industries.

The main benefit of the census data is that it covers all US firms (public and private). But the limited granularity/coverage poses significant limitations for its use in regression analyses. The 9 SIC sectors for which census entry/exit data are available were mapped to the BEA investment categories to analyze industry-level investment patterns. However, given the very broad segmentation, limited conclusions could be reached.[24] These data were therefore used to validate the representativeness of relevant Compustat series. For instance, Figure 8 above shows that from 2000 onward, changes in the number firms in Compustat closely resemble those of the US as a whole. This suggests that Compustat entry provides a good approximation of the aggregate US economy in recent years.

Similarly, the census concentration data is available at a more granular level, but only for a subset of years and industries. We use these metrics to test whether more concentrated industries exhibit lower investment; and to compare nationwide concentration measures with those computed from Compustat. Census and Compustat measures of concentration are found to be fairly correlated, and both are significant predictors of industry-wide (under-)investment. We use Compustat as the basis of our analyses because the corresponding measures are available for all industries and all years; but we also report some regression results using Census-based concentration measures.

[23] The 2008 PDII was conducted by Westat, and analyzed in Kleiner and Krueger [2013]. It is based on a survey of individual workers from across the nation.

[24] Q exhibited significant measurement error, leading to unintuitive coefficients

3.4.4 Governance

For governance, we gather data on institutional ownership from Thomson-Reuters' Institutional Holdings (13F) Database. We define the share of institutional ownership as the ratio of shares owned by fund managers filing 13Fs on a given firm over total shares outstanding. [25] We also add Brian Bushee's permanent classification of institutional owners (transient, quasi-indexer, and dedicated), available on his website. These classifications are based on the turnover and diversification of institutional investor's holdings. Dedicated institutions have large, long-term holdings in a small number of firms. Quasi-indexers have diversified holdings and low portfolio turnover – consistent with a passive, buy-and-hold strategy of investing portfolio funds in a broad set of firms. Transient owners have high diversification and high portfolio turnover. Quasi-indexers are the largest category, and account for ~60% of total institutional ownership. This includes 'pure' index investors as well as actively managed investors that hold diversified portfolios. Quasi-indexer ownership is therefore heavily influenced by index position and participation. This is obvious for index funds, but also affects actively managed funds that benchmark against these indices (see, for example, Wurgler [2011]).

Bushee [2001] shows that high levels of ownership by transient institutions are associated with significant over-weighting of the near-term earnings component of firm value. And Asker et al. [2014], shows that firms with more transient ownership exhibit lower investment sensitivity to Q. Appel et al. [2016a,b] and Crane et al. [2016] all use Bushee's classifications when studying the implications of institutional ownership on governance and payouts. The classification is available from 1981 to 2013.[26]

3.4.5 Other measures

Mergers and Acquisition, and Payout Ratios. In addition to the above metrics tied to specific theories, we compute the ratio of goodwill (item GDWL) to assets as a measure of past M&A activity; and the ratio of share repurchases (item PRSTKC) to assets as a measure of buybacks.[27] These two variables cut across several hypothesis. Acquisitions clearly has an impact on competition, but it can also be a sign of weak governance (a view supported by a large literature) or a sign of short-termism (since combining capital and labor into new units is much more time consuming than buying existing units of production). Similarly, high payout ratios can be a sign of strong governance, short-termism, or low competition.

Table 3 summarizes the data fields considered for each explanation. Investment rates as well as measures of external finance dependence, debt and equity issuance; measures of intangibles; R&D expense; and foreign pretax income are all winsorized at the 1% and 99% level by year to control

[25] We use CRSP's total shares outstanding instead of Thomson Reuter's since the latter are available only in millions for some periods.

[26] We also considered the GIM index of Gompers et al. [2003] as a proxy for managerial entrenchment; and the industry-level Earnings Response Coefficient, which measures the sensitivity of stock prices to earnings announcements. However,we did not find a strong relationship between these measures and investment.

[27] We also considered total payouts to assets and found very similar results

Table 3: Summary of data fields by potential explanation

Potential explanation		**Relevant data field(s)**
Financial Frictions	**1. External finance constraints**	Firm- and industry-level Rajan-Zingales (1998) external finance dependence (aggregate, equity and debt) as of 1999
	2. Bank dependence	Firm-level bank-dependence indicator as of 1999 (firms missing S&P rating)
	3. Safe asset	Industry-average spread as of 1999
		Firm-level Corporate Bond ratings as of 1999
Measurement error	**4. Intangibles**	Separate CAPX vs. IP investment rates (firm- and industry-level)
		Intangibles ex. goodwill/assets
	5. Globalization	Share of foreign profits, as proxy for foreign activities at the firm level
Competition	**6. Regulation & uncertainty**	Mercatus industry-level regulation index (restriction count)
		Share of workers with Occupational Licensing (PDII)
		Sales and stock market return volatility
	7. Concentration	Change in number of firms (Compustat and Census BDS)
		Share of total sales/market value of top X firms (Compustat and Economic Census)
		Sales and Market Value Herfindahls (Compustat)
Governance	**8. Ownership**	Firm-level share of institutional ownership
		Firm-level share of quasi-indexer, Dedicated and Transient ownership (Bushee (2001), updated through 2013)

for outliers. Buybacks are capped at 10% of assets and Q is capped at 10.

4 Results

Armed with the requisite industry- and firm-level data, we can analyze the determinants of aggregate, industry and firm-level under-investment. We start by showing that the aggregate-level investment gap is explained by low entry and high quasi-indexer institutional ownership. We then discuss industry- and firm-level OLS results, which (i) confirm that the observed aggregate-level under-investment appears consistently at the industry- and firm-level; and (ii) confirm that industries with more quasi-indexer institutional ownership and less competition (as measured by the number of firms in an industry, as well as sales and market value concentration) invest less. We report summary results in the body of the document, with detailed regression output contained in the Appendix.

4.1 Aggregate-level results

We start by regressing the aggregate net investment rate on aggregate Q (both from the flow of funds), along with additional explanatory variables $\boldsymbol{X}$.

$$\frac{NI_t}{K_{t-1}} = \beta_0 + \beta Q_{t-1} + \boldsymbol{\gamma X} + \varepsilon_t$$

Table 4 shows the results of these regressions for our 'core' explanations: changes in the number of firms and quasi-indexer ownership. Columns 1 through 4 include regressions from 1980 onward while columns 5 to 8 include results from 1990 onward. As shown, Q exhibits a substantially better fit since 1990, hence we focus on this period for most of our analyses. Note, however, that measures of competition (number of firms, entry and exit) and quasi-indexer ownership are fairly stable and significant across both periods. Columns 2 and 6 show that an increase in the total number of establishments is correlated with higher investment. Columns 3 and 7 add quasi-indexer institutional ownership, and show that increases in such ownership are correlated with lower investment.[28] Note that the R^2 in the regression is nearly 80%. Since, as discussed above, we primarily use Compustat measures of competition, columns 4 and 8 replace the census-based entry figures with Compustat figures. Coefficients remain significant and with the right sign when using Compustat measures; although the magnitude differs given the different patterns. Also note that the coefficient on entry in columns 4 and 8 remain roughly stable in industry- and firm-level regressions, suggesting that the more granular results can in fact explain a substantial portion of the aggregate under-investment. The coefficient on quasi-indexer ownership is substantially larger in industry regressions, primarily because of the addition of age and size controls.

These results are based on time series regressions of fairly persistent series. To control for the under-estimation of T-values, Table 15 in the appendix reports moving average regression results with 1 and 2 year lags. The coefficients are very similar and almost always significant, although with lower T-stats.

4.2 Industry and Firm-level results

4.2.1 Testing under-investment

In order to test our more granular hypotheses, we now move to industry- and firm-level data. We start by documenting that the observed under-investment at the aggregate-level persists at the industry- and firm-level. In particular, we perform the following OLS panel regression across industries or firms i:

$$\frac{NI_{it}}{K_{it-1}} = \beta_0 + \beta Q_{i,t-1} + \mu_i + \eta_t + \varepsilon_{it}$$

[28] Census-based firm entry and exit rates are also significant predictors, with positive and negative coefficients, respectively. However, these exhibit lower T-values than the change in number of firms.

Table 4: Aggregate Net Investment: Time Series Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Net I/K							
	≥1980	≥1980	≥1980	≥1980	≥1990	≥1990	≥1990	≥1990
Stock Q (t-1)	0.004	0.008*	0.016**	0.015**	0.025**	0.024**	0.024**	0.024**
	[0.80]	[2.10]	[5.01]	[4.64]	[5.21]	[6.36]	[6.86]	[7.31]
ΔLog#of Firms (t-1)†		0.218**	0.092*	0.018*		0.187**	0.119*	0.020**
		[4.11]	[2.06]	[2.32]		[3.97]	[2.35]	[3.26]
Mean % QIX own (t-1)			-0.066**	-0.063**			-0.032*	-0.028*
			[-5.29]	[-5.06]			[-2.21]	[-2.11]
Observations	36	36	34	34	26	26	25	25
R^2	2%	35%	67%	68%	53%	72%	79%	83%
# of Firms data	Census	Census	Census	CPSTAT	Census	Census	Census	CPSTAT

Notes: Annual data. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01. Investment and Q from the US Flow of Funds; Number of firms from the US Census (columns 2, 3, 6 and 7) and Compustat (columns 4 and 8); Ownership across all US incorporated firms in Compustat.
† We use the 2-year LogΔ#of Firms for census data and 3-year change for Compustat. The longer window is used for Compustat as it exhibits better performance given the volatility in the underlying series – particularly at the industry and firm-level. Using a 2-year window also yields significant coefficients in most regressions, albeit with lower T-stats.

where β_0 represents a constant, μ_i represents industry or firm fixed effects and η_t represents year fixed effects. We omit the regression results for brevity (which exhibit the expected signs and significance) and instead focus on the time fixed effects, which are shown in Figure 5. In particular, the left (right) chart shows the time effects for the industry (firm) panel regression. The vertical line highlights the average time effect across all years for each regression. As shown, the time-effects are substantially lower for both Industry- and Firm-level regressions from 2000 onward. In the industry regression, time effects were above average in most years from 1980 to 2000 but have been consistently below-average since. In the firm regression, time effects were fairly high in the 80s and slightly high in the 1990s. They approach the average as early as 1999 and turn substantially negative thereafter. Note that the time effects need not be zero, on average, given the impact of adjustment costs in Q theory and the inclusion of a constant in the regression.

These results suggest that the decline in investment is observed conditional on Q, and consistent across industries and firms (given the fixed effects). They are also robust to including additional financials such as operating surplus in the regression or including only a subset of industries.

4.2.2 Testing hypotheses

Having established the observed under-investment relative to fundamentals since 2000, we now test our eight theories of under-investment. We do so by expanding the above OLS panel regression to include additional measures for each theory:

$$\frac{NI_{it}}{K_{it-1}} = \beta_0 + \beta Q_{i,t-1} + \boldsymbol{\gamma X_{it-1}} + \boldsymbol{\alpha\, Y_{it-1}} + \mu_i + \eta_t + \varepsilon_{it}$$

where, again, β_0, μ_i and η_t represent a constant, industry/firm fixed effects, and year fixed effects, respectively. $\boldsymbol{X_{it-1}}$ denotes our 'core' explanations: one measure of competition (firm entry/exit or the share of sales by the top 8 firms in each industry) and the share of quasi-indexer institutional ownership; as well as firm demographics (log-age and log-size) which are included in all regressions. $\boldsymbol{Y_{it-1}}$ denotes the additional measures for each hypotheses, including measures of financial constraints, globalization, lack of ideas, etc. These measures are first included individually and then simultaneously (if significant) to assess their correlation with cross-sectional investment levels.

Note that including year fixed effects implies that we no longer see under-investment relative to Q. Instead, these regressions identify cross-sectional differences in investment, including which variables explain under-/over-investing relative to Q. For industry-level regressions, the dependent variable is the BEA net investment rate, and Q is the average Q across all Compustat firms in a given industry[29]. For firm-level regressions, the dependent variable is firm-level net investment (based on CAPX/PPENT) and Q is the corresponding a firm-level value. Results for intangible investment (i.e., using Intellectual Property investment at the industry level, and R&D expenses at the firm-level) are reported and discussed in Section 4.2.6.

Table 5 summarizes industry- and firm-level OLS regression results across all hypotheses. Tick-marks (✓) identify those variables that are significant and exhibit the 'right' coefficient. Crosses (✗) identify variables that are not significant or exhibit the 'wrong' coefficient. A minus sign after a tick-mark (✓-) highlights that the variable is significant but not robust across periods or to inclusion of additional variables. Detailed regression results underlying this summary table are included in Tables 16 to 19 in the appendix. Specifically, Table 16 includes industry-level results for all variables except measures of competition, which are included in Table 17. Table 18 shows firm-level OLS results for all explanations except governance and short-termism, which are shown in Table 19. Last, Tables 20 to 23 show the same results as Tables 16 to 19 but from 2000 onward, which show that results remain generally stable and robust over the more recent period.

For brevity, we include only the most significant variables/transformations for each type of measure in our reported regression results (e.g, we exclude the less significant transformations of foreign profits for Globalization, and the industry-average spread for safe asset scarcity). Qualitative results are robust to using the alternate definitions of firm-level investment and including only industries with good Compustat coverage.

We find strong support for measures of competition and quasi-indexer ownership; some support for intangibles, globalization and regulation; and no support for the remaining hypotheses.

Namely, measures of (Compustat and Census) competition all appear to be significant at the industry level – particularly changes in the number of firms and the concentration in the top 8/20 firms. Measures of total and quasi-indexer institutional ownership also appear to be strongly correlated with industry-level under-investment; as is the share of intangibles excluding goodwill. At the firm-level, measures of entry and quasi-indexer institutional ownership remain strongly significant. Industries with more regulations also appear to invest less, though this result is substantially less

[29] We also considered the weighted average and median Q but mean Q exhibits higher T-stats

Table 5: Summary of Firm- and Industry-level OLS results

Potential explanation		Relevant data field(s)	Significance	
			Industry	Firm
Financial constraints	1. External finance	RZ external finance dependence ('99)	✗	✗
	2. Bank dependence	Missing S&P rating ('99)	✗	✗
	3. Safe asset	Industry spread ('99)	✗	✗
		Firm-level ratings ('99)	✗	✗
Measurement error	4. Intangibles	Intangibles ex. goodwill/assets	✓	✓-
	5. Globalization	% foreign profits	✓	✗
Competition	6. Regulation & uncertainty	Regulation index	✓-	✗
		Occupational Licensing	✗	✗
	7. Concentration	ΔLog #of firms	✓	✓
		% sales/market value of top X firms	✓	✓
		Sales and Market Value Herfindahls (Compustat)	✓	✗
Governance	8. Ownership	Share of Institutional ownership	✓	✗
		Share of QIX ownership	✓	✓
		Share of DED ownership	✓-	✗
		Share of TRA ownership	✓-	✗

Notes: Table summarizes industry- and firm-level OLS regression results across all potential explanations. Tick-marks (✓) identify those variables that are significant and exhibit the 'right' coefficient. Crosses (✗) identify variables that are not significant or exhibit the 'wrong' coefficient. A minus sign after a tick mark (✓-) highlights that the variable is significant but not robust to inclusion of additional variables. See Appendix for detailed regression results and the text for caveats and discussions of the limitations of our results (e.g., in the case of bank dependence).

robust than measures of competition and quasi-indexer ownership. As expected, industries with higher foreign profits exhibit lower US investment. However, since this result is not significant at the firm-level (where we include all investment irrespective of the location), the under-investment in the US does not appear to be driven by US firms investing disproportionately more abroad, but rather by all firms investing less.

We highlight that these results cannot discard the theories for all subsets of firms. For instance, other papers have documented that reductions in bank lending affect investment by smaller firms (e.g.,Chen et al. [2016]). We do not observe a consistent effect on aggregate investment, using the lack of corporate bond ratings as a proxy for bank dependence, although we find some effect in the post-2009 period. Our results are not inconsistent with the existing literature since industry-level investment tends to be dominated by relatively large firms, and our firm-level data does not cover small firms. What our results suggest is that under-investment by small firms is unlikely to account quantitatively for the bulk of the aggregate investment gap. Finally, another caveat is that bank lending matters for business formation [Alfaro et al., 2015]. A decrease in bank lending can then, over time, lead to an increase in concentration.

The remainder of this section discusses the results in more detail. Section 4.2.3 and 4.2.4 discuss the primary industry and firm-level regression results. Section 4.2.5 provides additional analysis and support for discarding the safe asset scarcity hypothesis; while Section 4.2.6 discusses the implications of rising intangibles on investment. Detailed results are included in the Appendix.

4.2.3 Industry Results

Table 6 shows the results of industry regressions from 1990 onward, for our 'core' explanations. We use changes in the number of firms in columns 1 to 3 and the share of sales by the top 8 firms in each industry in columns 4 to 6. As shown, measures of entry and concentration are strongly significant over both periods and exhibit very similar coefficients as those in the aggregate regressions. Measures of quasi-indexer ownership are also significant. They exhibit substantially larger coefficients than the post-1990 aggregate regression, due to the inclusion of age and size controls.

4.2.4 Firm Results

Table 7 shows firm-level regression results including measures of entry and quasi-indexer ownership. [30] Columns 1 to 3 regress net investment (defined as CAPX/PPE), and columns 4 and 5 regress the ratio of buybacks to assets.

Column 1 includes year and industry fixed effects, and column 2 includes year and firm fixed effects. As shown, quasi-indexer institutional ownership and entry are significant predictors of investment. Firms with more quasi-indexer institutional ownership and firm in industries with less

[30] We use entry instead of competition and the 2-year moving average of quasi-indexer ownership because they exhibit stronger predictive power. Similar results are obtained using measures of concentration.

Table 6: Industry OLS regressions: 'Core' explanations

Table shows the results of industry OLS panel regressions of Net I/K over the periods specified. NI/K from BEA; remaining variables primarily from Compustat. Annual data. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01.

	(1)	(2)	(3)	(4)
	Net I/K			
	≥1980	≥1990	≥1980	≥1990
Mean Stock Q (t-1)	0.019**	0.017**	0.021**	0.019**
	[7.22]	[5.72]	[7.88]	[6.50]
ΔLog#of Firms (t-4,t-1)	**0.026****	**0.021****		
	[5.38]	**[3.41]**		
% sales by Top 8 firms (t-1)			**-0.035****	**-0.060****
			[-3.07]	**[-3.77]**
Mean % QIX own (t-1)	**-0.101****	**-0.162****	**-0.075***	**-0.153****
	[-3.44]	**[-4.61]**	**[-2.52]**	**[-4.35]**
Mean log(age) (t-1)	-0.009	-0.016*	-0.024**	-0.022**
	[-1.35]	[-2.09]	[-4.28]	[-3.14]
Mean log(assets) (t-1)	0.011**	0.018**	0.010**	0.015**
	[3.42]	[3.99]	[3.07]	[3.33]
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	1152	851	1152	851
Within R^2	0.254	0.286	0.24	0.288
OverallR^2	0.253	0.26	0.257	0.245

entry, invest less. Note that the corresponding coefficients are very similar to those recovered in the aggregate regressions. Column 3 includes industry-year fixed effects, and excludes the measure of entry because it would be absorbed into the fixed effects. Quasi-indexer institutional ownership is significant, suggesting that, within each industry-year and controlling for Q, firms with more quasi-indexer institutional ownership invest less.

Where do the excess funds go? Share buybacks. As shown in columns 4 and 5, firms with more quasi-indexer ownership do more buybacks. This is true including year, as well industry (column 4) or firm (column 5) fixed effects, and controlling for a wide range of financials such as market value, cash flow, profitability, leverage, sales growth, etc.

Some recent literature highlights that weak governance affects primarily firms in noncompetitive industries. In unreported tests, we interact quasi-indexer ownership with quartiles of entry, and find that such ownership leads to under-investment only in noncompetitive industries. This aligns with the results in Giroud and Mueller [2010, 2011].

4.2.5 Drill-down: Debt issuance and investment by high-rated firms

There has been substantial discussion on the implications of safe asset scarcity on debt issuance; and to a lesser extent, on investment. To better understand whether this hypotheses is supported by the data, this section discusses valuation and investment patterns of AA to AAA rated firms

Table 7: Firm OLS regressions: 'Core' explanations

Table shows the results of firm-level OLS panel regressions of Net CAPX/PPE over the periods specified. Data primarily sourced from Compustat. Annual data. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01.

	(1)	(2)	(3)	(4)	(5)
	Net CAPX/PPE			Buybacks/Assets	
	≥1990	≥1990	≥1990	≥1990	≥1990
Stock Q (t-1)	0.081**	0.078**	0.075**	-0.001**	-0.001**
	[64.04]	[55.56]	[70.22]	[-5.56]	[-4.88]
% QIX own MA2(t-1)	**-0.045****	**-0.050****	**-0.034****	**0.011****	**0.006****
	[-3.36]	**[-3.21]**	**[-3.46]**	**[12.07]**	**[4.84]**
ΔLog#of Firms (t-4,t-1)	**0.034****	**0.037****			
	[3.18]	**[3.26]**			
Log(age) (t-1)	-0.021**	-0.039**	-0.013**	-0.006**	-0.004**
	[-11.63]	[-14.11]	[-12.75]	[-10.60]	[-5.03]
Log(assets) (t-1)	-0.064**	-0.083**	-0.057**	0.002**	0.004**
	[-17.20]	[-12.54]	[-29.03]	[8.95]	[6.55]
Other controls				...	...
Year FE	Yes	Yes	No	Yes	Yes
Industry FE	Yes	No	No	Yes	No
Firm FE	No	Yes	No	No	Yes
Industry-Year FE	No	No	Yes	No	No
Observations	59312	59312	59312	55489	55489
WithinR^2	0.098	0.099	0.183	0.075	0.078
Overall R^2	0.163	0.136		0.172	0.138

Table 8: Safe Asset Scarcity: Valuation test

Table shows the results of firm-level OLS regressions of Q as of 2014 on Q as of 2006, and a AA-to-AAA rating indicator. Annual data, sourced from Compustat. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01.

	(1)	(2)	(1)	(2)	(1)	(2)
	Log MV (2014)		Log PPE (2014)		Log Assets (2014)	
AA to AAA rated (2006)	**-0.045**	**-0.221**	**-0.292**	**-0.077**	**-0.164**	**-0.242**
	[-0.21]	**[-1.01]**	**[-0.79]**	**[-0.24]**	**[-0.85]**	**[-1.26]**
Log MV (2006)	-0.003	-0.01	0.166*	0.161*	-0.013	-0.001
	[-0.06]	[-0.20]	[1.99]	[2.16]	[-0.29]	[-0.03]
Log Assets (2006)	1.110**	1.087**	0.371**	0.509**	0.583**	0.603**
	[26.01]	[24.62]	[5.10]	[7.74]	[15.54]	[15.58]
Log(age) (t-1)	-0.096*	-0.072	0.731**	0.536**	0.407**	0.378**
	[-2.24]	[-1.59]	[9.97]	[8.00]	[10.78]	[9.59]
Industry FE	No	Yes	No	Yes	No	Yes
Observations	1681	1681	1676	1676	1681	1681
Overall R^2	0.846	0.854	0.692	0.777	0.869	0.876

and below AA-rated firms. To mitigate endogeneity problems, we assign firms to rating groups based on their 2006 rating, before the Great Recession. 2006 is chosen because safe asset scarcity is understood to be a post-Great Recession effect.

We start with valuations. According to the safe asset scarcity hypothesis, the value of being able to issue safe assets increased after the Great Recession. In that case, the valuation of highly rated firms should increase relative to other firms. We regress the 2014 value on the 2006 value and an indicator for AA to AAA rated firms:

$$logMV_{i,2016} = \beta_0 + \beta_1 log\, age_i + \beta_2 log\, assets_{i,2006} + log\ MV_{i,2006} + \mathbb{I}\{AA - AAA_{i,2006}\} + \varepsilon_i$$

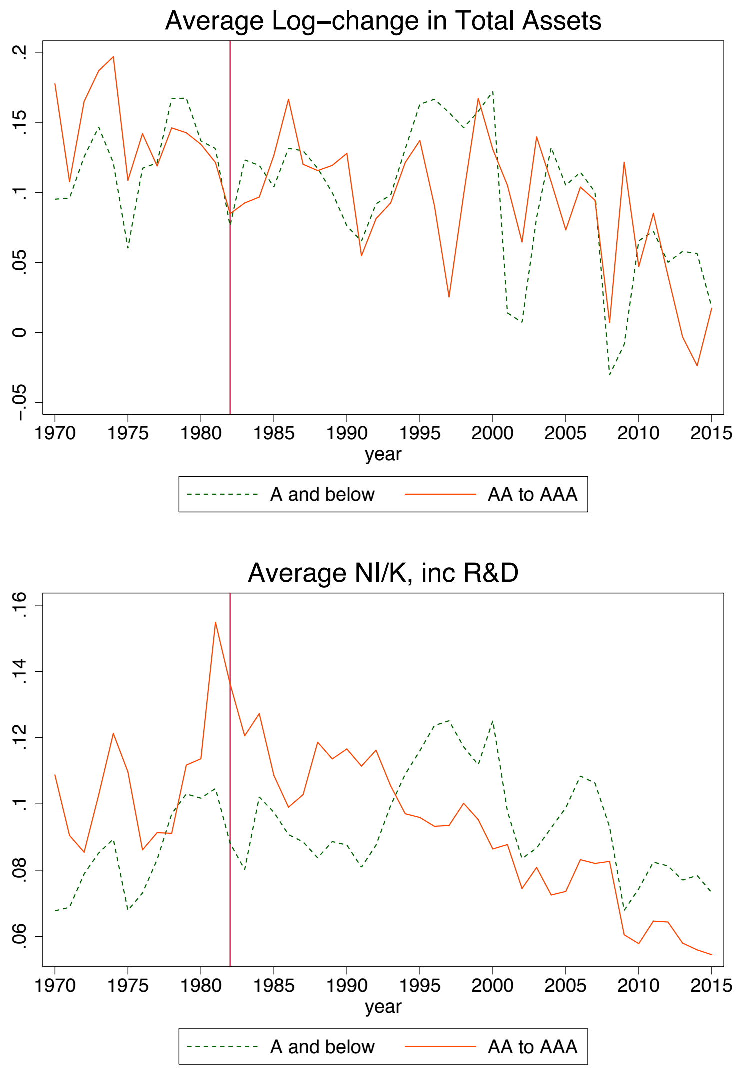
We include industry fixed effects in some regressions; and run a similar regression for capital (PP&E) and assets to test for higher (cumulative) capital expenditures or balance sheet growth. Table 8 summarizes the results. As shown, the coefficient on the AA to AAA rated indicator is not significant and, if anything, it is negative. At least for corporates, we do not find support for the safe asset scarcity hypothesis.

Graphically, Figure 14 shows the average log-change in total assets and the average net investment rate (including R&D expenses) for both groups of firms.[31] At least until 2012, both groups of firms seem to be increasing assets at roughly the same rate, and the investment rate of highly rated firms has been well-below that of lower rated firms since 1990. This suggests that highly rated firms have grown their balance sheets at roughly the same rate as lower-rated firms but have invested less.

Have these firms reduced external financing given the lower investment? To answer this question,

[31] Conclusions are qualitatively similar excluding R&D expenses from the NI/K calculation

Figure 14: Assets and investment, by rating



Note: Firms mapped to categories based on ratings as of 2006. The vertical line on 1982 highlights the passing of SEC rule 10b-18, which allows companies to repurchase their shares on the open market without regulatory limits.

we follow Frank and Goyal [2003] and compute the uses and sources of funding based on Compustat data. Specifically, we define the total finance deficit as the sum of dividends, investment and changes in working capital minus internal cash flow:[32]

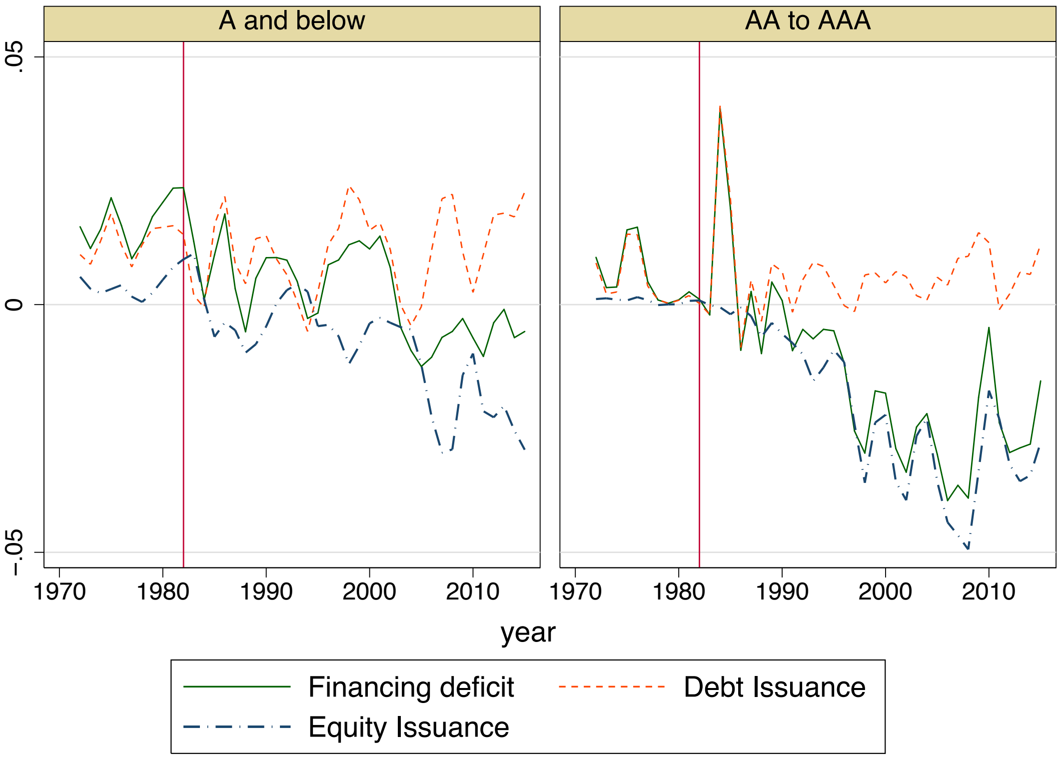
$$DEF = DIV + INV + \Delta WC - IntCF$$

Note that this definition of investment is substantially broader than capital expenditures: it includes all short and long term investment as defined in the statement of cash flows. We also compute net debt and equity issuance, such that $DEF = NetDebtIss + NetEqIss$.

Figure 15 shows the 2-year cumulative financing deficit, debt and equity issuance by rating group, normalized by total assets. We highlight the year 1982, when SEC Rule 10b-18 was instituted, which allows companies to repurchase their shares on the open market without regulatory limits. Two interesting conclusions arise: first, both types of firms have either maintained or increased their debt issuance since the mid-1990s. Highly rated firms issued a substantial amount of debt in 2009, at the height of the Great Recession. Such debt issuance allowed them to maintain large buybacks despite lower internal funds. They decreased issuance in the early 2010s but returned to the market in 2015 as internal funds decreased but buybacks remained high. Low rated firms issued almost no debt during the Great Recession, which led to a substantial decrease in buybacks. But they quickly returned to the market after the crisis, and used the funds raised primarily for buybacks. Second, buybacks at highly-rated firms increased soon after 1982, moving almost one-to-one with the internal finance deficit for the past 20 years. In contrast, the increase in buybacks is much less pronounced for lower rated firms until the mid-2000s. In fact, lower rated firms maintained a positive finance deficit until about 2000, which was financed primarily with debt.

[32] The following Compustat items are used: $Div = div$, $INV = capx + ivch + aqc - sppe - siv - ivstch - ivaco$, $\Delta WC = -recch - invch - apalch - txach - aoloch + chech - fiao - dlcch$ and $IntCF = ibc + xidoc + dpc + txdc + esubc + sppiv + fopo + exre$. Note that adjusted definitions are used for prior disclosure regimes – see Frank and Goyal [2003] for additional details.

Figure 15: Uses and sources of financing, by rating



Note: 2-year cumulative rates, normalized by total assets. Based on annual data. Firms mapped to categories based on ratings as of 2006. The vertical line on 1982 highlights the passing of SEC rule 10b-18, which allows companies to repurchase their shares on the open market without regulatory limits.

The improving finance deficit and associated buybacks may be driven by increasing profits, or by decreasing investments. Table 9 decomposes the sources and uses of financing for highly rated firms and lower-rated firms. As shown, the improving finance deficit for both types of firms is primarily driven by decreasing investments and, to a lesser extent, working capital. Cash dividends have remained stable while cash flow decreased slightly. The decrease in investment is particularly pronounced for highly rated firms, from ~12% in the 1970s and 1980s to only 6% in the 2000s.

4.2.6 Drill-down: Intangible investment

The top graph of Figure 16 shows the ratio of intangibles to assets (with and without goodwill) for all US-incorporated firms in Compustat. As shown, the share of intangibles has been increasing rapidly since 1985, and experienced its largest increase in the late 1990s. The rise is primarily driven by goodwill, such that total intangibles are primarily a measure past M&A activity rather than a true shift in the asset mix. Intangibles excluding goodwill remained low until the 2000s but have increased rapidly since then, to ~7% of assets. The bottom graph shows the share of intellectual property capital and investment reported by the BEA (as a percent of total capital and investment, respectively). As shown, both series experienced a substantial increase from 1980 to about 2000,

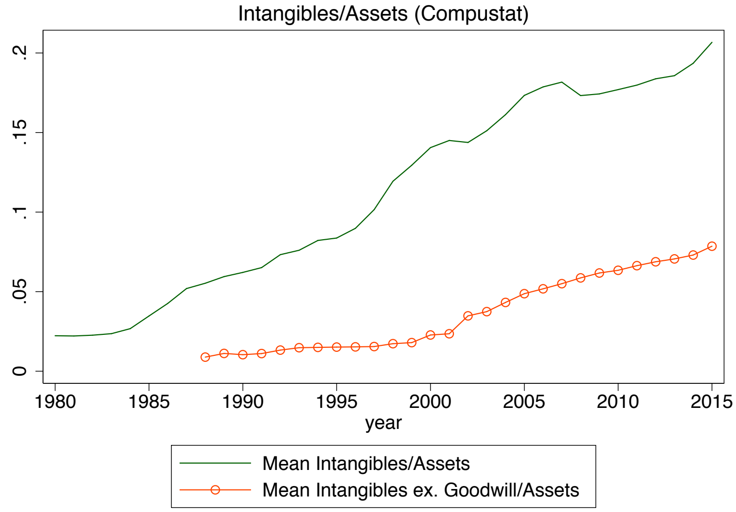
Table 9: Funds flow and financing as a fraction of total assets, by rating

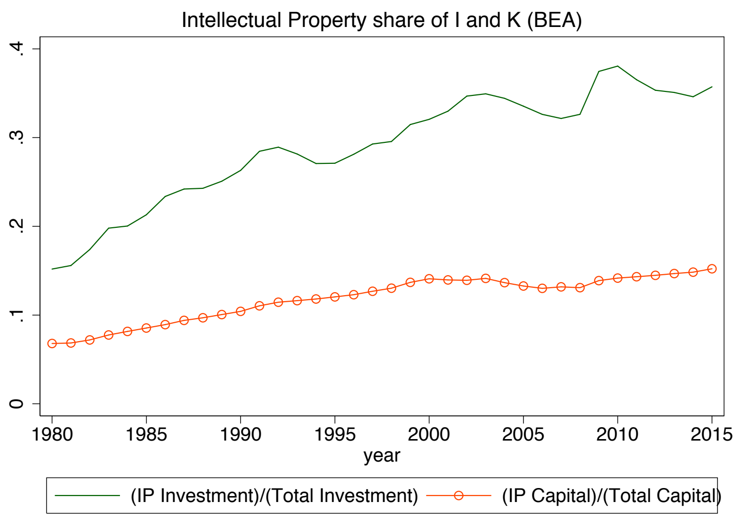
Rating	Field / Year	1970-1979	1980-1989	1990-1994	1995-1999	2000-2004	2005-2009	2010-2015
AA to AAA rated firms	Cash dividends[a]	0.037	0.039	0.043	0.047	0.045	0.042	0.04
	Investments[b]	0.097	0.119	0.084	0.079	0.073	0.062	0.062
	ΔWorking capital[c]	0.016	-0.003	0.005	0.014	0.014	0.008	0.001
	Internal cash flow[d]	0.142	0.158	0.138	0.156	0.163	0.157	0.13
	Financing deficit[a+b+c-d]	**0.007**	**0.001**	**-0.007**	**-0.019**	**-0.027**	**-0.03**	**-0.023**
	Net debt issues[1]	0.006	0.002	0.004	0.003	0.004	0.011	0.006
	Net equity issues[2]	0.001	-0.001	-0.011	-0.022	-0.031	-0.041	-0.029
	Net external financing[1+2]	**0.007**	**0.001**	**-0.007**	**-0.019**	**-0.027**	**-0.03**	**-0.023**
Below AA rated firms	Cash dividends[a]	0.026	0.025	0.021	0.018	0.013	0.017	0.02
	Investments[b]	0.107	0.122	0.078	0.093	0.068	0.074	0.078
	ΔWorking capital[c]	0.018	0.009	0.008	0.02	0.019	0.016	0.014
	Internal cash flow[d]	0.134	0.14	0.101	0.117	0.098	0.113	0.117
	Financing deficit[a+b+c-d]	**0.015**	**0.011**	**0.004**	**0.01**	**0.002**	**-0.007**	**-0.006**
	Net debt issues[1]	0.012	0.011	0.002	0.016	0.006	0.013	0.017
	Net equity issues[2]	0.003	0	0.002	-0.007	-0.004	-0.021	-0.024
	Net external financing[1+2]	**0.015**	**0.011**	**0.004**	**0.009**	**0.002**	**-0.008**	**-0.007**

Notes: Annual data. Based on the average of yearly cumulative totals across all firms in each category. Firms mapped to categories based on 2006 ratings.

but have remained stable since.

Figure 16: Intangibles and IP investment





Notes: Annual data. Top chart includes all US incorporated firms in Compustat. Bottom chart based on BEA-reported figures for the industries in our sample (see Section 3).

The rise of intangibles may affect investment in two ways: first, intangible investment is difficult to measure and is therefore prone to measurement error. This can be seen, for instance, in the very different trends between the share of intangibles in BEA data and the intangibles excluding goodwill in Compustat. If intangible investment is under-estimated, K would be under-estimated, and therefore Q would be over-estimated. Second, intangible assets might be more difficult to accumulate. A rise in the relative importance of intangible could lead to a higher equilibrium value of Q even if intangibles are correctly measured. We find some support for these hypotheses but their impact does not seem to be quantitatively very large. We test each of these hypothesis separately.

Measurement error. Denote net investments in tangible and intangible assets by $NI^T$and NI^I, such that total investments are $NI = NI^T + NI^I$. Assume that tangible capital is perfectly measured but intangible capital is under-estimated by a factor α – that is, assume that intangible investment is consistently under-estimated across all industries. This is a simplifying assumption, but it highlights the main reason for concern.

Under this assumptions, *measured* investment is given by

$$\hat{NI} \equiv \hat{NI}^T + \hat{NI}^I$$

$$= NI^T + \alpha NI^I$$

The under-estimation of investment leads to under-estimation of capital $\hat{K}$ and, since $\hat{Q}$ is the ratio of market value to replacement cost of capital, it leads to over-estimation of Q. Thus, a regression of the form

$$\frac{\hat{NI}_{it}}{\hat{K_{it-1}}} = \beta \hat{Q_{i,t-1}} + \gamma \frac{\hat{K}^I}{AT_{i,t-1}} + \mu_i + \eta_t + \varepsilon_{it}$$

would yield a negative and significant coefficient γ. More complex measurement errors would yield different structures, but broadly the negative coefficient should remain. Industries with higher dependence on intangibles would appear to be under-investing due to an over-estimation of Q and an under-estimation of investment.

We test this at the industry level, using BEA measures of investment (which includes intellectual property investment). Table 10 summarizes the results. As shown, the coefficient on intangibles is significant and negative, suggesting that industries-years with a larger share of intangibles exhibit more under-investment relative to Q. Thus, there is some support for measurement error. Note, however, that our 'core' hypotheses of competition and quasi-indexer ownership remain significant, and the addition of intangibles in the regression has limited effect on the coefficients or the R^2.

Higher equilibrium Q. A rise in the relative importance of intangibles could lead to a higher equilibrium value of Q even if intangibles are correctly measured. This would result in lower investment relative to Q, particularly at industries with a large share of intangible assets. We test this by analyzing investment patterns on intangible and tangible assets separately.

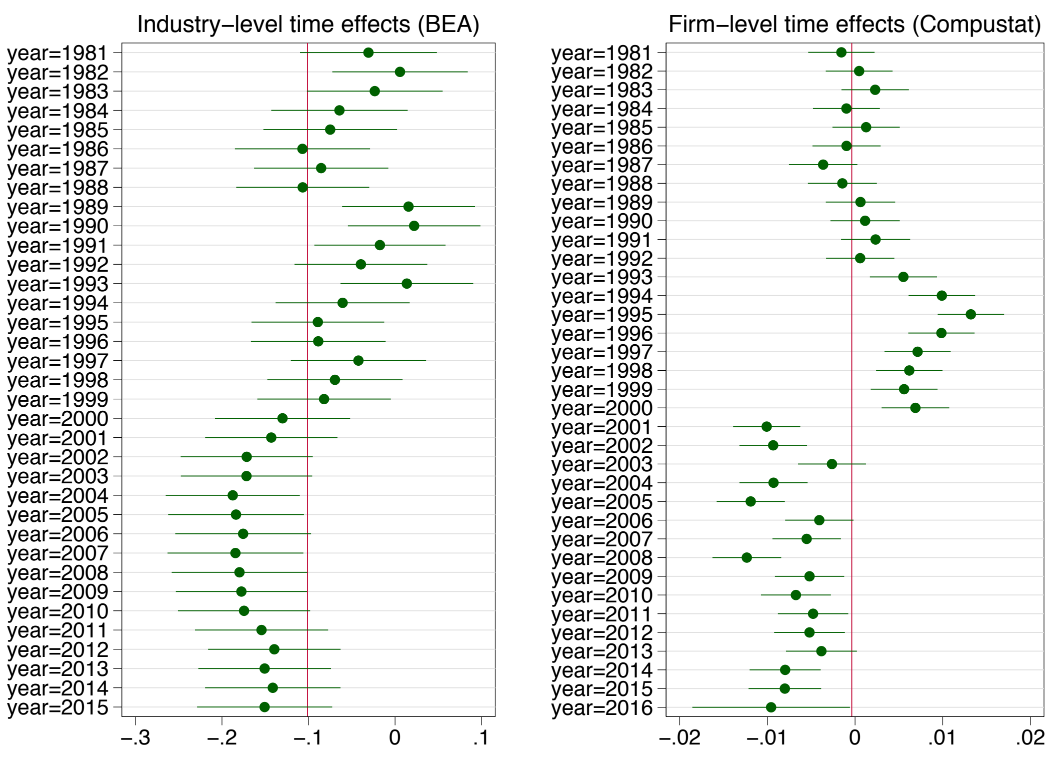
To begin with, Figure 17 shows the time effects arising from industry- and firm-level regressions on Q , but with intangible investment as the dependent variable (i.e., the same analysis as above, but using net investment in intellectual property as the industry level dependent variable, and the ratio of R&D expenses to assets as the firm-level dependent variable). As shown, time effects for both intangible regressions exhibit substantial decreases in 2000 – just as observed above for total investment at the industry-level and CAPX at the firm-level.

Table 10: Industry OLS regressions: Intangible Measurement Error

Table shows the results of industry OLS panel regressions of Net I/K on intangible assets, over the periods specified. NI/K from BEA; remaining variables primarily from Compustat. Annual data. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01.

	(1)	(2)
	Intan Net I/K	
	≥1990	≥1990
Mean Stock Q (t-1)	0.019**	0.018**
	[6.50]	[6.24]
% sales by Top 8 firms (t-1)	-0.060**	-0.060**
	[-3.77]	[-3.74]
Mean % QIX own (t-1)	-0.153**	-0.167**
	[-4.35]	[-4.73]
Intan ex. GW/Assets(t-1)		**-0.180****
		[-2.95]
Mean log(age) (t-1)	-0.022**	-0.018*
	[-3.14]	[-2.51]
Mean log(assets) (t-1)	0.015**	0.012**
	[3.33]	[2.60]
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observations	851	851
R^2	0.288	0.296

Figure 17: Time Effects from Intangible Asset Regressions



Note: Time fixed effects from industry- and firm-panel regressions of net investment on intangible assets and Q, with industry and firm fixed effects. Industry IP investment data from BEA; firm investment based on XRD/Assets from Compustat; omits firms with zero or missing R&D expenses.

Table 11: Industry OLS regressions, by asset type

Table shows the results of industry OLS panel regressions of Net I/K since 1990, split by asset type. NI/K from BEA; remaining variables primarily from Compustat. Annual data. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)
	Net I/K					
	All fixed assets[1+2]	Excluding IP[1]	IP[2]	All fixed assets[1+2]	Excluding IP[1]	IP[2]
Mean Stock Q (t-1)	0.017**	0.012**	0.017	0.019**	0.014**	0.014
	[5.72]	[4.48]	[1.03]	[6.50]	[5.18]	[0.87]
ΔLog#of Firms (t-4,t-1)	**0.021****	**0.009**	**-0.028**			
	[3.41]	**[1.52]**	**[-0.83]**			
% sales by Top 8 firms (t-1)				**-0.060****	**-0.089****	**0.068**
				[-3.77]	**[-6.14]**	**[0.77]**
Mean % QIX own (t-1)	**-0.162****	**-0.152****	**-0.433***	**-0.153****	**-0.144****	**-0.445***
	[-4.61]	**[-4.67]**	**[-2.25]**	**[-4.35]**	**[-4.54]**	**[-2.32]**
Mean log(age) (t-1)	-0.016*	-0.025**	-0.113**	-0.022**	-0.019**	-0.104**
	[-2.09]	[-3.40]	[-2.63]	[-3.14]	[-2.97]	[-2.67]
Mean log(assets) (t-1)	0.018**	0.019**	-0.016	0.015**	0.015**	-0.012
	[3.99]	[4.54]	[-0.64]	[3.33]	[3.69]	[-0.50]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	851	851	850	851	851	850
WithinR^2	0.286	0.27	0.21	0.288	0.301	0.21
OverallR^2	0.26	0.23	0.141	0.245	0.123	0.15

It may be, however, that the effect of competition and quasi-indexer ownership applies only for tangible investment. In that case, our conclusions would only apply to a subset of asset types. We test this by replicating the core industry-level regressions above, but separating tangible and intangible assets; and by analyzing firm-level investment in R&D. Industry-level results are shown in Table 11. As shown, quasi-indexer ownership exhibits significantly negative coefficients for IP and non-IP assets. In contrast, entry and concentration appear significant (or nearly so) for all assets as well as tangible assets, but not for intangible assets. Note that intangible investment appears fairly noisy: although the coefficient on Q is positive, it is not statistically significant.

Firm level results are shown in Table 12 (they should be compared to Table 7). As shown, competition leads to increasing R&D expenditures, while quasi-indexer ownership exhibits inconclusive results: it shows a positive sign in the time series but a negative sign within each industry and year.

Combined, these results suggest that the rise of intangibles accounts for some but not all of the observed under-investment. Corporations have reduced investment in both tangible and intangible assets since 2000, suggesting that other factors are in play.

Table 12: Firm OLS regressions: R&D expenses

Table shows the results of firm OLS panel regressions of R&D expenses over assets, for the periods specified. Firms with missing or zero R&D are omitted. Annual data. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01.

	(1)	(2)	(3)
		R&D/Assets	
	≥1990	≥1990	≥1990
Stock Q (t-1)	0.009**	0.008**	0.018**
	[37.21]	[32.27]	[56.56]
ΔLog#of Firms (t-4,t-1)	**0.007****	**0.010****	
	[2.65]	**[3.50]**	
% QIX own MA2(t-1)	**0.014****	**0.013****	**-0.011****
	[4.52]	**[3.95]**	**[-3.24]**
Log(age) (t-1)	-0.028**	-0.033**	-0.009**
	[-55.60]	[-57.63]	[-26.65]
Log(assets) (t-1)	-0.003*	0.006**	-0.020**
	[-2.32]	[4.34]	[-27.79]
Year FE	Yes	Yes	No
Industry FE	Yes	No	No
Firm FE	No	Yes	No
Industry-Year FE	No	No	Yes
Observations	29400	29400	29400
WithinR^2	0.187	0.191	
OverallR^2	0.294	0.143	0.383

5 Conclusion

Private fixed investment in the United States has been lower than expected since the early 2000's. The trend started before 2008, but the Great Recession made it more striking. Investment in the U.S. is low despite high levels of profitability and Tobin's Q. This simple observation rules out a whole class of theories that would explain low investment by low values of Tobin's Q. We test various 8 alternative theories that can explain the investment gap, i.e., low investment despite high Q. Among these, the only ones that find consistent support in our industry and firm level datasets are decreased competition, tightened governance and, potentially, increased short-termist pressures. Combined, the competition and governance measures explain about 80% of the the aggregate under-investment relative to Q. The rise of intangibles explains some of the remaining investment gap, and it does not diminish the explanatory power of competition and governance.

The above conclusions are based on simple regressions and therefore cannot establish causality between competition, governance and investment. In follow-up work [Gutiérrez and Philippon, 2016] we use a combination of instrumental variables and natural experiments to test the causality of our two main explanations: lack of competition and tight or short-termist governance.

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Appendix I: Industry Investment Data

As noted above, investment is available for 63 granular industry groupings from the BEA. These are grouped into 39 categories (3 of which are omitted) to ensure all groupings have material investment and better Compustat coverage. If industries are not grouped, some segments would exhibit highly erratic investment patterns early in the sample, which does not support robust regression analysis. The groupings are summarized in Table 13, including the BEA industry code, the granular industry name and the mapped industry group. We also include the dollar value and % of total capital as of 2014. Table 14 shows the total (nominal) investment from 2000 to 2015 by grouping, along with the Compustat coverage ratios defined as described in the text.

Table 13: Investment and coverage, by industry

BEA code	**Industry**	**Mapped segment**	**Capital (2014)**	**% of total**
721	Accommodation	Acc_accommodation	358.9	2.2%
722	Food services and drinking places	Acc_food	249.2	1.5%
561	Administrative and support services	Adm_and_waste_mgmt	189.2	1.2%
562	Waste management and remediation services	Adm_and_waste_mgmt	102.3	0.6%
110	Farms	Agriculture	567.7	3.5%
113	Forestry, fishing, and related activities	Agriculture	62.3	0.4%
713	Amusements, gambling, and recreation industries	Arts_amusement	163.7	1.0%
711	Performing arts, spectator sports, museums, and related activities	Arts_performing	159.9	1.0%
230	Construction	Construction	284.6	1.7%
334	Computer and electronic products	Dur_Computer	506.3	3.1%
335	Electrical equipment, appliances, and components	Dur_Computer	73.5	0.5%
333	Machinery	Dur_Machinery	234.4	1.4%
337	Furniture and related products	Dur_Other	22.8	0.1%
338	Miscellaneous manufacturing	Dur_Other	115.1	0.7%
336	Motor vehicles, bodies and trailers, and parts	Dur_Transportation	383.7	2.4%
321	Wood products	Dur_Wood_and_Metal	42.6	0.3%
327	Nonmetallic mineral products	Dur_Wood_and_Metal	87.1	0.5%
331	Primary metals	Dur_Wood_and_Metal	165.5	1.0%
332	Fabricated metal products	Dur_Wood_and_Metal	175.3	1.1%
610	Educational services	Educational	557.7	3.4%
521	Federal Reserve banks	Finance	Omitted	
522	Credit intermediation and related activities	Finance	Omitted	
523	Securities, commodity contracts, and investments	Finance	Omitted	
524	Insurance carriers and related activities	Finance	Omitted	
525	Funds, trusts, and other financial vehicles	Finance	Omitted	
622	Hospitals	Health_hospitals	916.1	5.6%
623	Nursing and residential care facilities	Health_hospitals	94.6	0.6%

Table 14: Investment and coverage, by industry (cont'd)

BEA code	**Industry**	**Mapped segment**	**Capital (2014)**	**% of total**
621	Ambulatory health care services	Health_other	352	2.2%
624	Social assistance	Health_other	65.4	0.4%
514	Information and data processing services	Inf_data	168.3	1.0%
512	Motion picture and sound recording industries	Inf_motion	287.8	1.8%
511	Publishing industries (includes software)	Inf_publish	196.5	1.2%
513	Broadcasting and telecommunications	Inf_telecom	1352.5	8.3%
550	Management of companies and enterprises	Mgmt	401.4	2.5%
212	Mining, except oil and gas	Min_exOil	186.5	1.1%
211	Oil and gas extraction	Min_Oil_and_gas	1475.2	9.1%
213	Support activities for mining	Min_support	142	0.9%
325	Chemical products	Nondur_chemical	900.1	5.5%
311	Food and beverage and tobacco products	Nondur_Food	336.4	2.1%
313	Textile mills and textile product mills	Nondur_other	40.4	0.2%
315	Apparel and leather and allied products	Nondur_other	17.5	0.1%
322	Paper products	Nondur_other	120.7	0.7%
323	Printing and related support activities	Nondur_other	49.4	0.3%
326	Plastics and rubber products	Nondur_other	104.2	0.6%
324	Petroleum and coal products	Nondur_petroleum	221	1.4%
810	Other services, except government	Other_ex_gov	619.5	3.8%
541	Legal services	Prof_serv	42.6	0.3%
541	Computer systems design and related services	Prof_serv	74.3	0.5%
541	Miscellaneous professional, scientific, and technical services	Prof_serv	477.6	2.9%
531	Real estate	Real Estate	Omitted	
532	Rental and leasing services and lessors of intangible assets	Real Estate	Omitted	
44R	Retail trade	Retail_trade	1236.4	7.6%
481	Air transportation	Transp_air	249.1	1.5%
484	Truck transportation	Transp_ground	143.6	0.9%
485	Transit and ground passenger transportation	Transp_ground	44.8	0.3%
487	Other transportation and support activities	Transp_other	132.6	0.8%
493	Warehousing and storage	Transp_other	46	0.3%
486	Pipeline transportation	Transp_pipeline	227.3	1.4%
482	Railroad transportation	Transp_rail_and_water	405.7	2.5%
483	Water transportation	Transp_rail_and_water	45.6	0.3%
220	Omitted	Utilities	Omitted	
420	Wholesale trade	Wholesale_trade	590.1	3.6%

Table 14: Investment and coverage, by industry

Rank	**Industry**	**Total investment** ('00- '15; USD)	**% of total**	**PPE Coverage** ('00-'15)	**CAPX Coverage** ('00-'15)
1	Information - telecom	$463	12.0%	32%	56%
2	Health - hospitals	$411	10.6%	4%	5%
3	Nondurable goods - chemical	$358	9.3%	34%	39%
4	Professional Services	$259	6.7%	7%	9%
5	Retail trade	$225	5.8%	15%	34%
6	Mining - oil & gas	$202	5.2%	36%	93%
7	Educational	$174	4.5%	1%	2%
8	Information - data	$160	4.1%	22%	23%
9	Wholesale trade	$158	4.1%	7%	9%
10	Agriculture	$146	3.8%	2%	2%
11	Health - other	$120	3.1%	2%	3%
12	Adm and waste mgmt	$101	2.6%	3%	5%
13	Other exc. government	$100	2.6%	1%	1%
14	Information - motion	$99	2.5%	6%	7%
15	Transportation - pipeline	$97	2.5%	15%	20%
16	Nondurable goods - petroleum	$81	2.1%	100%	100%
17	Acc & Food -accomodation	$81	2.1%	20%	31%
18	Durable goods - computer	$74	1.9%	29%	40%
19	Construction	$66	1.7%	2%	4%
20	Nondurable goods - food	$62	1.6%	39%	63%
21	Transportation - ground	$58	1.5%	7%	10%
22	Mining - support industries	$55	1.4%	37%	65%
23	Information - publishing	$55	1.4%	12%	18%
24	Durable goods - transp	$51	1.3%	46%	53%
25	Arts and Rec - Amusement	$51	1.3%	9%	14%
26	Mining - excluding Oil	$50	1.3%	51%	63%
27	Arts and Rec - performing	$40	1.0%	3%	2%
28	Acc & Food - food	$27	0.7%	23%	42%
29	Durable goods - other	$23	0.6%	14%	23%
30	Durable goods - machinery	$23	0.6%	25%	49%
31	Transportation - rail & water	$23	0.6%	28%	60%
32	Transportation - Air	$22	0.6%	28%	48%
33	Durable goods - wood & metal	$5	0.1%	21%	31%
34	Transportation - other	$2	0.0%	24%	57%
35	Management	($0)	0.0%	0%	0%
36	Nondurable goods - other	($51)	-1.3%	29%	40%

Appendix II: Detailed Regression Results

This appendix contains detailed regression results. In particular, it includes the following Tables:

1. Detailed regression results
    (a) Table 15: Aggregate Moving Average Regressions
    (b) Table 16: Industry OLS regressions: all explanations except competition
    (c) Table 17: Industry OLS regressions: competition
    (d) Table 18: Firm OLS regressions: all explanations except governance and short-termism
    (e) Table 19: Firm OLS regressions: governance and short-termism
2. Post-2000 regression results
    (a) Table 20: Post-2000 industry OLS regressions: all explanations except competition
    (b) Table 21: Post-2000 industry OLS regressions: competition
    (c) Table 22: Post-2000 firm OLS regressions: all explanations except governance and short-termism
    (d) Table 23: Post-2000 firm OLS regressions: governance and short-termism

Table 15: Aggregate Moving Average Regressions

Table shows the results of aggregate moving average regressions of Net I/K on Q, measures of competition and quasi-indexer institutional ownership over the periods specified. As shown, the coefficients remain stable and often significant even when accounting for serial correlation in the time series. Annual data. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Net I/K							
	≥1980	≥1980	≥1980	≥1980	≥1990	≥1990	≥1990	≥1990
Stock Q (t-1)	0.008**	0.012*	0.015**	0.013**	0.017**	0.019**	0.021**	0.019**
	[2.71]	[2.41]	[3.50]	[3.89]	[3.10]	[3.96]	[5.36]	[4.11]
ΔLog # of Firms (t-1)†		0.129*	0.078	0.024**†		0.154*	0.088	0.021*†
		[2.07]	[1.60]	[3.09]		[2.07]	[1.52]	[2.47]
Mean % QIX own (t-1)			-0.078**	-0.056**			-0.054*	-0.03
			[-4.63]	[-3.67]			[-2.48]	[-1.39]
MA (t-1)	1.071**	0.978**	0.718	0.825**	0.757**	0.775**	0.605**	0.589*
	[11.12]	[6.48]	[0.00]	[4.37]	[3.58]	[4.47]	[4.24]	[2.19]
MA (t-2)	1	0.777**	1	0.352+	0.654**	0.633**	1	0.459
	[0.0]	[3.92]	[0.00]	[1.74]	[3.90]	[3.20]	[0.0]	[1.57]
Observations	36	36	34	34	26	26	25	25
Log-likelihood	141.9	145.0	143.0	143.5	107.4	110.7	108.2	108.2
Entry source	Census	Census	Census	CPSTAT	Census	Census	Census	CPSTAT

Notes: Investment and Q from the US Flow of Funds; Number of firms from the US Census (columns 2, 3, 6 and 7) and Compustat (columns 4 and 8); Ownership across all US incorporated firms in Compustat.

† We use the 2-year LogΔ#of Firms for census data and 3-year change for Compustat. The longer window is used for Compustat as it exhibits better performance given the volatility in the underlying series – particularly at the industry and firm-level. Using a 2-year window also yields significant coefficients in most regressions, albeit with lower T-stats.

Table 16: Industry OLS regressions: all explanations except competition

Table shows the results of industry OLS panel regressions of Net I/K over the periods specified. All regressions include our 'core' explanations: Q, firm entry/exit and quasi-indexer ownership, as well as mean log-age and log-size. We add additional explanatory variables one by one in columns 3-7 and simultaneously (when significant and properly signed) in column 8. Annual data. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Net I/K							
	≥1980	≥1990	≥2000	≥2000	≥2000	≥1990	≥1990	≥1990
Mean Stock Q (t-1)	0.021**	0.019**	0.018**	0.018**	0.018**	0.018**	0.019**	0.018**
	[7.88]	[6.50]	[5.56]	[5.55]	[5.67]	[6.24]	[6.51]	[6.27]
% sales by Top 8 firms (t-1)	-0.035**	-0.060**	-0.031*	-0.028+	-0.031*	-0.060**	-0.058**	-0.057**
	[-3.07]	[-3.77]	[-2.05]	[-1.87]	[-2.05]	[-3.74]	[-3.63]	[-3.61]
% QIX own (t-1)†	-0.075*	-0.153**	-0.033	-0.048	-0.034	-0.167**	-0.160**	-0.174**
	[-2.52]	[-4.35]	[-0.87]	[-1.19]	[-0.89]	[-4.73]	[-4.59]	[-4.94]
Mean log(age) (t-1)	-0.024**	-0.022**	-0.060**	-0.059**	-0.059**	-0.018*	-0.020**	-0.016*
	[-4.28]	[-3.14]	[-7.34]	[-7.16]	[-7.29]	[-2.51]	[-2.87]	[-2.29]
Mean log(assets) (t-1)	0.010**	0.015**	0.016**	0.019**	0.017**	0.012**	0.015**	0.012*
	[3.07]	[3.33]	[3.93]	[3.68]	[3.84]	[2.60]	[3.27]	[2.57]
Mean ext fin dep ('96-'00)			0					
			[0.15]					
Mean % bank dep ('96-'00)				-0.031				
				[-0.93]				
% rated AA to AAA ('96-'00)					-0.016			
					[-0.12]			
Mean (Intan ex GW)/at (t-1)						-0.180**		-0.172**
						[-2.95]		[-2.82]
Mean % foreign prof (t-1)‡							-0.044**	-0.042**
							[-3.01]	[-2.88]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	No	No	No	Yes	Yes	Yes
Observations	1152	851	503	503	503	851	851	851
Within R^2	0.24	0.288	0.31	0.311	0.31	0.296	0.296	0.303
Overall R^2	0.257	0.245	0.356	0.359	0.356	0.23	0.264	0.253

† quasi-indexer ownership measured as the change from average 1996-2000 level in columns 3, 4 and 5 ‡ Foreign profits set to zero if missing

Table 17: Industry OLS regressions: competition

Table shows the results of industry OLS panel regressions of Net I/K over the periods specified. All regressions include Q, firm demographics, and alternate measures of competition. A wide range of measures sourced from Compustat and the Economic Census appear significant. Annual data. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Net I/K									
	≥1990	≥1990	≥1990	≥1990	≥2000	≥2000	≥1990	≥2000	≥1990	≥2000
Mean Stock Q (t-1)	0.017**	0.017**	0.019**	0.018**	0.020**	0.019**	0.019**	0.020**	0.008*	0.019**
	[6.20]	[6.41]	[7.03]	[6.73]	[6.85]	[6.48]	[5.39]	[5.78]	[2.49]	[6.43]
Mean Age (t-1)	-0.022**	-0.030**	-0.025**	-0.027**	-0.042**	-0.048**	-0.009	-0.007	-0.037**	-0.051**
	[-3.56]	[-5.76]	[-4.66]	[-4.90]	[-6.23]	[-7.22]	[-1.12]	[-0.98]	[-6.87]	[-7.81]
Mean log(age) (t-1)	0.007*	0.007+	0.005	0.005	0.010**	0.011**	0.014**	0.006*	0.017**	0.012**
	[1.99]	[1.94]	[1.42]	[1.34]	[2.90]	[3.18]	[2.64]	[1.96]	[4.54]	[3.35]
3YΔLog#of Firms (t-1)	0.018**									
	[3.20]									
Sales Herfindahl (CP) (t-1)		-0.028*								
		[-2.15]								
% sales in Top 8 (CP) (t-1)			-0.064**							
			[-4.22]							
% MV in Top 8 (CP) (t-1)				-0.041**						
				[-2.97]						
Δ in % sales Top 8 (CP) (t-1)(t-1)†					-0.073**					
					[-3.60]					
Δ in % MV Top 8 (CP) (t-1)†						-0.027				
						[-1.46]				
% sales in Top 20 (Census) (t-1)‡							0			
							[-1.02]			
Δ in % sales Top 20 (1997 to 2012) (Census) ‡								-0.000*		
								[-2.10]		
Log of Reg index (t-1)									-0.007+	
									[-1.85]	
% Licensed ('08)										0.004
										[0.28]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	No
Observations	910	910	910	910	560	560	440	304	672	560
WithinR^2	0.26	0.255	0.266	0.259	0.294	0.284	0.354	0.375	0.292	0.282
OverallR^2	0.303	0.289	0.201	0.252	0.371	0.337	0.245	0.346	0.081	0.333

† Change from average 1996-2000 level. ‡ When a given BEA category includes more than one NAICS Level 3 code, we use the simple average of Census-based concentrations across all relevant NAICS Level 3 categories. We assume concentration remains flat at the last reported level between census (e.g., from 1997 to 2002).

Table 18: Firm OLS regressions: all explanations except governance and short-termism

Table shows the results of firm-level OLS panel regressions of Net CAPX/PPE over the periods specified. All regressions include our 'core' firm-level explanations: Q, measures of competition and quasi-indexer, as well as firm log-age and log-size. We add additional explanatory variables individually in columns 1-7. Annual data. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Net CAPX/PPE						
	≥1990	≥2000	≥2000	≥2000	≥1990	≥1990	≥1990
Stock Q (t-1)	0.078**	0.098**	0.101**	0.073**	0.075**	0.078**	0.075**
	[55.56]	[57.85]	[58.45]	[41.72]	[46.09]	[55.57]	[49.70]
3YΔLog#of Firms (t-1)	0.037**	0.045**	0.041**	-0.002	0.040**	0.037**	0.034*
	[3.26]	[3.03]	[2.76]	[-0.11]	[3.08]	[3.26]	[2.44]
% QIX own (t-2,t-1)†	-0.050**	-0.031+	-0.035+	-0.003	-0.055**	-0.050**	-0.058**
	[-3.21]	[-1.73]	[-1.85]	[-0.17]	[-3.13]	[-3.22]	[-3.54]
Log(age) (t-1)	-0.083**	-0.085**	-0.090**	-0.034**	-0.092**	-0.083**	-0.082**
	[-12.54]	[-10.91]	[-11.20]	[-4.43]	[-11.98]	[-12.54]	[-11.87]
Log(assets) (t-1)	-0.039**	-0.017**	-0.018**	-0.020**	-0.039**	-0.040**	-0.038**
	[-14.11]	[-6.34]	[-5.60]	[-8.09]	[-12.18]	[-14.14]	[-12.80]
Ext fin dep ('96-'00)		0					
		[-1.36]					
Bank dep ('00)			0.023				
			[1.36]				
AA to AAA rating ('00)				-0.016			
				[-0.38]			
(Intan ex GW)/at (t-1)					0.070+		
					[1.86]		
% foreign prof (t-1)						0.003	
						[0.84]	
Log of Reg index (t-1)							-0.002
							[-0.25]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	No	No	No	Yes	Yes	Yes
Observations	59312	27445	26182	24070	48562	59310	51355
WithinR^2	0.099	0.15	0.158	0.091	0.09	0.099	0.091
OverallR^2	0.136	0.211	0.216	0.156	0.132	0.136	0.123

† Quasi-indexer ownership measured as the change from average 1996-2000 level in columns 2, 3 and 4

Table 19: Firm OLS regressions: governance and short-termism

Table shows the results of firm-level OLS panel regressions of Net CAPX/PPE over the periods specified. Regressions include alternate measures of governance and short-termism as well as firm-level Q and firm demographics. Annual data. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01.

	(1)	(2)	(3)	(3)
	Net CAPX/PPE			
	≥1990	≥1990	≥1990	≥1990
Stock Q (t-1)	0.078**	0.077**	0.073**	0.078**
	[55.84]	[54.90]	[50.79]	[55.84]
Log(age) (t-1)	-0.085**	-0.091**	-0.086**	-0.088**
	[-12.94]	[-14.10]	[-13.30]	[-13.57]
Log(assets) (t-1)	-0.039**	-0.046**	-0.050**	-0.042**
	[-13.97]	[-16.51]	[-18.49]	[-15.64]
% QIX ownership (t-1)†	-0.051**			
	[-3.24]			
% Institutional own (t-1)		0.049**		
		[4.36]		
% TRA ownership (t-1)†			0.324**	
			[14.63]	
% DED ownership (t-1)†				-0.04
				[-1.56]
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	59312	61230	59312	59312
Within R^2	0.099	0.096	0.102	0.099
Overall R^2	0.135	0.135	0.142	0.135

Table 20: Post-2000 industry OLS regressions: all explanations except competition

Table shows the results of industry OLS panel regressions of Net I/K over the periods specified. All regressions include our 'core' explanations: Q, firm entry/exit and quasi-indexer ownership, as well as mean log-age and log-size. We add additional explanatory variables one by one in columns 3-6 and simultaneously (when significant and properly signed) in column 8. Annual data. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	≥1990	≥2000	≥2000	≥2000	≥1990	≥1990	≥1990
Mean Stock Q (t-1)	0.020**	0.018**	0.018**	0.018**	0.018**	0.020**	0.019**
	[5.91]	[5.56]	[5.55]	[5.67]	[5.62]	[5.97]	[5.68]
% sales by Top 8 firms (t-1)	-0.075**	-0.031*	-0.028+	-0.031*	-0.068**	-0.070**	-0.065*
	[-2.88]	[-2.05]	[-1.87]	[-2.05]	[-2.66]	[-2.70]	[-2.51]
% QIX own (t-1)†	-0.046	-0.033	-0.048	-0.034	-0.046	-0.054	-0.053
	[-1.11]	[-0.87]	[-1.19]	[-0.89]	[-1.12]	[-1.30]	[-1.29]
Mean log(age) (t-1)	-0.046**	-0.060**	-0.059**	-0.059**	-0.041**	-0.045**	-0.040**
	[-4.83]	[-7.34]	[-7.16]	[-7.29]	[-4.29]	[-4.71]	[-4.20]
Mean log(assets) (t-1)	0.021**	0.016**	0.019**	0.017**	0.019**	0.021**	0.019**
	[3.57]	[3.93]	[3.68]	[3.84]	[3.24]	[3.55]	[3.23]
Mean ext fin dep ('96-'00)		0					
		[0.15]					
Mean % bank dep ('96-'00)‡			-0.031				
			[-0.93]				
% rated AA to AAA ('96-'00)				-0.016			
				[-0.12]			
Mean (Intan ex GW)/at (t-1)					-0.272**		-0.262**
					[-3.38]		[-3.27]
Mean % foreign prof (t-1)‡						-0.029+	-0.025+
						[-1.90]	[-1.70]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	No	No	No	Yes	Yes
Observations	516	503	503	503	516	516	516
Within R^2	0.306	0.31	0.311	0.31	0.323	0.312	0.327
Overall R^2	0.265	0.356	0.359	0.356	0.224	0.288	0.247

† quasi-indexer ownership measured as the change from average 1996-2000 level in columns 3, 4 and 5 ‡ Foreign profits set to zero if missing

Table 21: Post-2000 industry OLS regressions: competition

Table shows the results of industry OLS panel regressions of Net I/K over the periods specified. All regressions include Q, firm demographics, and alternate measures of competition. As shown, a wide range of measures sourced from Compustat and the Economic Census appear significant. Annual data. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Net I/K									
	≥1990	≥1990	≥1990	≥1990	≥2000	≥2000	≥1990	≥2000	≥1990	≥2000
Mean Stock Q (t-1)	0.017**	0.019**	0.020**	0.019**	0.020**	0.019**	0.019**	0.020**	0.013**	0.019**
	[5.54]	[6.11]	[6.48]	[6.11]	[6.85]	[6.48]	[5.39]	[5.78]	[3.66]	[6.43]
Mean log(age) (t-1)	-0.043**	-0.050**	-0.044**	-0.049**	-0.042**	-0.048**	-0.009	-0.007	-0.053**	-0.051**
	[-4.93]	[-6.49]	[-5.50]	[-6.40]	[-6.23]	[-7.22]	[-1.12]	[-0.98]	[-6.77]	[-7.81]
Mean log(assets) (t-1)	0.019**	0.018**	0.017**	0.017**	0.010**	0.011**	0.014**	0.006*	0.033**	0.012**
	[3.80]	[3.60]	[3.34]	[3.39]	[2.90]	[3.18]	[2.64]	[1.96]	[5.71]	[3.35]
3YΔLog#of Firms (t-1)	0.016*									
	[2.18]									
Sales Herfindahl (CP) (t-1)		-0.021								
		[-1.01]								
% sales in Top 8 (CP) (t-1)			-0.071**							
			[-2.97]							
% MV in Top 8 (CP) (t-1)				-0.027						
				[-1.30]						
Δ in % sales Top 8 (CP) (t-1)(t-1)†					-0.073**					
					[-3.60]					
Δ in % MV Top 8 (CP) (t-1)†						-0.027				
						[-1.46]				
% sales in Top 20 (Census) (t-1)‡							0			
							[-1.02]			
Δ in % sales Top 20 (1997 to 2012) (Census) ‡								-0.000*		
								[-2.10]		
Log of Reg index (t-1)									-0.014*	
									[-2.42]	
% Licensed ('08)										0.004
										[0.28]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	No
Observations	560	560	560	560	560	560	440	304	413	560
WithinR^2	0.291	0.286	0.296	0.287	0.294	0.284	0.354	0.375	0.318	0.282
OverallR^2	0.277	0.309	0.243	0.306	0.371	0.337	0.245	0.346	0.032	0.333

† Change from average 1996-2000 level. ‡ When a given BEA category includes more than one NAICS Level 3 code, we use the simple average of Census-based concentrations across all relevant NAICS Level 3 categories. We assume concentration remains flat at the last reported level between census (e.g., from 1997 to 2002).

Table 22: Post-2000 firm OLS regressions: all explanations except governance and short-termism

Table shows the results of firm-level OLS panel regressions of Net CAPX/PPE over the periods specified. All regressions include our 'core' firm-level explanations: Q, measures of competition and QIX ownership, as well as firm log-age and log-size. We add additional explanatory variables individually in columns 1-7. Annual data. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Net CAPX/PPE						
	≥1990	≥2000	≥2000	≥2000	≥1990	≥1990	≥1990
Stock Q (t-1)	0.074**	0.098**	0.101**	0.073**	0.068**	0.074**	0.074**
	[41.09]	[57.85]	[58.45]	[41.72]	[34.08]	[41.09]	[37.47]
3YΔLog#of Firms (t-1)	0.006	0.045**	0.041**	-0.002	0.013	0.006	0.001
	[0.37]	[3.03]	[2.76]	[-0.11]	[0.80]	[0.37]	[0.05]
% QIX own MA2(t-1)†	-0.062**	-0.031+	-0.035+	-0.003	-0.075**	-0.062**	-0.083**
	[-2.99]	[-1.73]	[-1.85]	[-0.17]	[-3.45]	[-2.99]	[-3.77]
Log(age) (t-1)	-0.029*	-0.085**	-0.090**	-0.034**	-0.026*	-0.029*	-0.047**
	[-2.43]	[-10.91]	[-11.20]	[-4.43]	[-2.02]	[-2.43]	[-3.64]
Log(assets) (t-1)	-0.022**	-0.017**	-0.018**	-0.020**	-0.021**	-0.022**	-0.025**
	[-5.07]	[-6.34]	[-5.60]	[-8.09]	[-4.62]	[-5.07]	[-5.42]
Ext fin dep ('96-'00)		0					
		[-1.36]					
Bank dep ('00)			0.023				
			[1.36]				
AA to AAA rating ('00)				-0.016			
				[-0.38]			
(Intan ex GW)/at (t-1)					0.005		
					[0.11]		
% foreign prof (t-1)						0	
						[0.12]	
Log of Reg index (t-1)							-0.015
							[-1.52]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	No	No	No	Yes	Yes	Yes
Observations	33803	27445	26182	24070	30667	33802	33803
WithinR^2	0.085	0.15	0.158	0.091	0.071	0.085	0.09
OverallR^2	0.137	0.211	0.216	0.156	0.131	0.137	0.14

† QIX ownership measured as the change from average 1996-2000 level in columns 2, 3 and 4

Table 23: Post-2000 firm OLS regressions: governance and short-termism

Table shows the results of firm-level OLS panel regressions of Net CAPX/PPE over the periods specified. Regressions include alternate measures of governance and short-termism as well as firm-level Q and firm demographics. Annual data. T-stats in brackets. + p<0.10, * p<0.05, ** p<.01.

	(1)	(2)	(3)	(3)
	Net CAPX/PPE			
	≥1990	≥1990	≥1990	≥1990
Stock Q (t-1)	0.074**	0.074**	0.071**	0.074**
	[41.19]	[41.03]	[38.44]	[41.23]
Log(age) (t-1)	-0.030*	-0.038**	-0.036**	-0.034**
	[-2.49]	[-3.27]	[-3.05]	[-2.91]
Log(assets) (t-1)	-0.021**	-0.029**	-0.031**	-0.025**
	[-5.06]	[-6.81]	[-7.59]	[-6.07]
% QIX ownership (t-1)†	-0.062**			
	[-2.99]			
% Institutional own (t-1)		0.022		
		[1.41]		
% TRA ownership (t-1)†			0.250**	
			[8.66]	
% DED ownership (t-1)†				-0.052
				[-1.52]
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	33803	35721	33803	33803
Within R^2	0.085	0.08	0.087	0.084
Overall R^2	0.137	0.136	0.147	0.137