GERMÁN GUTIÉRREZ
New York University

THOMAS PHILIPPON
New York University

Investmentless Growth: An Empirical Investigation

ABSTRACT We analyze private fixed investment in the United States during 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 2000s. There are two broad categories of explanations: theories that predict low investment *along with* a low Q, and theories that predict low investment *despite* a high Q. We argue that the data do not support the first category, so we focus on the second one. We use industry-level and firm-level data to test whether underinvestment relative to Q is driven by (i) financial frictions; (ii) changes in the nature or localization of investment, due to the rise of intangibles, globalization, and the like; (iii) decreased competition, due to technology, regulation, or common ownership; or (iv) tightened corporate governance or increased short-termism. We do not find support for theories based on financial frictions. We find some support for globalization and regulation; and we find strong support for the intangibles, competition, and short-termism or corporate governance hypotheses. We estimate that the rise of intangibles explains about one-third of the drop in investment, while concentration and corporate governance explain the rest. Industries with more concentration and more common ownership invest less, even after controlling for current market conditions and intangibles. Within each industry-year, the investment gap is driven by firms owned by quasi-indexers and located in industries with more concentration and common ownership. These firms return a disproportionate amount of free cash flows to shareholders. Finally, we show that

Conflict of Interest Disclosure: The authors did not receive financial support from any firm or person for this paper or from any firm or person with a financial or political interest in this paper. They are currently not officers, directors, or board members of any organization with an interest in this paper. No outside party had the right to review this paper before publication.

slow-moving changes in competition are difficult to detect in macroeconomic series; standard growth-accounting decompositions confound market power and other medium-run trends, such as falling total factor productivity and labor participation.

In his March 2014 letter to corporate executives, Laurence Fink, BlackRock's CEO, 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; International Monetary Fund 2015; Vashakmadze and others 2017) as well as in academic papers (Hall 2014; Alexander and Eberly 2016; Fernald and others 2017). And it appears to affect not only the United States but also Europe and other emerging markets (Bussière, Ferrara, and Milovich 2015; Buca and Vermeulen 2015; Döttling, Gutiérrez, and Philippon 2017; Lewis and others 2014; Kose and others 2017).

This paper presents systematic evidence on the extent of the investment puzzle for the United States and provides a preliminary assessment of the potential explanations. We clarify some of the theory and the empirical evidence, and we test whether alternative theories of underinvestment 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 a high value for Tobin's *Q*; and (ii) this investment wedge is linked to rising intangibles, decreased competition, and changes in corporate governance that encourage payouts instead of investment.

We present a broad overview of the available evidence and review the proposed theoretical explanations. We spend much effort reconciling results at the firm level, at the industry level, and in the aggregate; and we discuss the macroeconomic implications of our findings. We find that competition and corporate governance are promising explanations, but here we do not try to establish causality. Instead, we address the causality issue, using a combination of instrumental variables and natural experiments, in two related papers—Gutiérrez and Philippon (2017a) for competition, and Gutiérrez and Philippon (forthcoming) for corporate governance and short-termism.

APPROACH Throughout the paper, we use Tobin's *Q* theory as a measurement tool to distinguish between two broad types of shocks: (i) shocks that fit the *Q* equation, and therefore predict low investment *along with* a low

Tobin's Q; and (ii) shocks that change the Q equation, and therefore predict low investment *despite* a high Tobin's Q. The first category includes shocks to risk aversion and expected growth. The standard Q equation holds under these shocks, so the only way they can explain low investment is by predicting low values for Q. The second category ranges from credit constraints to oligopolistic competition, and implies a shift in the first-order condition for optimal investment. Such shocks create a gap between Q and investment due to differences between average and marginal Q (for example, market power and growth options) or differences between firm value and the manager's objective function (for example, corporate governance and short-termism).

We find that 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 suggest that this weakness starts in about 2000. This is true when controlling for firm age, size, and profitability; when focusing on subsets of industries; and even when considering tangible and intangible investment separately. Given these results, we discard shocks that predict low investment along with a low Q, and we focus on theories that create a gap between Q and investment. This still leaves a large set of potential explanations—out of which we consider the following eight (grouped into four broad categories):[1]

—Financial frictions: (i) external finance, (ii) bank dependence, and (iii) safe asset scarcity.

—Changes in the nature or localization of investment: (iv) intangibles and (v) globalization.

—Decreased competition: (vi) regulation and (vii) market power, due to other factors.

—Tighter corporate governance: (viii) ownership and shareholder activism.

Testing these hypotheses requires data at different levels of aggregation. Some are industry-level theories (for example, competition), some are firm-level theories (for example, ownership), and some are theories that can be tested at both the industry and firm levels. We gather industry investment data from the U.S. Bureau of Economic Analysis (BEA), we collect firm investment data from Compustat, and we also include additional data needed to test each of the eight hypotheses.

For instance, for market power, we obtain measures of firm entry, firm exit, price–cost margins, and concentration (including "traditional" and

1. See section II for a detailed discussion of these hypotheses.

common ownership–adjusted Herfindahl index values,[2] as well as concentration ratios defined as the share of sales and market value of the top 4, 8, 20, and 50 firms in each industry) from Compustat and the U.S. Census Bureau. For corporate governance and short-termism, we use Brian Bushee's (2001) institutional investor classification. The classification identifies dedicated, quasi-indexer, and transient 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. Transient owners have high diversification and high portfolio turnover. Sample dedicated, quasi-indexer, and transient institutions, respectively, include Berkshire Hathaway, Vanguard, and Credit Suisse. See section III for additional details.

Firm- and industry-level data are not readily comparable because they differ in their coverage and in their definitions of investment and capital. As a result, we spent a fair amount of time simply reconciling and understanding the various data sources. The key conclusions are summarized in section III and in the online appendix.[3] The final data sets are not entirely comparable, primarily due to differences between accounting and economic values. But they exhibit similar trends. And our conclusions are robust across data sets and levels of aggregation.

CONCLUSIONS We test whether each of the eight hypotheses is supported by the data through industry- and firm-level panel regressions. We use the cumulant estimator developed by Timothy Erickson, Colin Huan Jiang, and Toni Whited (2014) to control for "classical" errors-in-variables problems in Q, and we discuss key sources of measurement error where appropriate. We find strong support for the market power, corporate governance, and intangibles hypotheses.

Market power and corporate governance. At the industry level, we find that industries with more quasi-indexer institutional ownership and less competition (as measured by higher "traditional" and common ownership–adjusted Herfindahl index values, as well as higher price–cost margins) invest less. These results are robust to controlling for intangible intensity, firm age, and Q. The decrease in competition is supported by a growing

2. We follow O'Brien and Salop (2000) and Azar, Schmalz, and Tecu (2016) to compute the common ownership–adjusted Herfindahl index, which accounts for anticompetitive incentives due to common ownership. See section II for additional details.

3. The online appendixes for this and all other papers in this volume may be found at the *Brookings Papers* web page, www.brookings.edu/bpea, under "Past BPEA Editions."

body of literature,[4] though the empirical implications for investment have not been recently studied (to our knowledge). Similarly, the mechanisms through which quasi-indexer institutional ownership affects investment remain to be fully understood; though such ownership may eliminate empire building by improving corporate governance (Appel, Gormley, and Keim 2016a), it may also increase short-termism (Asker, Farre-Mensa, and Ljungqvist 2014; Almeida, Fos, and Kronlund 2016; Bushee 1998)—both of which could lead to higher payouts and less investment. At this point, we are unable to differentiate empirically between these two hypotheses. We simply show that firms with higher passive institutional ownership have higher payouts and lower investment. Relatedly, Gutiérrez (2017) uses industry-level data to study the evolution of labor and profit shares across advanced economies. He shows that labor shares decreased and profit shares increased only in the United States, while they remained relatively stable in the rest of the world. This unique evolution in the United States is explained by rising U.S. concentration, compared with stable concentration in Europe.

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.

Intangibles. The rise of intangibles can affect investment in two primary ways. First, intangible investment is difficult to measure. Underestimation of intangible investment would lead to underestimation of intangible capital, and therefore overestimation of Q; which could translate to an "observed" underinvestment in industries with a higher share of intangibles. Second, intangible assets might be more difficult to accumulate. A rise in the relative importance of intangibles could lead to a higher equilibrium value of Q, even if intangibles are correctly measured. Ryan Peters and Lucian Taylor (2017) and Lewis Alexander and Janice Eberly (2016) study the relationship between Q and intangible investment. Consistent with their work, we find that industries with a rising share of intangibles exhibit lower investment. We estimate that intangibles can explain a quarter to a third of the observed investment gap; but this still leaves large, persistent residuals

4. For instance, the Council of Economic Advisers (2016, p. 4) "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 and others (2016) and Grullon, Larkin, and Michaely (2017).

after 2000—residuals that are strongly correlated with increased concentration and quasi-indexer ownership.[5]

None of the other theories (for example, credit constraints) appear to be supported by the data. They often exhibit "wrong" or inconsistent signs or are not statistically significant.[6]

MACROECONOMIC IMPLICATIONS To conclude, we study the implications of our findings vis-à-vis recent work in the macroeconomics literature. In particular, John Fernald and others (2017) rely on a quantitative, growth-accounting decomposition to study the output shortfall in the United States after the Great Recession. They conclude that the shortfall is explained by slower growth in total factor productivity (TFP) and decreased labor force participation.

This explanation appears to leave no room for the ones that we emphasize, so we test how growth accounting would capture changes in competition or corporate governance. To do so, we simulate macroeconomic series under rising markups using the model of Callum Jones and Philippon (2016),[7] and we study whether growth-accounting decompositions recover the true shocks. We find that a rise in markups decreases output, capital,

5. It is also worth emphasizing, as Peters and Taylor (2017) do, that *Q* explains intangible investment relatively well, and works even better when both tangible and intangible investments are combined. This is exactly as the theory would predict. Moreover, intangible investment exhibits roughly the same weakness as tangible investment starting in about 2000. Properly accounting for intangible investment is clearly a first-order empirical issue, but as far as we can tell, it does not lessen the puzzle that we document. See Döttling and Perotti (2017) for related evidence.

6. Additional details are warranted for two explanations. First, regarding globalization, we do find that industries with higher foreign profits, sales, or capital expenditures invest less in the United States. But firm-level investment does not depend on the share of foreign profits, suggesting that firms are investing less relative to *Q*, irrespective of location. And, perhaps more important, the observed underinvestment and significant correlations to concentration and ownership remain even after controlling for foreign activity. Second, we find no support for regulation when directly including the Mercatus Center's regulation index (Al-Ubaydli and McLaughlin 2015) in panel regressions. But this may be due to measurement error in the regulation index, or because regulation works through competition. In fact, we use the same regulation index as an instrument for concentration in Gutiérrez and Philippon (2017b), and find that increasing regulation explains higher concentration and lower investment.

7. Jones and Philippon (2016) explore the macroeconomic consequences of decreased competition in a standard dynamic stochastic general equilibrium model with time-varying parameters and an occasionally binding zero lower bound. They show that the trend decrease in competition can explain the joint evolution of investment, *Q*, and the nominal interest rate. Absent the decrease in competition, they find that the U.S. economy would have escaped the zero lower bound by the end of 2010 and that the nominal rate in 2016 would be close to 2 percent.

labor, and the capital–output ratio (as expected). "Measured" TFP decreases slightly when using standard growth approaches (Fernald and others 2017; Fernald 2014) and adjusting for changes in the capital share. Applying the trend/cycle/irregular decomposition of Fernald and others (2017), we find that it would attribute the drop in output to a combination of TFP and decreased labor supply. Growth accounting therefore seems unlikely to be able to separately identify changes driven by market power from those driven by other factors. We conclude that some of the observed decline in TFP growth and labor input can be explained by rising market power and changes in corporate governance.

The remainder of this paper is organized as follows. Section I presents four important facts about the nonfinancial sector and its investment. Section II discusses the theories that may explain underinvestment relative to *Q* and reviews the related literature. Section III describes the data used to test our eight hypotheses. Section IV discusses the methodology and results of our analyses. Section V drills down to provide detailed discussions of four hypotheses: (i) increased concentration, particularly as it relates to "superstar" firms; (ii) the rise of intangibles; (iii) globalization; and (iv) the effect of safe asset scarcity on investment. Section VI discusses the macroeconomic implications of our results; and section VII concludes. The online appendix provides more detailed discussions of data sources and results.

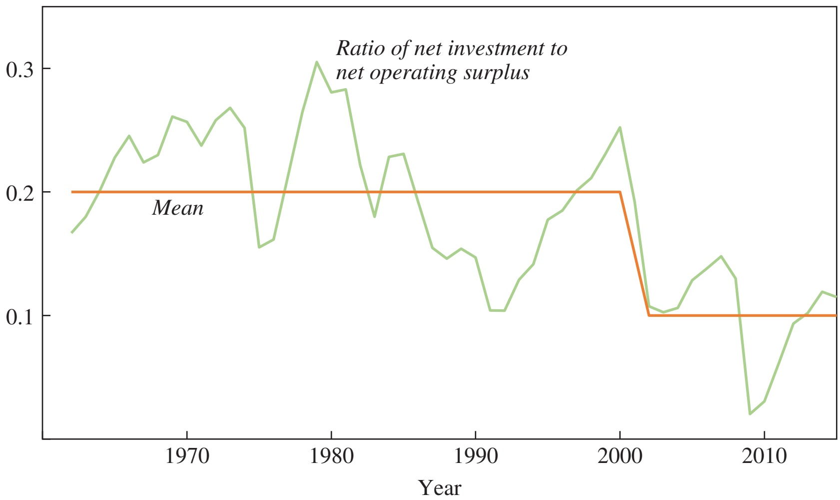
I. Four Facts about the U.S. Nonfinancial Sector

We present four important facts related to investment by the U.S. nonfinancial sector in recent years. We focus on the nonfinancial sector for three main reasons. First, this sector is the main source of nonresidential investment. Second, we can roughly reconcile aggregate data from the Financial Accounts of the United States with industry-level investment data from the BEA (which include residential and nonresidential investment, as well as investment in intellectual property). Finally, we can use data on the market value of stocks and bonds for the nonfinancial corporate sector to disentangle various theories of secular stagnation.

I.A. Fact 1: The Nonfinancial Business Sector Is Profitable but Does Not Invest

One reason investment might be low is that profits might be low. This, however, is not the case. As documented by Paul Gomme, B. Ravikumar, and Peter Rupert (2011) (and as shown in figure 21 in the online appendix),

Figure 1. Net Investment Relative to Net Operating Surplus, 1962–2015[a]



Sources: Financial Accounts of the United States; FRED.
a. The data are for nonfinancial corporate and noncorporate business,

the operating return on capital of the nonfinancial corporate, nonfinancial noncorporate, and nonfinancial business sectors was not severely affected by the Great Recession, and has been consistently near its highest value since 2011.[8] Instead, firms are investing a smaller fraction of their operating returns than they used to. Figure 1 shows the ratio of net investment, NI, to net operating surplus, OS, for the nonfinancial business sector, defined as

$$\text{(1)} \qquad \frac{NI}{OS} = \frac{P_t^k\left(I_t - \delta_t K_t\right)}{P_t Y_t - \delta_t P_t^k K_t - W_t N_t - T_t^y},$$

where NI is defined as investment (I_t) net of depreciation ($\delta_t K_t$), adjusted for the price of capital (P_t^k); and OS is defined as output ($P_t Y_t$) net of depreciation ($\delta_t P_t^k K_t$), wages ($W_t N_t$), and taxes on production and imports, less subsidies (T_t^y).

8. Relatedly, Barkai (2017) shows that the profit share of the nonfinancial corporate sector has increased drastically since 1980.

The average for the ratio between 1962 and 2001 is 20 percent. The average for the ratio from 2002 to 2015 is only 10 percent.[9] Current investment is low relative to operating margins.

I.B. 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, 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 neoclassical theory of investment—developed by Dale Jorgenson (1963), William Brainard and James Tobin (1968), and Tobin (1969), among others—captures this trade-off.[10] According to this theory, Tobin's *Q*—defined as the ratio of the market value to the replacement cost of capital stock—is a sufficient statistic for investment (see section II for additional details). Figure 2 shows the evolution of *Q*, measured as

$$Q = \frac{V^e + (L - FA) - Inventories}{P_k K}, \quad (2)$$

where V^e is the market value of equity; L are liabilities (mostly measured at book values, but this is a rather small adjustment; see Hall 2001); FA are financial assets; and $P_k K$ is the replacement cost of capital.[11] As shown, Q is quite high by historical standards. This is consistent with the rapid rise in corporate profits shown in figure 21 in the online appendix and the rise in net savings (not shown).

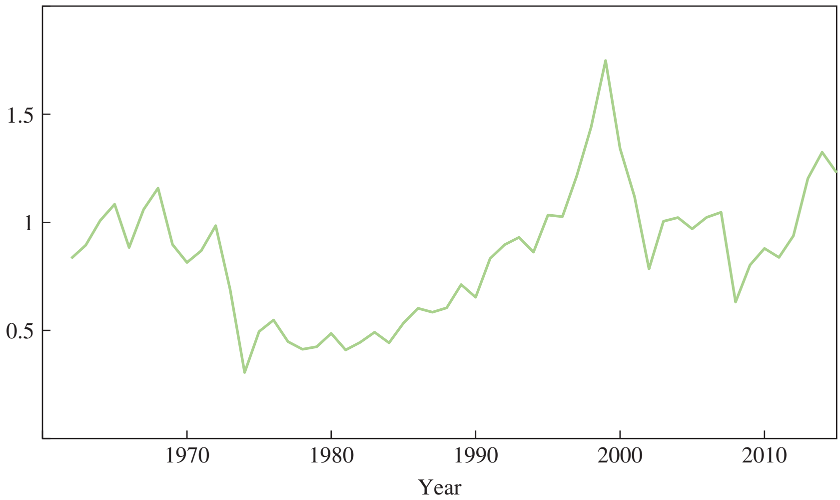
Comparing Q and investment, we reach our main conclusion: Investment is low relative to Q. The left panel of figure 3 shows the aggregate net investment rate for the nonfinancial business sector along with the fitted

9. Note that 2002 is used for illustration purposes only; the cutoff is not based on a formal statistical analysis.

10. See Dixit and Pindyck (1994), among others, for a rigorous treatment of the theory of investment with nonconvex adjustment costs.

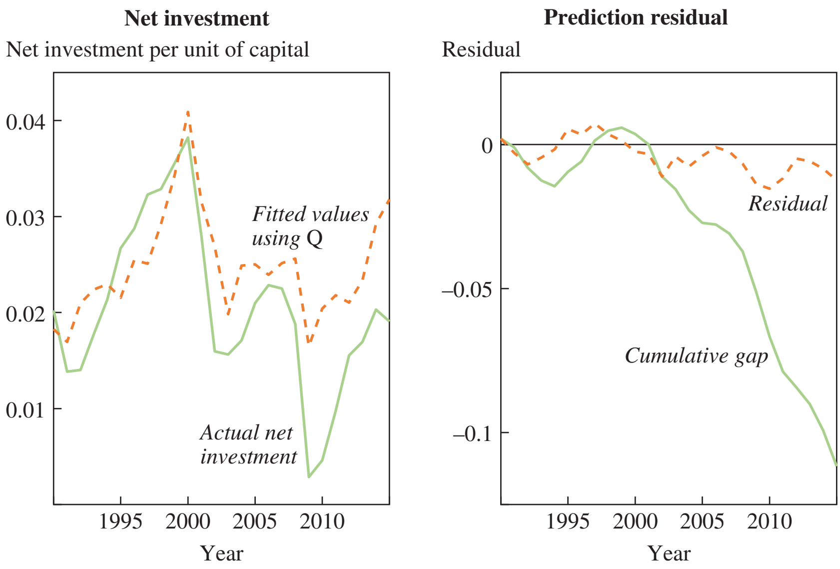
11. Note that the BEA measure of K now includes intangible assets—including software; research and development; and entertainment, literary, and artistic originals—so that our measure of Q is lower than in the previous literature. Because financial assets and liabilities contain large residuals, we also compute $Q^{misc} = Q + \frac{A^{misc} - L^{misc}}{P_k K}$ where A^{misc} and L^{misc} are the miscellaneous assets and liabilities recorded in the Financial Accounts. Because $A^{misc} > L^{misc}$, it follows that $Q^{misc} > Q$. It is unclear which measure is more appropriate; but the conclusions remain the same.

Figure 2. Stock Market *Q*, 1962–2015[a]



Sources: Financial Accounts of the United States; FRED.
a. The data are for nonfinancial corporate business.

Figure 3. Net Investment versus *Q*, 1990–2015[a]



Sources: Financial Accounts of the United States; FRED.
a. The data are for nonfinancial corporate and noncorporate business.

value for a regression on lagged *Q* from 1990 to 2001. The right panel shows the regression residuals (for each period and cumulative) from 1990 to 2015. Both panels clearly show that investment has been low relative to *Q* since sometime in the early 2000s.[12] By 2015, the cumulative underinvestment is more than 10 percent of capital.[13] This pattern is even more striking when considering the 1967–2016 period as plotted by Robert Hall in figure 2 of his comment. Moreover, as discussed below, this conclusion is robust to studying more granular (industry- and firm-level) trends; including additional measures of fundamentals, such as cash flow; considering only a subset of industries; and even splitting tangible and intangible assets. See subsection IV.B for additional details.[14]

Because we argue that underinvestment relative to *Q* is explained by rising concentration and increased quasi-indexer ownership, the next two facts discuss the relevant aggregate trends.

I.C. Fact 3: Business Dynamism Has Decreased

The evolution of a wide range of measures of business dynamism, concentration, and market power all point to declining competition in the United States.[15] To illustrate these trends, figure 4 shows the establishment entry and exit rates from the U.S. Census Bureau's Business Dynamics Statistics. The observed downward trend in business dynamism has been highlighted by numerous authors (for example, Ryan Decker and others 2014), and has been particularly severe in recent years. In fact, Decker and others (2016) argue that dynamism declined in selected sectors (notably

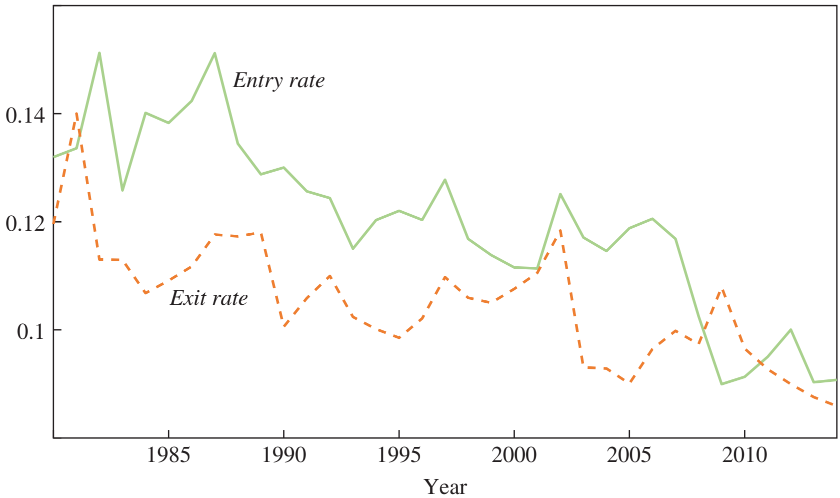
12. By the definition of ordinary least squares, the cumulative residual for 2001 is zero, but the underinvestment from then on is striking.

13. 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 or participation in equity markets that make it difficult to compare the 2000s with the 1960s. Even in shorter windows, van Binsbergen and Opp (2017) 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.

14. The decrease in net investment could be the result of changes in the depreciation rate or the relative price of investment. However, as shown in the online appendix, both these quantities have remained relatively stable since 2000.

15. See Davis and others (2006) and Decker and others (2014, 2016) for evidence of declining business dynamism; see Council of Economic Advisers (2016), Autor and others (2017a), and Grullon, Larkin, and Michaely (2017) for evidence of rising concentration; and see Barkai (2017), De Loecker and Eeckhout (2017), and Gutiérrez (2017) for evidence of rising markups.

Figure 4. Establishment Entry and Exit Rates, 1980–2014



Source: U.S. Census Bureau, Business Dynamics Statistics.

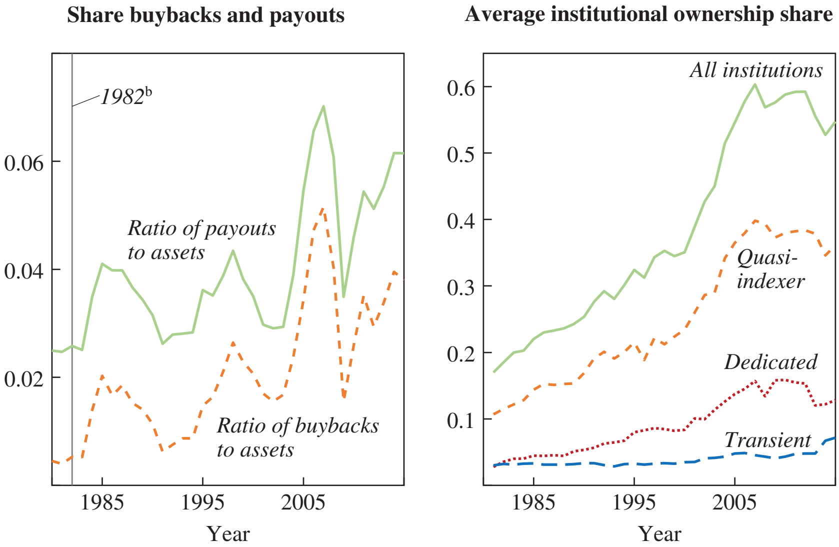
retail) in the 1980s and 1990s, and in all sectors in the 2000s—including the traditionally high-growth information technology sector.

I.D. Fact 4: Institutional Ownership and Payouts Have Increased

The left panel of figure 5 shows the total buybacks and payouts for firms incorporated in the United States that are included in our Compustat sample (see section III). As shown, there has been a substantial increase in total payouts, primarily driven by share buybacks. The increase has been so substantial that, since 2005, firms have been repurchasing as much as 3 percent of their assets per year.[16] The figure's right panel shows the average share of institutional ownership, by type. Again, we see a substantial increase in institutional ownership after 2000—primarily driven by growth in quasi-indexer institutions. This is not shown in the figure, but the increase has been particularly pronounced for smaller firms; since 2000, the dollar-weighted share of quasi-indexer institutional ownership has increased from about 35 percent to about 50 percent, while the median

16. The increase starts soon after 1982, when the U.S. Securities and Exchange Commission issued rule 10b-18 (noted by the vertical line). Rule 10b-18 allows companies to repurchase their shares on the open market without regulatory limits.

Figure 5. Payouts and Institutional Ownership, 1980–2015[a]



Sources: Compustat; Thomson Reuters; Brian Bushee.

a. The data are for all firms incorporated in the United States in our Compustat sample. The results are similar when we include firms incorporated outside the United States.

b. This line at 1982 highlights the passing of the U.S. Securities and Exchange Commission's rule 10b-18, which allows companies to repurchase their shares on the open market without regulatory limits.

share has increased from about 15 percent to about 40 percent. That is, while the dollar-weighted quasi-indexer ownership has increased by about 50 percent, it has more than doubled for the median firm. These two effects closely match the timing of decreasing investments at the aggregate level.

II. What Might Explain the Underinvestment?

Section I shows that investment is low relative to Q. This section provides a brief overview of Q theory, and outlines the theories that could explain a gap between Q and investment.

II.A. Q Theory

Consider a firm that chooses a sequence of investments 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 and the like). The firm's program is then

$$\text{(3)}\quad V_t(K_t) = \max_{I_t} \mu_t P_t K_t - P_t^k I_t - \frac{\gamma}{2} P_t^k K_t \left(\frac{I_t}{K_t} - \delta_t \right)^2 + E_t[\Lambda_{t+1} V_{t+1} K_{t+1}],$$

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

$$\text{(4)}\qquad \mathcal{V}_t = \max_{x} \mu_t P_t - P_t^k (x_t + \delta_t) - \frac{\gamma}{2} P_t^k x^2 + (1 + x_t) E_t\left[\Lambda_{t+1} \mathcal{V}_{t+1}\right],$$

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

$$\text{(5)}\qquad x_t = \frac{1}{\gamma}(Q_t - 1),$$

where

$$\text{(6)}\qquad Q_t \equiv \frac{E_t\left[\Lambda_{t+1} \mathcal{V}_{t+1}\right]}{P_t^k} = \frac{E_t[\Lambda_{t+1} V_{t+1}]}{P_t^k K_{t+1}}.$$

Q is the ex-dividend market value of the firm divided by the replacement cost of its capital stock. Clearly, Q is just one first-order condition satisfied by the firm—with another condition driving demand for the firm's output; and several other conditions needed to close the standard model. As a result, Q is not a causal force for investment. It is simply a useful endogenous measure to classify shocks over time.

Q theory is based on the following assumptions (Hayashi 1982): (i) no financial constraints, (ii) shareholder value maximization, (iii) constant returns to scale, and (iv) perfect competition. Since its inception, Q theory has been tested empirically by a large body of literature. Q performs strongly in the cross section, but less so in the time series. The basic Q equation fits aggregate U.S. data poorly, leaves large unexplained residuals correlated with cash flows, and implies implausible parameters for the adjustment cost function. Kevin Hassett and Glenn Hubbard (1997) and Ricardo Caballero (1999) provide reviews of the early literature.

Several theories emerged to explain these failures—including market power (Abel and Eberly 1994), nonconvex adjustment costs (Caballero and Engel 1999), and financial frictions (Bernanke and Gertler 1989). But none of these is fully satisfactory. The evidence for constant returns and price taking seems quite strong (Hall 2003). Adjustment costs are certainly not convex at the firm level, but it is not clear that this really matters at the industry level or in the aggregate (Thomas 2002; Hall 2004)—though this is still a controversial issue (Bachmann, Caballero, and Engel 2013). Joao Gomes (2001) shows that *Q* should capture most investment dynamics, even when there are credit constraints. And heterogeneity and aggregation do not seem to create strong biases (Hall 2004).

A fourth explanation—measurement error in *Q*—has found strong support in the recent literature. During the 1990s and early 2000s, several researchers emphasized measurement error in the market value of equity (Gilchrist and Himmelberg 1995; Cummins, Hassett, and Oliner 2006; Erickson and Whited 2000). Erickson and Whited (2000, 2006) use generalized method of moments estimators to purge measurement errors from *Q*. They find that only 40 percent of observed variations are due to fundamental changes, implying that market values contain large measurement errors. *Q* theory performs substantially better once such classical measurement errors have been controlled for, and residuals are no longer correlated with cash flows. Peters and Taylor (2017) emphasize measurement error in intangible capital, and show that properly accounting for intangibles substantially improves the performance of *Q* theory (although, as we discuss below, this is in part due to their choice of an empirical proxy for the traditional *Q*).

We take these theories—and the implied deviations between *Q* and investment—seriously. We control for classical errors-in-variables problems using the cumulant estimator developed by Erickson, Jiang, and Whited (2014); and we use empirical proxies for the remaining theories to test whether they can explain underinvestment. In other words, we use *Q* theory as a benchmark and a useful way to sort the explanations into two groups: those where *Q* theory fits (for example, changes in risk premiums, expected demand, or technology), and those that imply a divergence between *Q* and investment (for example, changes in market power). The next subsection details the specific hypotheses (that is, the variations of these theories) that we consider.

As noted above, the approach we take in this paper does not allow us to prove a causal relationship between a particular factor and investment. We deal with causality issues in two companion papers. In Gutiérrez and

Philippon (2017a) we deal with the endogeneity of concentration measures due to entry, exit, and mergers. We present three identification strategies that show the causal impact of competition on investment. In Gutiérrez and Philippon (forthcoming), we focus on corporate governance issues. We use the Russell index threshold as a natural experiment, and predetermined relative quasi-indexer ownership as an instrumental variable. We find that tighter corporate governance causes higher payouts and less investment.[17]

II.B. Hypotheses

We consider the following eight hypotheses (grouped into four broad categories) for explaining low investment *despite* a high Q:[18]

FINANCIAL FRICTIONS

External finance. A large body of literature—following Steven Fazzari, Hubbard, and Bruce Petersen (1988)—argues that frictions in financial markets can constrain investment decisions and force firms to rely on internal funds. Raghuram Rajan and Luigi 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. Viral Acharya and Guillaume Plantin (2017) argue that weak investment may be linked to excessive leverage encouraged by loose monetary policy. That said, one issue with the external finance story is that, in most calibrated models, the Q equation fits well even when financial constraints are material, because Q also captures the value of access to finance (Hennessy and Whited 2007; Gomes 2001).

Bank dependence. Bank dependence is a particular financial constraint that affects the subset of firms without access to capital markets. We test whether bank-dependent firms are responsible for underinvestment (Alfaro, Beck, and Calomiris 2015). This hypothesis is supported by recent papers—such as that by Brian Chen, Samuel Hanson, and Jeremy Stein

17. In Gutiérrez and Philippon (forthcoming), we also study the interaction between corporate governance and competition in causing underinvestment. At the firm level, we show that corporate governance matters most for firms in noncompetitive industries, which tend to buy back more shares and invest less.

18. We also considered changes in research and development (R&D) expenses as a proxy for a lack of ideas. Firms increasing R&D expenses are likely to have better ideas and therefore a higher marginal Q. So we test whether underinvesting industries (and firms) exhibit a parallel decrease in R&D expenses. 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 (for example, if ideas are harder to identify). We were unable to find a better measure for (a lack of) ideas, so we cannot rule out this hypothesis.

(2017), which shows that reductions in small business lending have affected investment by smaller firms.[19]

Safe asset scarcity. Safe asset scarcity or changes in the composition of assets may affect corporations' capital costs (Caballero and Farhi, forthcoming). In their simple form, such variations would have an impact on Q but would not cause a gap between Q and investment. However, a gap may appear if safe firms are unable or unwilling to take full advantage of low funding costs (due to, for example, product market rents). See subsection V.D for additional discussion and results relevant to this hypothesis.

CHANGES IN THE NATURE OR LOCALIZATION OF INVESTMENT

Intangibles. The rise of intangibles may affect investment in several ways. First, intangible investment is difficult to measure. Underestimation of intangible investment would lead to underestimation of intangible capital, and therefore overestimation of Q; and this would translate to an "observed" underinvestment in industries with a higher share of intangibles. Alternatively, intangible assets might be more difficult to accumulate, due to higher adjustment costs. A rise in the relative importance of intangibles could then lead to a higher equilibrium value of Q, even if intangibles are correctly measured.

Fortunately, the relationship between Q and intangible investment has been thoroughly studied by Peters and Taylor (2017). They propose a new proxy for Q that aims to correct for measurement error by explicitly accounting for intangible capital,[20] and show that Q explains intangible investment relatively well, and works even better when tangible and intangible investments are combined. This is exactly what the theory would predict. Peters and Taylor (2017) also show that intangible capital adjusts more slowly to changes in investment opportunities than tangible capital, which is consistent with higher adjustment costs.

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 (for example, structures and equipment), and thus to a lower investment level of tangible assets. Generally, this would still be consistent with Q theory, because the Q of

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

20. Our results are robust to using this new proxy of Q (known as "total Q") instead of our base measure of Q, as described in section III. Using total Q slightly decreases the significance of quasi-indexer ownership at the industry level.

the incumbent would fall. Amazon would then increase its investments in intangible assets. Whether the Q of Amazon remains large then depends mostly on competition, which in turn depends on intangible assets, because the latter can be used as a barrier to entry. Relatedly, Alexander and Eberly (2016) and Robin Döttling, Tomislav Ladika, and Enrico Perotti (2017) link a rise in intangibles to a decrease in investment.

Globalization. It is important to emphasize that our firm-level and industry-level data are consolidated differently. The National Income and Product Accounts and the BEA's measures of private investment capture investment by U.S.-owned as well as foreign-owned firms in the United States. They would not include investment in China by a U.S. retail company, for example. We may therefore observe lower U.S. private investment if U.S. firms with foreign activities are investing more abroad, or if foreign firms are investing less in the United States. At the firm level (in Compustat), however, consolidated investment would still follow Q.

COMPETITION

Regulation, enforcement, and uncertainty. Regulation, enforcement, and regulatory uncertainty may affect investment in two ways. First, increased uncertainty due to regulation may restrain investment if economic agents are uncertain about future payoffs—though this might be priced in (Bernanke 1983; Dixit and Pindyck 1994).[21] Second, increased regulation and decreased antitrust enforcement may stifle competition. Grullon, Larkin, and Michaely (2017) and Ramsi Woodcock (2017) provide evidence of decreased enforcement since the 1980s. James Bessen (2016) provides evidence that political factors have been the primary drivers of increased profitability since 2000; and Mara Faccio and Zingales (2017) show that competition and investment in the mobile telecommunication industry are heavily influenced by political factors. Gutiérrez and Philippon (2017b) show that industries with increasing regulation have become more concentrated; and Döttling, Gutiérrez, and Philippon (2017) compare concentration trends between the United States and Europe, and find that concentration has remained stable in Europe while increasing in the United States in industries that are very similar in technology. They link these patterns to decreasing antitrust enforcement in the United States compared with stronger enforcement and decreasing barriers to entry in Europe.

21. Increases in firm-specific uncertainty may also lead to lower investment levels due to manager risk aversion (Panousi and Papanikolauo 2012) or irreversible investment (Dixit and Pindyck 1994; Abel and Eberly 2012). We test this hypothesis using stock market returns and sales volatility, and we find some, albeit limited, support.

Market power. Market power affects firms' incentives to invest and innovate. With respect to investment, Andrew Abel and Eberly (1994) show that market power induces a gap between average and marginal Q, which can lead to a gap between average Q and investment. With respect to innovation, we know that its relation with competition is nonmonotonic because of a trade-off between average and marginal profits. For a large set of parameters, however, we can expect competition to increase innovation and investment because firms in industries that do not face the threat of entry might have weak incentives to invest (Aghion and others 2014). Controlling for competition is difficult, however, because of endogenous entry and exit. We develop a simple model to study the determinants of the econometric bias in Gutiérrez and Philippon (2017a).

Empirically, the hypothesis of rising market power is supported by a growing body of literature arguing that competition may be decreasing in several economic sectors (Council of Economic Advisers 2016; Decker and others 2016). The decrease in competition was first discovered in flow quantities (firm volatility, entry, exit, initial public offerings, job creation and destruction, and so on). For instance, John Haltiwanger, Ron Jarmin, and Javier Miranda (2011, p. 2) write, "It is, however, noticeable that job creation and destruction both exhibit a downward trend over the past few decades." The Council of Economic Advisers (2016) was among the first to document that the majority of industries saw increases in the revenue share enjoyed by the 50 largest firms between 1997 and 2012. We refer the reader to Gutiérrez and Philippon (2017a) for a more comprehensive literature review.[22]

22. Grullon, Larkin, and Michaely (2017) study changes in industry concentration, and find that "over 75 percent of U.S. industries have registered an increase in concentration levels over the last two decades," and that firms in industries that have become more concentrated have enjoyed higher profit margins, positive abnormal stock returns, and more profitable mergers and acquisitions. Mongey (2017) studies cross-regional variation in market concentration and its effect on price flexibility. Blonigen and Pierce (2016) study the impact of mergers and acquisitions on productivity and market power, and find that they are associated with increases in average markups. Autor and others (2017a, 2017b) link the increase in concentration with the rise of more productive, superstar firms. And Barkai (2017) shows that the profit share of the U.S. nonfinancial corporate sector has increased drastically since 1985. Relatedly, De Loecker and Eeckhout (2017) show that firm-level markups have increased drastically since the 1980s. Finally, as noted above, Döttling, Gutiérrez, and Philippon (2017) compare concentration (and investment) trends between the United States and Europe. We find that concentration has increased in the United States while it has remained stable (or decreased) in Europe, and also that concentrated industries in the United States decreased investment more than the corresponding industries in Europe.

Beyond the traditional measures of concentration, the rapid increase in institutional ownership (see figure 5), coupled with increased concentration in the asset management industry, may have introduced anticompetitive effects of common ownership.[23] Such anticompetitive effects are the subject of a large body of theoretical literature on industrial organization, which argues that common ownership of natural competitors may reduce incentives to compete. For instance, Daniel O'Brien and Steven Salop (2000) develop an oligopoly model with common ownership, where firms maximize total shareholder portfolio profits. In doing so, firms place some weight on their (commonly owned) competitors' profits; and therefore they optimally increase markups with common ownership. José Azar, Sahil Raina, and Martin Schmalz (2016) and Azar, Schmalz, and Isabel Tecu (2016) show that this effect is empirically important, using the U.S. airline and banking industries as test cases; and Schmalz (2017) reviews the literature.[24]

CORPORATE GOVERNANCE

Ownership and shareholder activism. Beyond the anticompetitive effects of common ownership discussed above, ownership can affect management incentives through corporate governance and the effective investment horizon (short-termism). To be clear, our hypothesis is not necessarily that markets have become more short-termist, but rather that corporate governance has changed to better align the decisions of managers with the preferences of market participants. In all cases, the key friction is the conflict between the preferences of the managers and those of the shareholders.[25] The effects of corporate governance on investment have been studied in a large body of literature. Michael Jensen (1986) argues that conflicts of interest between managers and shareholders can lead firms to invest in ways that do not maximize shareholder value. This is supported

23. For instance, Fichtner, Heemskerk, and Garcia-Bernardo (2017) show that the "Big Three" asset managers—BlackRock, Vanguard, and State Street—together constitute the largest shareholder in 88 percent of the S&P 500 firms, which account for 82 percent of market capitalization.

24. It is worth noting that the exact mechanisms through which common ownership reduces competition remain to be identified; but they need not be explicit directions from shareholders. They may result from lower incentives for owners to push firms to compete aggressively if they hold diversified positions in natural competitors; or from the ability of board members elected by and representing the largest shareholders to minimize breakdowns of cooperative arrangements and undesirable price wars between their commonly owned firms. See Schmalz (2017) for additional details.

25. For corporate governance, the conflict is about the optimal size of the firm. This does not necessarily imply that managers invest too much; they might invest in the wrong

by Jarrad Harford, Sattar Mansi, and William Maxwell (2012) and by Scott Richardson (2006), who show that poor corporate governance is associated with greater industry-adjusted investment. Thus, improvements in corporate governance driven by changes in ownership may lead to lower investment levels.

Regarding short-termism, one can argue that equity markets put excessive emphasis on quarterly earnings, and that stock-based compensation incentivizes managers to focus on short-term capital gains (Martin 2015; Lazonick 2014). In support of this hypothesis, Heitor Almeida, Vyacheslav Fos, and Mathias Kronlund (2016) show that the probability of share repurchases is sharply higher for firms that would have just missed the earnings per share forecast in the absence of a repurchase; Stephen Terry (2017) shows that firms just meeting Wall Street forecasts have lower research and development (R&D) growth; and Christine Jolls (1998) and George Fenn and Nellie Liang (2001) show that firms that rely more heavily on stock option–based compensation are more likely to repurchase their stock than other firms. Given the rise of institutional ownership, and the shift toward stock-based compensation, an increase in market-induced short-termism may lead firms to increase payouts and cut long-term investment. Conversely, Steven Kaplan (2017) argues against sustained short-termism by studying the time series of corporate profits and valuations, together with venture capital and private equity investments.

We focus on the effect of institutional ownership on corporate governance, investment, and payouts. This is the subject of several papers. Roni Kisin (2011) finds that exogenous changes in mutual fund ownership affect corporate investment according to the preferences of individual funds. Philippe Aghion, John Van Reenen, and Zingales (2013) find that greater dedicated ownership incentivizes higher R&D investment, while Bushee (1998) finds that higher transient ownership increases the probability that managers will reduce R&D investment to reverse an earnings decline.

Ian Appel, Todd Gormley, and Donald Keim (2016a) focus on passive owners, and find that such owners influence firms' governance choices;

projects instead. The general view, however, is that managers are reluctant to return cash to shareholders, and that they might overinvest (empire building). In the case of short-termism, the conflict is between two discount factors. If shareholders have lower discount factors than managers, they prefer lower investment. In both cases, market values increase when tighter corporate governance forces the managers to more closely follow the preferences of the shareholders. What happens to investment depends on the initial bias of the managers, but in the examples just described, we would observe a decrease in investment.

they lead to more independent directors, lower takeover defenses, and more equal voting rights, as well as more votes against management. Appel, Gormley, and Keim (2016b) also find that larger passive ownership makes firms more susceptible to activist investors, increasing the ambitiousness of activist objectives as well as the rate of success; and Alan Crane, Sébastien Michenaud, and James Weston (2016) show that higher (total and quasi-indexer) institutional ownership causes firms to increase their payouts. But the evidence is not clear-cut; Cornelius Schmidt and Rüdiger Fahlenbrach (2017) find opposite effects for some corporate governance measures (including the likelihood of CEOs becoming chairmen and the appointment of new independent directors), and an increase in value-destroying mergers and acquisitions linked to higher institutional ownership.

In the end, it is unclear whether higher payouts and increased susceptibility to activist investors are evidence of tighter corporate governance or increased short-termism. The reason is that the two hypotheses differ more in their normative implications than in their positive ones. Investment decreases in both cases. Under tighter corporate governance, it goes from excessive to (privately) optimal. Under short-termism, it goes from optimal to less than optimal.[26]

We emphasize that these hypotheses are not mutually exclusive. For instance, a growing body of literature focuses precisely on the interaction between corporate governance and competition (Giroud and Mueller 2010, 2011). As a result, our tests do not map one-to-one into our eight hypotheses; some tests overlap two or more hypotheses (for example, measures of firm ownership affect both corporate governance and competition). In section IV, we report the results of our tests and discuss their implications for the hypotheses given above.

26. Some papers provide qualitative support for corporate governance, but the evidence is inconclusive. Crane, Michenaud, and Weston (2016) refer to Chang, Hong, and Liskovich (2015), who argue that increasing passive institutional ownership leads to increases in share price, but that could happen under short-termism as well. Other studies, such as that by Asker, Farre-Mensa, and Ljungqvist (2014), show that public firms invest substantially less and are less responsive to changes in investment opportunities than private firms. Robert Hall notes in his comment that private equity ownership has grown rapidly, and now counts for a modest share of nonpublic businesses. To the extent that private equity improves corporate governance (or increases short-termism), this may lead to lower investment. Kaplan and Stromberg (2009) review related evidence showing that firms transitioning to private equity ownership decrease capital expenditures. We leave the testing of this hypothesis for future work.

Table 1. Data Sources

Data field	*Source*	*Granularity*[a]
Aggregate investment and *Q*	Federal Reserve Board, Financial Accounts of the United States	Sector
Industry-level investment and operating surplus	U.S. Bureau of Economic Analysis, Fixed Assets tables, section 3	3-digit NAICS
Firm-level financials	Compustat	Firm
Concentration	U.S. Census Bureau, Economic Census	3-digit NAICS
Entry, exit, and firm demographics	U.S. Census Bureau, Business Dynamics Statistics	2-digit SIC
Multinational transactions	U.S. Bureau of Economic Analysis, U.S. Direct Investment Abroad	2-digit NAICS
Occupational licensing	Princeton Data Improvement Initiative, Kleiner and Krueger (2013)	3-digit NAICS
Regulation index	Mercatus Center, Al-Ubaydli and McLaughlin (2015)	3-digit NAICS
Industry-level credit spreads	Egon Zakrajšek, Gilchrist and Zakrajšek (2012)	3-digit NAICS
Manufacturing industry data	NBER-CES Manufacturing Industry Database	6-digit NAICS
Institutional ownership	Thomson Reuters, Institutional Holdings (Form 13F) database	Firm
Institutional investor classification	Brian Bushee	Institutional investor

a. NAICS stands for North American Industry Classification System; SIC stands for Standard Industrial Classification.

III. Data

Testing the theories described above requires the use of microeconomic 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 1. Subsections III.A and III.B discuss the aggregate and industry data sets, respectively. Subsection III.C discusses the firm-level investment and *Q* data sets; and subsection III.D summarizes the explanatory variables used to test each theory. The online appendix provides additional details on data sources and limitations, as well as the data reconciliation and validation efforts.

III.A. Aggregate Data

Aggregate data on funding costs, profitability, investment, and market value for the U.S. economy and the nonfinancial sector are gathered from the U.S. Financial Accounts, through Federal Reserve Economic Data

(FRED). These data are used in the aggregate analyses discussed in section I; 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 are gathered from the U.S. Census Bureau's Business Dynamics Statistics, and used in aggregate regressions similar to those reported in section IV.

III.B. Industry-Level Data

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 (output, gross operating surplus, compensation, and taxes)—are gathered from the BEA.

Fixed assets data are available in three categories: structures, equipment, and intellectual property (which includes software; R&D; and expenditures for entertainment, literary, and artistic originals). This breakdown allows us to (i) study investment patterns for intellectual property separately 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 (19 groups) and detailed industry (63 groups) levels, in a similar categorization as the 2007 NAICS level 3.[27] We start with the 63 detailed industries and group them into 47 industry groupings to ensure that investment, entry, and concentration measures are stable over time. In particular, we group detailed industries to ensure that each group has at least about 10 firms, on average, from 1990 to 2015, and that it contributes a material share of investment (see the online appendix for details on the investment data set). We exclude financials and real estate; and we also exclude utilities, given the influence of government actions in their investment and their unique experience after the 2008 global financial crisis (for example, they have exhibited decreasing operating surpluses since 2000). Finally, we exclude management because there are no companies in Compustat that map to this category. This leaves 43 industry groupings for our analyses, whose total net investment since 2000 is summarized in table 17 in the online appendix. All other data sets are mapped into these 43 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

27. NAICS stands for North American Industry Classification System.

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.

III.C. Firm-Level Data

DATA SET Firm-level data are primarily sourced from Compustat, which includes all public firms in the United States. Data are available from 1950 through 2016, but coverage is fairly thin until the 1970s. We exclude firm-year observations with assets under $1 million; with a negative book or market value; or with missing year, assets, *Q*, or book liabilities.[28] To more closely mirror the aggregate and industry figures, we exclude utilities (SIC codes 4900–4999) and financial and real estate firms (SIC codes 6000–6999);[29] and focus on firms incorporated in the United States (see the online appendix 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 (9000–9999) are excluded from industry-level analyses because they cannot be mapped to an industry.

Firm-level data are used for two purposes. The first is to analyze the determinants of firm-level investment through firm-level panel regressions. And the second is to compute industry-level metrics and use the aggregated quantities to explain industry-level investment (for example, by computing industry-level *Q*). We consider the aggregate (that is, the weighted average) and the mean and median for all quantities, as well as direct and log transformed measures of investment and *Q*. We report the specification or transformation that exhibits the highest statistical significance for each variable. In particular, we use the median log transformed *Q* for industry-level regressions on net investment; firm-level log transformed *Q* for firm-level regressions on log gross investment; and *Q* for firm-level regressions on net investment. The results are generally consistent across variable transformations, but using the one that provides the best fit for *Q* is conservative when testing alternative hypotheses.

28. 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.

29. SIC stands for Standard Industrial Classification.

DEFINITION OF INVESTMENT We consider three definitions of investment. First, the "traditional" gross investment rate is as defined by Rajan and Zingales (1998), among others: capital expenditures (Compustat item CAPX) at time t scaled by net property, plant, and equipment (abbreviated herein as PP&E, Compustat item PPENT) at time $t - 1$. Net investment for this definition is estimated assuming that industry-level depreciation rates from the BEA apply to all firms. We use BEA depreciation rates because depreciation figures available in Compustat follow accounting rather than economic rules.[30] Using BEA depreciation measures is unlikely to alter our conclusions because we are interested in aggregate quantities. The net investment rate is therefore defined as the gross investment rate minus the BEA-implied depreciation rate for structures and equipment in each industry.

Our second definition focuses on intangible investment by measuring the ratio of R&D expenses to assets (Compustat items XRD/AT). We consider only the gross investment rate (that is, we do not subtract depreciation) because a good proxy for R&D depreciation is not available. We acknowledge that R&D expenses are a fairly narrow and noisy measure of intangible investment (for example, the BEA also capitalizes software, entertainment, and artistic originals). Unfortunately, we were unable to identify a better proxy for intangible investment. Other measures, such as those used by Peters and Taylor (2017), yield substantially higher intangible capital estimates than those of national accounts.

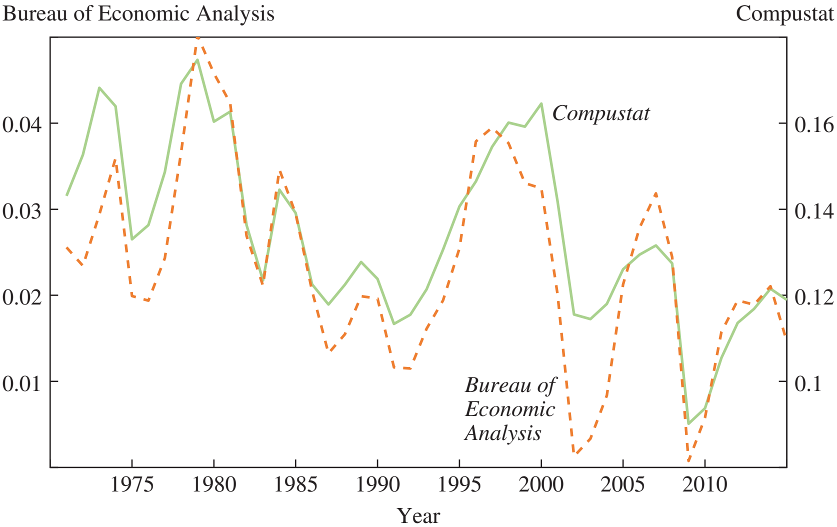
Finally, we define the firm-level total gross investment in tangible and intangible assets as (CAPX + XRD)/AT. We again consider only gross investment due to a lack of robust depreciation.[31]

As shown in figure 6, the resulting firm-level net investment figures closely mirror the BEA's official estimates. Figure 19 in the online appendix shows the BEA's official net investment rate along with the aggregate

30. On one hand, accounting depreciation schedules are typically accelerated relative to economic depreciation. On the other hand, the Compustat depreciation field excludes the portion of depreciation that can be included as part of the cost of goods sold under generally accepted accounting principles.

31. In order to ensure robustness, we also test two alternative definitions: (i) 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 items (CAPX + IVCH – SIV)/(PPENT + IVAEQ + IVAO)); and (ii) investment over market value, in which case Q is omitted from the regression equations. Definition (i) aims to capture a broader set of long-term investment activities than just capital expenditures. All qualitative conclusions are broadly robust to using either of them as our measure of investment.

Figure 6. Comparison of Net Investment Rates, 1971–2015



Sources: U.S. Bureau of Economic Analysis; Compustat.

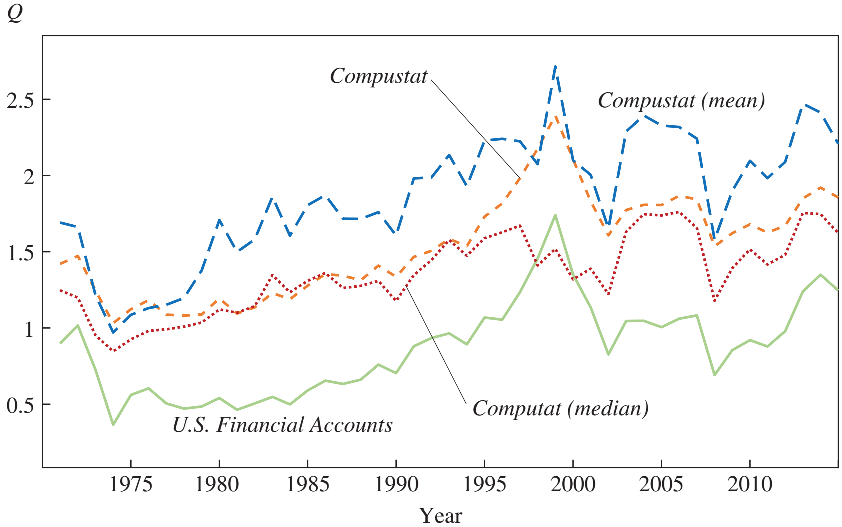
net investment rate for our Compustat sample (adjusted to mirror the BEA industry mix). The Compustat series is higher because of the differences in definitions (for example, PP&E covers only a portion of capital, and is depreciated more quickly in accounting standards), but the trends are very similar.

DEFINTION OF *Q* Our primary proxy for firm-level *Q* is the ratio of market value to total assets:

$$Q^{used} = \frac{\text{ME} + \text{LT} + \text{PSTK}}{\text{AT}}, \quad (7)$$

where ME denotes the market value of equity, LT denotes total liabilities, PSTK denotes preferred stock, and AT denotes total assets. The market value of equity is defined as the total number of common shares outstanding (Compustat item CSHO) times the closing stock price at the end of the fiscal year (item PRCCF). Current assets (such as cash and marketable securities) are included in both the numerator and denominator; hence, the recent rise of cash holdings has a limited effect on Q^{used}. Figure 7 compares the aggregate, mean, and median Q^{used} across all firms in our Compustat sample with the measure of *Q* constructed for nonfinancial corporates using the U.S. Financial Accounts. As shown, the aggregate and mean *Q* from

Figure 7. Comparisons of Measures of *Q*, 1971–2015



Sources: Financial Accounts of the United States; FRED; Compustat.

Compustat closely mirror the series from the U.S. Financial Accounts. The median Q is substantially lower than aggregate Q in the early 2000s, because the increase in aggregate Q was driven by a few firms with extremely high valuations.

Our definition, and small variations of the market-to-book ratio, have been widely used in the literature as proxies for Q. But no empirical measure of Q is perfect; and other definitions are also common in the literature. See subsection V.B for a comparison of our measure of Q (Q^{used}) with two additional measures: Q^{alt}, defined as the ratio of market value of productive assets to gross PP&E; and Q^{tot}, defined as the ratio of market value of productive assets to gross PP&E plus intangibles.[32] All three measures are affected by differences between accounting rules and economic values, as well as measurement error in both the numerator and denominator.[33] A detailed analysis of all the sources of measurement error and their implications is outside the scope of this paper. Instead, we follow a three-pronged approach to mitigate these limitations: First, we use the available tools in the literature to control for classical measurement error (namely, the cumulant estimator); second, we explicitly test those theories that predict

32. Q^{tot} was introduced by Peters and Taylor (2017).

33. See Erickson and Whited (2006) for a comparison of alternative measures of Q.

Table 2. Summary of Data Fields by Potential Explanation

Potential explanation	*Relevant data field*
Financial frictions	
External finance constraints	Firm- and industry-level external finance dependence (aggregate equity and debt) (Rajan and Zingales 1998)
Bank dependence	Firm-level bank dependence indicator (firms missing an S&P rating)
Safe assets	Industry average spread
	Firm-level corporate bond ratings
Investment composition	
Intangibles	Separate capital expenditure and intangible investment rates (firm- and industry-level)
	Intangible investment as a share of total capital and assets
Globalization	Share of foreign profits or sales (Compustat and U.S. Census Bureau)
Competition	
Regulation and uncertainty	Industry-level regulation (Mercatus Center)
	Share of workers with occupational licensing (Princeton Data Improvement Initiative)
	Sales and stock market return volatility
Concentration	Change in number of firms (Compustat and Business Dynamics Statistics)
	Concentration ratios (share of industry sales captured by top firms) (Compustat and Economic Census)
	Lerner index (price–cost ratio) (Compustat)
	Traditional Herfindahl index (Compustat)
	Modified Herfindahl index (common-ownership adjusted) (Compustat)
Corporate governance	
Ownership	Firm-level share of institutional ownership (Thomson Reuters)
	Firm-level share of quasi-indexer, dedicated, and transient ownership (Bushee 2001, updated through 2015)

a wedge between Q and investment; and third, we ensure that our results are robust to using Q^{tot} as well as Q^{used}.

III.D. Explanatory Variables

Finally, a wide range of additional variables are gathered or computed to test our eight theories of underinvestment. These measures are summarized in table 2. Because they are our core hypotheses, we provide a brief discussion of the competition and ownership measures in the rest of this section. The online appendix provides a more detailed discussion of all measures, including the underlying data sources and data limitations. In addition to the explanatory variables, we also compute firm age (from entrance into Compustat) as a control for firm demographics.

MARKET POWER AND DEMOGRAPHICS For concentration and firm demographics, we use three different sources: Compustat, the U.S. Census Bureau, and the Thomson Reuters Institutional Holdings (Form 13F) database.

From Compustat, we compute four measures of market power: (i) the log change in the number of firms in a given industry as a measure of entry and exit; (ii) sales Herfindahl index values; (iii) sales concentration ratios, defined as the share of sales held by the top 4, 8, and 20 firms in each industry;[34] and (iv) the price–cost ratio, also known as the Lerner index. The price–cost ratio is computed as operating income before depreciation minus depreciation: (Compustat items OIBDP – DP) divided by sales (item SALE). The Lerner index differs from the Herfindahl index and concentration ratios because it does not rely on precise definitions of geographic and product markets. Rather, it aims to measure a firm's ability to extract rents from the market.

From the U.S. Census Bureau, we gather industry-level concentration ratios, which include the share of sales held by the top 4, 8, 20, and 50 firms in each industry. Concentration ratios are available for a subset of NAICS level 3 industries for 1997, 2002, 2007, and 2012. Where necessary, we aggregate concentration ratios to our 43 BEA industry groupings by taking the weighted average by sales across NAICS level 3 industries. We use only NAICS level 3 industries that can be mapped consistently to BEA categories over time.

Finally, to account for the anticompetitive effects of common ownership, we compute the modified Herfindahl–Hirschman index ($MHHI$), which is defined as

$$(8) \qquad MHHI = \sum_j s_j^2 + \sum_j \sum_{k \neq j} s_j s_k \frac{\Sigma_i \beta_{i,j} \beta_{i,k}}{\Sigma_i \beta_{i,j}^2} = HHI + HHI_{adj},$$

where s_j and s_k denote the share of sales for firms j and k in a given industry; and $\beta_{i,k}$ denotes the ownership share of investor i in firm j.[35] Ownership data

34. Herfindahl index values and concentration ratios based on market value were also considered, but measures based on sales perform better and are therefore reported.

35. According to the theory, it would better to compute

$$HHI = HHI + \sum_j \sum_{k \neq j} s_j s_k \frac{\Sigma_i \gamma_{i,j} \beta_{i,k}}{\Sigma_i \gamma_{i,j} \beta_{i,j}},$$

are sourced from the Thomson Reuters Institutional Holdings (Form 13F) database (described below). The first term is the traditional Herfindahl–Hirschman index (*HHI*). The second term measures anticompetitive incentives due to common ownership. Theoretical justification for this measure can be derived from the model of O'Brien and Salop (2000). See Schmalz (2017) for additional details. We consider the combined *MHHI* in most of our tests; but we also separate *HHI* and HHI_{adj} to assess their independent effects in some cases.

CORPORATE GOVERNANCE For corporate governance, we gather data on institutional ownership from the Thomson Reuters Institutional Holdings (Form 13F) database. This database includes the U.S. public stock holdings of all institutional investors managing more than $100 million.

We define the share of institutional ownership as the ratio of shares owned by fund managers filing 13Fs for a given firm over total shares outstanding.[36] We also add Bushee's permanent classification of institutional owners into dedicated, quasi-indexer, and transient.[37] This classification is based on the turnover and diversification of institutional investors' 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 about 60 percent of total institutional ownership. This category includes "pure" index investors as well as actively managed investors that hold diversified portfolios and benchmark against these indexes. As a result, quasi-indexer

where $\gamma_{i,j}$ denotes the control share of investor i in firm j. However, because data on the total number of voting shares per company are not readily available, we assume $\gamma_{i,j} = \beta_{i,k}$ (that is, we consider total ownership rather than voting and nonvoting shares separately).

36. We use data from the Center for Research in Security Prices for total shares outstanding instead of Thomson Reuters because the latter are available only in millions for some periods.

37. Bushee (2001) shows that high levels of ownership by transient institutions are associated with significant overweighting of the near-term earnings component of firm value. Asker, Farre-Mensa, and Ljungqvist (2014) show that firms with more transient ownership exhibit lower investment sensitivity to *Q*. Appel, Gormley, and Keim (2016a, 2016b), Aghion, Van Reenen, and Zingales (2013), and Crane, Michenaud, and Weston (2016) all use Bushee's classifications when studying the implications of institutional ownership on corporate governance, payouts, and investment. The classification is available from 1981 to 2015.

ownership is heavily influenced by index position and participation. Nonetheless, quasi-indexers maintain some discretion on their investments; beyond their requirements to track or benchmark against particular indexes, they aim to maximize alpha (Wurgler 2011).[38]

IV. Results

Armed with the requisite industry- and firm-level data, we can analyze the determinants of aggregate-, industry-, and firm-level investment. We start by showing that the aggregate-level investment gap is explained by low competition and high quasi-indexer institutional ownership. We then discuss the industry- and firm-level panel regression results, which confirm that (i) the observed aggregate-level underinvestment appears consistently at the industry and firm levels; and (ii) industries with more quasi-indexer institutional ownership and less competition (as measured by the traditional and modified Herfindahl indexes and the Lerner index) invest less. We report summary results in the body of the paper, and detailed regression output in the online appendix.

Ordinary least squares (OLS) regressions on Q suffer from two problems: The slopes on Q are biased due to measurement error, and the corresponding R^2 depends on the extent of measurement error. To correct for classical measurement error, all industry- and firm-level panel regression results reported in this paper are based on the cumulant estimator of Erickson, Jiang, and Whited (2014), unless otherwise noted. Qualitative results are robust to using simple OLS, but coefficients on Q and other parameters are smaller, as expected. In addition to the unbiased slopes produced by the estimator, we report the R^2 of the regression, which is labeled ρ^2. Note that the errors-in-variables estimator requires demeaned data (and does not compute fixed effects internally). We therefore demean all industry- and firm-level variables over the corresponding regression period before running the regressions. Note also that the cumulant estimator uses a clustered weighting matrix, which effectively clusters standard errors at the industry level in industry regressions, and at the firm level in firm regressions.

38. We also considered the governance index of Gompers, Ishii, and Metrick (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.

IV.A. Aggregate-Level Results

We start by regressing the aggregate net investment rate for the nonfinancial business sector (from the U.S. Financial Accounts) on aggregate Q (from Compustat), along with additional explanatory variables $\mathbf{X}$:

$$\frac{NI_t}{K_{t-1}} = \beta_0 + \beta Q_{t-1} + \gamma \mathbf{X} + \varepsilon_t. \tag{9}$$

Table 3 shows the results of these regressions for our "core" explanations: industry concentration and quasi-indexer ownership. We report the results using the median sales Herfindahl index values across all industries as our measure of concentration; but alternative measures—such as Census- and Compustat-based firm entry and exit rates, changes in the number of firms, and average concentration ratios (percentage of sales by the top 4, 8, and 20 firms)—are also significant predictors, with appropriate signs.

Columns 1 through 3 of table 3 include regressions from 1980 onward, and columns 4 through 6 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. Measures of competition and quasi-indexer ownership are fairly stable across regressions. Columns 2 and 5 show that an increase in the sales Herfindahl index values is correlated with lower investment. Columns 3 and 6 add quasi-indexer institutional ownership, and show that increases in such ownership are correlated with lower investment. Quasi-indexer ownership is not significant after 1990, but this is likely due to the limited data in the aggregate. This measure exhibits strong significance in the cross section. Note that the R^2 in column 6 is .80, suggesting a very high correlation between these measures and investment.

These results are based on time series regressions of fairly persistent series. To control for the overestimation of t values, table 20 in the online appendix reports moving-average regression results with one- and two-year lags. The coefficients are very similar and are often significant.

IV.B. Industry- and Firm-Level Results

TESTING UNDERINVESTMENT To test our more granular hypotheses, we now move to industry- and firm-level data. We start by documenting that the observed underinvestment at the aggregate level persists at the industry

Table 3. Aggregate Net Investment: OLS Regressions[a]

	Net investment rate					
	After 1980 *(1)*	*After 1980* *(2)*	*After 1980* *(3)*	*After 1990* *(4)*	*After 1990* *(5)*	*After 1990* *(6)*
Aggregate Compustat Q (t – 1)	0.002	0.003	0.012***	0.023***	0.016***	0.019***
	[0.48]	[1.13]	[3.03]	[4.56]	[4.53]	[4.69]
Median sales Herfindahl index (t – 1)		–0.516***	–0.270**		–0.386***	–0.253**
		[–6.74]	[–2.18]		[–5.77]	[–2.26]
Mean share of quasi-indexer owners (t – 1)			–0.038*			–0.024
			[–2.02]			[–1.46]
No. of observations	36	36	34	26	26	26
R^2	0.01	0.58	0.67	0.47	0.78	0.80

Sources: Financial Accounts of the United States; Compustat; authors' calculations.

a. The data are annual. t statistics are shown in brackets. Statistical significance is indicated at the ***1 percent, **5 percent, and *10 percent levels.

and firm levels. In particular, we perform errors-in-variables panel regressions of the following form:

$$(10)\quad \left(\frac{\ddot{NI}_{j,t}}{K_{j,t-1}}\right) = \beta_0 + \beta[\text{medlo}\ddot{\text{g}}(Q_{j,t-1})] + \alpha[\text{medlo}\ddot{\text{g}}(age_j)] + \eta_t + \varepsilon_{j,t}$$

across industries j, and

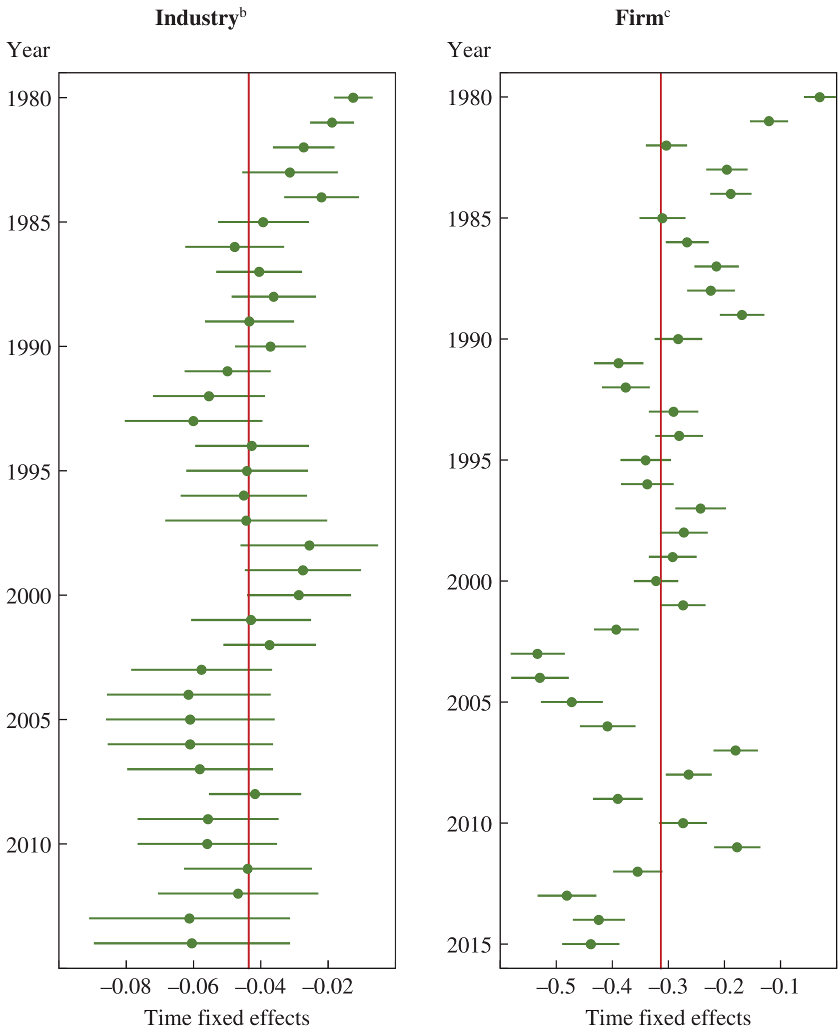
$$(11)\quad \left[\log\left(\frac{\text{CAPX}_{i,t} + \text{XRD}_{i,t}}{\text{AT}_{i,t}}\right)\right]^{\cdot\cdot} = \beta_0 + \beta[\log(\ddot{Q}_{i,t-1})] + \alpha[\log(\ddot{age}_i)] + \eta_t + \varepsilon_{i,t}$$

across firms i, where β_0 represents a constant and η_t represents year fixed effects. The operator medlog denotes the median logarithm. The double dots denote demeaned variables at the industry or firm level, as noted in each table. We include firm age controls for conservatism, but the results are consistent without them. Industry regressions are based on net investment across all asset types, while firm regressions consider log[(CAPX + R&D)/AT] to include tangible and intangible investment.

We omit the regression results for brevity (which exhibit the expected signs) and instead focus on the time fixed effects. The results are shown in figure 8. The left panel shows the time effects for the industry regressions, and the right panel shows the time effects for the firm regressions. 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 after approximately 2000. Time effects are above average in most years in the 1980s, average in the 1990s, and below average after 2002. Time effects increase at the height of the Great Recession (when Q decreased drastically), but reach some of their lowest levels after 2013. Note that 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.

It is particularly important that these results are robust to including additional measures of fundamentals, such as cash flow, considering only a subset of industries, or even splitting tangible and intangible assets. They are consistent with the results of Alexander and Eberly (2016), who use OLS to study firm-level gross investment (defined as the ratio of capital expenditures to assets). They are somewhat dampened when intangible intensity is controlled for, but they remain material (see figure 12 below).

Figure 8. Time Fixed Effects from Industry- and Firm-Level Regressions, 1980–2015[a]



Sources: U.S. Bureau of Economic Analysis; Compustat; authors' calculations.

a. The figure shows time fixed effects from an errors-in-variables panel regression. The regressions include controls for firm age, and all variables are demeaned.

b. The left panel shows the time fixed effects from an errors-in-variables panel regression of industry net investment on median log(Q).

c. The right panel shows the time fixed effects from an errors-in-variables panel regression of log[(CAPX+R&D)/AT] on firm-level log(Q).

We conclude that investment has been low relative to *Q* since the early 2000s—a decrease that is partially, though not fully, explained by the rise of intangibles. The timing of the decrease aligns with the research of Dong Lee, Han Shin, and René Stulz (2016), who find that industries that receive more funds have a higher industry *Q* until the mid-1990s, but not since then. According to Lee, Shin, and Stulz (2016), 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.

TESTING HYPOTHESES

Approach. Having established the observed underinvestment relative to fundamentals since 2000, we now test our eight theories. We do so by expanding the errors-in-variables panel regression to include additional measures for each theory:

$$\left(\frac{\ddot{NI}_{j,t}}{K_{j,t-1}}\right) = \beta_0 + \beta\left(\ddot{Q}_{j,t-1}\right) + \gamma\left(\ddot{\mathbf{X}}_{j,t-1}\right) + \alpha\left(\ddot{\mathbf{Y}}_{j,t-1}\right) + \eta_t + \varepsilon_{j,t}, \tag{12}$$

where, again, β_0 and η_t represent a constant and year fixed effects, respectively. The double dots above each variable denote a within transformation over the corresponding regression period. ($\ddot{\mathbf{X}}_{j,t-1}$) denotes "core" explanations, which are included in all regressions. These include the modified Herfindahl index and the share of quasi-indexer institutional ownership, as well as controls for firm age. We use the modified Herfindahl index as our base measure of competition because it controls for the anticompetitive effects of common ownership as well as traditional measures of concentration. ($\ddot{\mathbf{Y}}_{j,t-1}$) denotes the additional measures for each hypothesis, including measures of financial constraints, globalization, and so on. These measures are first included individually and then simultaneously (if significant). Note that including year fixed effects implies that we no longer see underinvestment relative to *Q*. Instead, these regressions identify cross-sectional differences in investment, including which variables explain underinvesting or overinvesting relative to *Q*.

Various transformations of investment and *Q* are used throughout the paper, as noted in each table and figure. In particular, the dependent variable in industry-level regressions is the BEA net investment rate, and *Q* is the median log *Q* across all Compustat firms in a given industry.[39]

39. We also considered the weighted average and mean *Q*; but median *Q* exhibits higher *t* statistics.

Firm-level regressions include net investment (based on Compustat items CAPX/PPENT) on Q, as well as log transformed XRD/AT on log transformed Q. We use log transformation for gross investment measures due to skewness, and choose the transformation of Q that yields the highest statistical significance. To avoid endogeneity concerns with measures of financial constraints, we use 1999 measures and restrict the corresponding regressions to the post-2000 period.

Results. Table 4 summarizes industry- and firm-level error-corrected regression results across all hypotheses. Check 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 check mark (✓–) highlights that the variable is significant but not robust across periods, against the inclusion of other predictor variables, or against changes in the specification.

Detailed regression results underlying this summary table are included in tables 21 through 25 in the online appendix. Specifically, table 21 includes industry-level results for all variables except measures of competition and ownership, which are included in tables 22 and 23, respectively. Table 24 shows firm-level results for all explanations except corporate governance and short-termism, which are included in table 25. Tables 26 through 29 show the same results as tables 21 through 25, but from 2000 onward, to demonstrate that results have generally remained stable and robust during the more recent period (although coefficients are not always significant, given the short-fitting period).

Note that, for brevity, we only report results for the most significant variables or transformations for each type of measure (for example, we exclude the industry-average spread for safe asset scarcity). Qualitative results are robust to using the alternative definitions of firm-level investment, including only industries with good Compustat coverage, and (almost always) allowing for measurement error in the modified Herfindahl and Lerner indexes in addition to Q.

As shown, we find strong support for measures of competition and ownership. Several measures of competition appear to be significant at the industry and firm levels—including the traditional and modified Herfindahl indexes, as well as concentration ratios and the Lerner index. Similarly, measures of total, transient, and quasi-indexer ownership are strongly correlated with industry- and firm-level underinvestment. Interestingly, we find a positive and significant relationship between firm-level dedicated ownership and investment, suggesting that not all types of ownership are correlated with lower investment. We emphasize quasi-indexer ownership

Table 4. Summary of Industry- and Firm-Level Results[a]

		Significance	
Potential explanation	*Relevant data field*	*Industry*	*Firm*
Financial frictions			
External finance constraints	External finance dependence	✗	✗
Bank dependence	Missing S&P rating	✗	✗
Safe assets	Industry spread	✗	✗
	Firm-level bond ratings	✗	✗
Investment composition			
Intangibles	Ratio of intangibles (excluding goodwill) to assets	✓–	✓[b]
	Share of intangible investment	✓	✓[b]
Globalization	Share of foreign profits	✓	✗
Competition			
Regulation and uncertainty	Regulation index	✓–	✗
	Occupational licensing	✗	✗
Concentration	Change in the number of firms	✗	✗
	Ratio of total sales to market value for top firms	✓	✗
	Lerner index	✓	✗
	Traditional Herfindahl index	✓	✓
	Modified Herfindahl index	✓	✓
Corporate governance			
Ownership	Share of institutional ownership	✓	✓
	Share of quasi-indexer ownership	✓	✓
	Share of dedicated ownership	✗	✗
	Share of transient ownership	✓	✓

Source: Authors' calculations.

a. This table summarizes industry- and firm-level errors-in-variables regression results across all potential explanations. Check marks (✓) identify variables that are both significant and exhibit the "right" coefficient. Crosses (✗) identify variables that are not significant and exhibit the "wrong" coefficient. A check-minus sign (✓–) identifies variables that are significant, but not robust to inclusion of additional variables, or are sensitive to treatment of measurement error of alternative regression periods. See the text for caveats and discussion of the limitations of our results. See the online appendix for detailed regression results.

b. At the firm level, intangibles are correlated with underinvestment in the cross section of firms, but not within firms.

throughout the paper because it exhibits high levels of significance across all specifications and robustness tests, and because of its rapid growth since 2000; but we note that transient and total institutional ownership are also significant.[40]

Among the remaining hypotheses, we find some support for intangibles, regulation, and globalization. Industries with a higher share of intangibles tend to invest less; and high-intangible firms invest less within each industry. Industries with higher foreign profits also exhibit lower U.S. investment. This is expected, given their larger foreign operations. However, this result is not significant at the firm level (where we include all investment, irrespective of the location) and has limited explanatory power in the aggregate. Our hypotheses of concentration and ownership remain significant when foreign activity is controlled for (see subsection V.C for additional discussion). Finally, straight regressions of investment rates on the regulation index typically yield insignificant coefficients. However, we show a ✓– because regulation appears to work through competition, rather than directly on investment. In particular, we provide evidence in Gutiérrez and Philippon (2017b) that industries with rising regulation have become more concentrated and also invest less.

We highlight the fact that, based on our results, we 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 (Chen, Hanson, and Stein 2017). We do not observe such an effect in our sample, using the lack of corporate bond ratings as a proxy for bank dependence. But our results are not inconsistent with the existing literature. Industry-level investment tends to be dominated by relatively large firms (which are rarely bank dependent), and our firm-level data do not cover small firms. What our results suggest is that underinvestment 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

40. Our conclusion for ownership somewhat contrasts with that of Bena and others (2017) and Aghion, Van Reenen, and Zingales (2013). Bena and others (2017) 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. Aghion, Van Reenen, and Zingales (2013) find that greater dedicated and transient ownership incentivizes higher R&D investment, while quasi-indexer ownership has no effect. We find positive results for dedicated ownership, but negative and strongly significant results for transient and quasi-indexer ownership. Differences are likely due to the time periods; Aghion, Van Reenen, and Zingales (2013) focus on the 1991–2004 period.

Table 5. Industry-Level Regressions: "Core" Explanations[a]

	Net investment rate			
	After 1980 *(1)*	*After 1990* *(2)*	*After 1980* *(3)*	*After 1990* *(4)*
Median log Q $(t-1)$	0.170***	0.163***	0.173***	0.275***
	[14.633]	[16.812]	[14.894]	[6.610]
Mean share of quasi-indexer owners $(t-1)$	–0.091**	–0.118***	–0.092**	–0.125**
	[–2.276]	[–3.068]	[–2.269]	[–2.454]
Modified Herfindahl index $(t-1)$	–0.056**	–0.056**		
	[–2.556]	[–2.394]		
Traditional Herfindahl index $(t-1)$			–0.054**	–0.093***
			[–2.417]	[–2.614]
Common ownership–adjusted Herfindahl index $(t-1)$			–0.063**	–0.104**
			[–2.373]	[–2.373]
Age controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Industry demeaned	Yes	Yes	Yes	Yes
No. of observations	1,445	1,110	1,445	1,110
ρ^2	0.380	0.390	0.381	0.499

Sources: U.S. Bureau of Economic Analysis; Compustat; authors' calculations.

a. The data are annual. t statistics are shown in brackets. Statistical significance is indicated at the ***1 percent, **5 percent, and *10 percent levels.

(Alfaro, Beck, and Calomiris 2015). Thus, a decrease in bank lending can, over time, lead to an increase in concentration.

The remainder of this subsection discusses the industry- and firm-level results in more detail.

INDUSTRY-LEVEL RESULTS Table 5 shows the results of error-corrected industry regressions for our "core" explanations. We include the modified Herfindahl index values in columns 1 and 2, and separate the traditional and common ownership components in columns 3 and 4. As shown, all measures of concentration are significant from 1980 and 1990 onward. The differences in the magnitude of coefficients relative to the aggregate results of table 3 are driven by a larger coefficient on Q due to measurement error correction. Measures of quasi-indexer ownership are also significant.

FIRM-LEVEL RESULTS Table 6 shows firm-level regression results, including the modified Herfindahl index values and quasi-indexer ownership. Columns 1 to 3 regress net investment (defined as Compustat items (CAPX – DP)/PPENT), and columns 4 to 6 regress log(R&D/AT). Using a

Table 6. Firm-Level Regressions: "Core" Explanations[a]

	Net CAPX/PP&E			*Log(R&D/AT)*		
	After 1990 (1)	*After 1990* (2)	*After 1990* (3)	*After 1990* (4)	*After 1990* (5)	*After 1990* (6)
Q (t – 1)	0.120***	0.223***	0.138***			
	[59.779]	[51.793]	[59.732]			
Log Q (t – 1)				1.082***	0.940***	1.093***
				[51.468]	[24.118]	[51.145]
Share of quasi-indexer owners (t –1)	–0.067***	–0.120***	–0.072***	–0.731***	–0.483***	–0.719***
	[–6.417]	[–6.671]	[–6.381]	[–9.081]	[–7.405]	[–8.903]
Modified Herfindahl index (t – 1)	–0.055**	–0.074***		–0.286*	–0.404***	
	[–2.251]	[–2.753]		[–1.833]	[–3.739]	
Age controls	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	No	Yes	Yes	No
Industry demeaned	Yes	No	No	Yes	No	No
Firm demeaned	No	Yes	No	No	Yes	No
Industry-year demeaned	No	No	Yes	No	No	Yes
No. of observations	77,772	77,772	77,772	40,696	40,696	40,696
ρ^2	0.218	0.267	0.221	0.241	0.169	0.240

Sources: Compustat; authors' calculations.

a. The data are annual. t statistics are shown in brackets. Statistical significance is indicated at the ***1 percent, **5 percent, and *10 percent levels.

log transformation implies that firm-year observations with zero or missing R&D are omitted from the regression. That said, results are robust to using R&D/AT without the log transformation, while including those firms with zero R&D expenses.

Columns 1, 2, 4, and 5 include year fixed effects. Columns 1 and 4 demean all variables within each industry, while columns 2 and 5 demean variables within firms. As shown, quasi-indexer institutional ownership and concentration are significant predictors of investment. Firms with more quasi-indexer institutional ownership and firms in industries with higher modified Herfindahl index values invest less. Note that the coefficients on quasi-indexer ownership and modified Herfindahl index values are similar to those recovered in industry regressions (when using net investment).

Columns 3 and 6 demean all variables within each industry-year, and exclude the measure of concentration because it would be absorbed into the means. As shown, quasi-indexer institutional ownership is significant, which suggests that, within each industry-year and controlling for *Q*, firms with more quasi-indexer institutional ownership invest less.

Excess funds go to share buybacks and payouts. As shown in table 7, firms with more quasi-indexer ownership do more buybacks and have higher payouts. This is true when year, industry (columns 1 and 4), firm (columns 2 and 5), and industry-year (column 3 and 6) fixed effects are included; and when controlling for a wide range of financials, such as market value, cash flow, profitability, leverage, and sales growth.

Some recent literature highlights that weak corporate governance affects primarily firms in noncompetitive industries. We discuss these interactions in Gutiérrez and Philippon (forthcoming), where we show that ownership leads to underinvestment only in noncompetitive industries. This aligns with the results of Xavier Giroud and Holger Mueller (2010, 2011).

AGGREGATE IMPACT Together with the rise of intangibles (discussed below), decreased competition, tightened corporate governance, and increased short-termism explain the entire decline in investment. To illustrate this, figure 9 plots the time effects of a regression of industry-level investment on *Q*; on *Q* and intangibles; and on *Q*, intangibles, competition, and corporate governance (the line labeled "all"). We recenter the fixed effects at zero and flip the plot for readability. As shown, the time effects from regressions on *Q* and on *Q* and intangibles are consistently below zero after 2000. The time effects including all three explanations oscillate with the economic cycle but exhibit no trend.

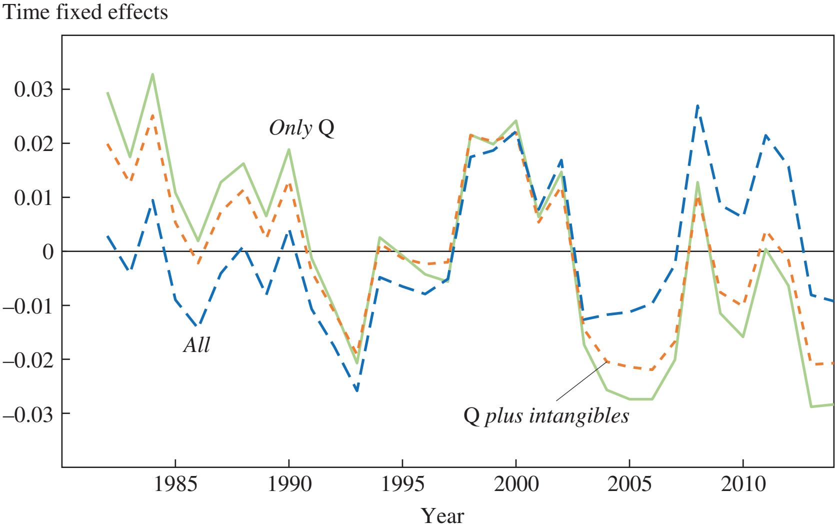
Table 7. Firm-Level Regressions: Buybacks and Payouts[a]

	Ratio of buybacks to assets			Ratio of payouts to assets		
	After 1990 (1)	*After 1990* (2)	*After 1990* (3)	*After 1990* (4)	*After 1990* (5)	*After 1990* (6)
Log Q ($t-1$)	–0.173***	0.019***	–0.066***	–0.618***	0.035***	–0.341***
	[–14.878]	[3.543]	[–9.411]	[–33.272]	[8.206]	[–29.640]
Share of quasi-indexer owners ($t-1$)	0.015***	0.010***	0.014***	0.016***	0.010***	0.006***
	[10.143]	[6.092]	[9.947]	[9.748]	[6.133]	[3.174]
Age controls	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	No	Yes	Yes	No
Industry demeaned	Yes	No	No	Yes	No	No
Firm demeaned	No	Yes	No	No	Yes	No
Industry-year demeaned	No	No	Yes	No	No	Yes
No. of observations	66,699	66,699	66,699	66,699	66,699	66,643
ρ^2	0.148	0.0648	0.122	0.129	0.0653	0.162

Sources: Compustat; authors' calculations.

a. The data are annual. t statistics are shown in brackets. Statistical significance is indicated at the ***1 percent, **5 percent, and *10 percent levels.

Figure 9. Time Fixed Effects from Industry- and Firm-Level Regressions, 1982–2014[a]



Sources: U.S. Bureau of Economic Analysis; Compustat; authors' calculations.
a. The figure shows time fixed effects from errors-in-variables panel regressions of industry net investment on median log(Q), firm age, and additional variables as shown. All variables are demeaned.

V. Detailed Discussion of Selected Hypotheses

This section provides detailed discussions of four prominent hypotheses: "superstar" firms, intangible capital, globalization, and safe asset scarcity. We discuss the potential for concentration to be driven by the rise of superstar firms but do not find evidence consistent with the superstar hypothesis in the 2000s. Next, we provide a detailed discussion of the rise of intangible assets, and its implications for investment and the measurement of Q. We discuss the evolution of foreign profits, capital expenditures, and sales, and their implications for U.S. investment. Finally, we provide additional evidence that safe asset scarcity is unlikely to be the explanation for low investment in recent years.

V.A. Superstar Firms

As noted above, David Autor and others (2017a, 2017b) link the increase in concentration (and decrease in labor share) to the rise of more productive, superstar firms. According to this hypothesis, the efficient scale of operation has increased so that better firms account for a larger share of industry output—thereby increasing concentration. Because superstar firms are more productive, industries that become more concentrated should also become more productive, and thus may require less investment.

To test this hypothesis, we estimate the relationship between changes in concentration and productivity across NAICS level 6 manufacturing industries. We measure changes in concentration using the U.S. Economic Census over the available five-year periods (1997, 2002, 2007, and 2012), as well as cumulatively from 1997 and 2002 to 2012. We measure changes in productivity using the NBER-CES Manufacturing Industry Database over the same periods as changes in concentration, except that the last observation ends on 2009 (the last year available in the NBER-CES database).[41] The NBER-CES database includes industry-level TFP, output and value added per worker, and output and value added per unit of capital.

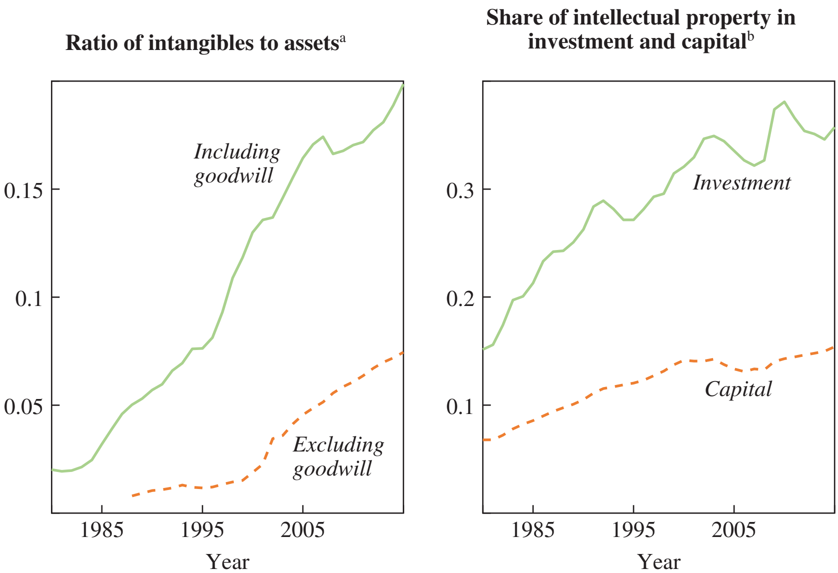
We find positive correlations between concentration and value added per worker, which would be true under essentially any model of increasing market power. The relationship between concentration and TFP, however, is inconsistent. We find positive and significant correlations before 2002, but an insignificant and sometimes negative correlation after 2002 (see table 19 in the online appendix). These results broadly match the qualitative discussion by Autor and others (2017a, p. 184), who report that "industries that became more concentrated . . . were also the industries in which productivity—measured by either output per worker, value-added per worker, TFP, or patents per worker—increased the most." But the lack of correlation between concentration and TFP after 2000 suggests that other factors may be affecting recent dynamics.[42]

Relatedly, Döttling, Gutiérrez, and Philippon (2017) compare concentration trends between the United States and Europe. We find that concentration in industries that are very similar in terms of technology has increased in the United States, yet has decreased or remained stable in Europe. Such differences in concentration patterns suggest that technological factors are not the only driver of concentration. Gutiérrez (2017) compares labor and profit share trends across advanced economies (excluding real estate). He

41. The NBER-CES Manufacturing Industry Database is a joint effort of the National Bureau of Economic Research and the U.S. Census Bureau's Center for Economic Studies; see http://www.nber.org/nberces/.

42. Note that our analyses differ from those of Autor and others (2017a) in terms of time periods, levels of granularity, and approaches. In particular, Autor and others (2017a) consider NAICS level 4 industries over longer periods of analysis (1982 to 2012). Autor and others (2017b) provide evidence that the relationship between lower labor shares and increased concentration remains significant after 2000, but no such evidence is provided for measures of productivity. And a rise in markups due to market power after 2000 would also lead to a decrease in the labor share, so this evidence is inconclusive.

Figure 10. Intangibles as a Share of Assets and Investment, 1980–2015



Sources: U.S. Bureau of Economic Analysis; Compustat.
a. The left panel includes all firms incorporated in the United States in our Compustat sample.
b. The right panel is based on figures reported by the Bureau of Economic Analysis for the industries in our sample.

finds that the labor share decreased (or profit share increased) only in the United States, while remaining relatively stable in the rest of the world.

Grullon, Larkin, and Michaely (2017) and Gutiérrez and Philippon (2017a) also discuss alternative hypotheses for the rise of concentration, including (i) decreased antitrust enforcement, (ii) competitive barriers to entry and incumbent innovation, (iii) omission of private firms in Compustat-based measures, (iv) the presence of foreign firms, (v) consolidation in unprofitable industries, and (vi) aging demographics. We provide evidence in Gutiérrez and Philippon (2017b) that U.S. industries in which regulation has increased have also become more concentrated.

V.B. Intangibles

Next, we discuss the role of rising intangibles on investment dynamics and capital accumulation.

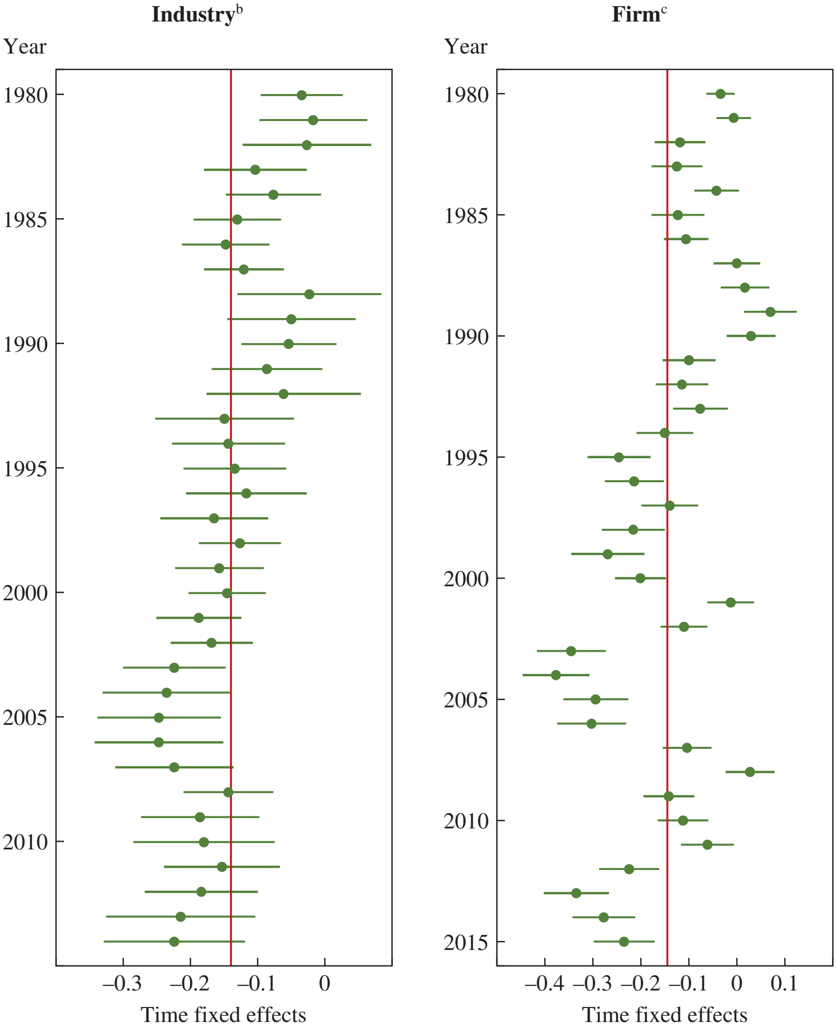
THE RISE OF INTANGIBLES To begin with, the left panel of figure 10 shows the ratio of intangibles to assets (with and without goodwill) for all firms incorporated in the United States whose data are in Compustat. As shown, the share of intangibles has been increasing rapidly since 1985, and experienced its largest increase in the late 1990s. The rise is primarily driven by goodwill, such that total intangibles are primarily a measure of past merger and acquisition 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 about 7 percent of total assets. The right panel shows the share of intellectual property capital and investment reported by the BEA (as a percentage of total capital and investment, respectively). As shown, both series experienced a substantial increase from 1980 to about 2000, but have remained relatively stable since. The share of intangible investment was 14 percent and the share of intangible capital was 35 percent in 2002, compared with 15 and 36 percent in 2015. The movement in the share of investment since 2000 is mainly because of a shift away from equipment and structures at the height of the Great Recession.

The rise of intangibles may affect investment in two ways. First, intangible investment is difficult to measure. This can be seen, for instance, in the very different trends between the share of intangibles in BEA data and intangibles (excluding goodwill) in Compustat. If intangible investment is underestimated, intangible capital would be underestimated, and therefore Q would be overestimated. Second, intangible assets might be more difficult to accumulate, due to higher adjustment costs. A rise in the relative importance of intangibles could lead to a higher equilibrium value of Q, even if intangibles are correctly measured.

INTANGIBLE INVESTMENT AND *Q* Adjustment costs might differ between intangible and tangible assets. This could affect both the equilibrium value of Q and the dynamics of capital accumulation. To test this idea, we consider asset types separately. To begin with, figure 11 shows the time effects from industry- and firm-level regressions of intangible investment on Q (that is, the same analysis as in figure 8, 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). Time effects exhibit very similar patterns as those observed for total investment. In particular, time effects were above average in the 1980s, average in the 1990s, and below average since 2000. Both time effects increase at the height of the Great Recession but again reach some of their lowest levels after 2013.

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.

Figure 11. Time Fixed Effects from Intangible Asset Regressions, 1980–2015[a]



Sources: U.S. Bureau of Economic Analysis; Compustat; authors' calculations.

a. The figure shows time fixed effects from an errors-in-variables panel regression. The regressions include controls for firm age, and all variables are demeaned.

b. The left panel shows the time fixed effects from an errors-in-variables panel regression of industry net investment on median log(Q).

c. The right panel shows the time fixed effects from an errors-in-variables panel regression of log(R&D/AT) on firm-level log(Q).

Table 8. Industry-Level Regressions, by Asset Type[a]

	Net investment rate		
	Fixed assets, including intellectual property (1)	*Fixed assets, excluding intellectual property (2)*	*Intellectual property (3)*
Median log Q $(t-1)$	0.163***	0.190***	0.166*
	[16.812]	[7.870]	[1.940]
Mean share of quasi-indexer owners $(t-1)$	–0.118***	–0.114***	–0.368
	[–3.068]	[–2.869]	[–1.340]
Modified Herfindahl index $(t-1)$	–0.056**	–0.086***	–0.143*
	[–2.394]	[–2.950]	[–1.754]
Age controls	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Industry demeaned	Yes	Yes	Yes
No. of observations	1,110	1,110	1,110
ρ^2	0.390	0.427	0.194

Sources: U.S. Bureau of Economic Analysis; Compustat; authors' calculations.

a. The data are annual. *t* statistics are shown in brackets. Statistical significance is indicated at the ***1 percent, **5 percent, and *10 percent levels.

Industry-level results are shown in table 8. The modified Herfindahl index value is significant across all asset types. Quasi-indexer ownership exhibits significantly negative coefficients for all assets and non–intellectual property (IP) assets; and negative but insignificant coefficients for IP. Coefficients on competition and ownership are larger yet noisier for IP assets—which explains the lower significance. Note that the t statistic on Q is the largest for all assets, which is consistent with Peters and Taylor's (2017) result that Q explains total investment better than either physical or intangible investment separately. Firm-level results are shown in table 6 above, which suggest that increased concentration and quasi-indexer ownership lead to underinvestment in R&D.

We conclude that intangible assets are potentially more difficult to accumulate; yet our results for the role of competition and corporate governance apply to both types of assets. Moreover, we find that Q theory works best when we combine tangible and intangible investment, suggesting that they are complementarily and jointly accumulated.

MISSING INTANGIBLES We 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 underestimated by a factor α—that is, assume that intangible investment is consistently underestimated across all industries. This is a simplifying assumption, but it highlights the main reason for concern. Under this assumption, *measured* investment is given by

$$\widehat{NI} \equiv \widehat{NI}^T + \widehat{NI}^I = NI^T + \alpha NI^I. \tag{13}$$

The underestimation of investment leads to the underestimation of capital $\widehat{K}$ and, because $\widehat{Q}$ is the ratio of the market value to the replacement cost of capital, it leads to an overestimation of Q. Thus, a regression of the form

$$\frac{\widehat{NI}_{i,t}}{\widehat{K}_{i,t-1}} = \beta \widehat{Q}_{i,t-1} + \gamma \frac{\widehat{K}^I}{AT_{i,t-1}} + \mu_i + \eta_t + \varepsilon_{i,t} \tag{14}$$

would yield a negative and significant coefficient γ. More complex measurement errors would yield different structures; but, broadly, the negative coefficient should remain. Industries and firms with a higher dependence on intangibles would appear to be underinvesting due to an overestimation of Q and an underestimation of investment.

Industry level. We start by testing this at the industry level, in two ways. First, we estimate panel regressions following equation 16 on BEA measures of investment (which include IP investment) and the traditional Compustat Q. The results are shown in columns 1 and 2 of table 9. As shown, the coefficient on intangibles is significant and negative, suggesting that industry-years with a larger share of intangibles exhibit more underinvestment relative to Q.

Second, we replace the Compustat Q with the Q^{tot} of Peters and Taylor (2017). As noted below, Q^{tot} aims to correct for measurement error in intangibles by recognizing R&D and part of selling, general, and administrative expenses as investments. This procedure reduces the measurement error in Q due to intangibles, and should therefore reduce the explanatory power of $\widehat{K}^I/AT_{i,t-1}$. The results are shown in column 3. Intangibles are no longer significant, although they retain the negative sign. Note, however, that our core hypotheses of competition and quasi-indexer ownership remain significant, and the addition of intangibles in the regression has only a limited effect on the coefficients or R^2 (when using the Compustat Q; the coefficients change when using Q^{tot}, due to differences in the series).

Table 9. Industry-Level Regressions: Measurement Error for Intangibles[a]

	Net investment rate		
	After 1990 (1)	*After 1990 (2)*	*After 1990 (3)*
Median log Q (t – 1)	0.163***	0.138***	
	[16.812]	[27.700]	
Median log Q^{tot} (t – 1)			0.138***
			[20.330]
Mean share of quasi-indexer owners (t – 1)	–0.118***	–0.110***	–0.183***
	[–3.068]	[–3.015]	[–3.231]
Modified Herfindahl index (t – 1)	–0.056**	–0.043**	–0.075***
	[–2.394]	[–2.111]	[–2.703]
Share of intangible investments (t – 1)		–0.064**	–0.015
		[–2.298]	[–0.295]
Age controls	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Industry demeaned	Yes	Yes	Yes
No. of observations	1,110	1,110	1,109
ρ^2	0.390	0.387	0.545

Sources: U.S. Bureau of Economic Analysis; Compustat; Peters and Taylor (2017); authors' calculations.
a. The data are annual. t statistics are shown in brackets. Statistical significance is indicated at the ***1 percent, **5 percent, and *10 percent levels.

Firm level. The concern for measurement error in intangible investment and Q is even more significant at the firm level. We study the empirical distribution of three common definitions of firm-level Q, as well as their implications on investment.

The first measure is Q^{used}, as defined above. It is essentially a proxy for firm-level market-to-book ratio. The second measure, Q^{alt}, is the ratio of market value of productive assets to gross PP&E. It is defined as $Q^{alt} \equiv (ME + DLTT + DLC - ACT)/PPEGT$ in Compustat, where ME is the market value of equity defined above; DLTT and DLC denote long-term and current debt liabilities, respectively; ACT denotes current assets, including cash, inventory, and marketable securities; and PPEGT denotes gross PP&E (before depreciation). This definition explicitly excludes current assets, to isolate the market and book values of the output-producing capital (that is, long-term capital). However, considering only PP&E in the denominator can be troublesome for high-intangible firms that carry limited PP&E on their balance sheets. The distribution of Q can be quite

Table 10. Percentiles of Three Measures of Q

	1975–80			*2010–15*		
Percentile	Q^{used}	Q^{alt}	Q^{tot}	Q^{used}	Q^{alt}	Q^{tot}
1	0.5	−4.8	−1.0	0.5	−5.1	−0.9
5	0.7	−1.5	−0.5	0.7	−0.6	−0.2
10	0.7	−0.8	−0.3	0.9	0.0	0.0
25	0.8	−0.2	−0.1	1.1	0.7	0.3
50	1.0	0.3	0.2	1.6	2.1	0.8
75	1.3	0.9	0.6	2.5	7.6	1.6
90	1.9	2.5	1.4	4.4	30.0	3.4
95	2.7	4.6	2.4	6.5	73.1	5.9
99	6.6	24.1	9.6	16.2	746.2	22.4

Source: Authors' calculations.

skewed and fairly volatile. The third measure is Q^{tot}, which aims to address the skewness in Q^{alt} by including an estimate of the value of intangible capital in the denominator. Namely, it is defined as

$$Q^{tot} \equiv \frac{\text{ME} + \text{DLTT} + \text{DLC} - \text{ACT}}{\text{PPEGT} + K^{Int}}, \tag{15}$$

where K^{Int} measures intangible capital based on granular capital accumulation and depreciation assumptions. Peters and Taylor (2017) show that Q^{tot} performs better than Q^{alt}.

Table 10 compares the empirical distribution (before Winsorizing) of our three measures of Q over two periods: 1975–80 and 2010–15.[43] As shown, all three distributions have become increasingly skewed since 1980, but Q^{alt} has been by far the most affected; the 75th percentile of the distribution as of 2010–15 is 7.6, and the 90th percentile is 30. This is likely due to high-intangible firms carrying low PP&E balances. Q^{tot} resolves some of these issues by adding an estimate of intangible assets to the denominator, reaching a distribution similar to our proxy Q^{used}. Interestingly,

43. We consider firms after applying our data cleaning and exclusion criteria. In other words, our population includes only firms incorporated in the United States and excludes utilities, financials, and real estate. See subsection III.C for details.

the median Q has also increased across all measures—especially Q^{alt} and Q^{tot}, which have increased by a factor of 8 and 4, respectively. Our measure, Q^{used}, appears to be the most stable of the three.

Such drastic differences in the distribution and skewness of Q have material implications for regression results—particularly as they relate to the role of intangibles vis-à-vis investment and the effect of correcting for measurement error using the cumulant estimator. Let us study these implications.[44]

Table 11 shows the results of regressing firm-level net investment on Q^{used}, Q^{alt}, and Q^{tot}. Columns 1 through 3 show OLS results with firm fixed effects. Q^{used} and Q^{tot} exhibit strong statistical significance, especially compared with Q^{alt}.[45] All three regressions suggest that rising intangibles are correlated with decreasing firm-level investment. This conclusion, however, is sensitive to measurement error corrections; as shown in columns 4 through 6, the coefficient on intangible assets remains negative only for Q^{alt} when using the cumulant estimator.[46]

This does not contradict our industry-level results, however. Columns 7 and 8 shift from firm to industry fixed effects, using Q^{used} and Q^{tot}, respectively. We recover a negative and significant coefficient on intangible intensity—suggesting that high-intangible firms do invest less in the cross section. This is consistent with the findings of Döttling, Gutiérrez, and

44. Two papers have studied the relationship of intangibles, Q, and firm-level investment. First, Alexander and Eberly (2016) link within-firm increases in intangible assets to decreases in tangible investment. Namely, they regress

$$\log\left(\frac{\text{CAPX}_i}{\text{AT}_i}\right) = \beta_0 + \beta_1 \log\left(\frac{\text{CF}_i}{\text{AT}_i}\right) + \beta_2 \log(Q_i) + \beta_3 \log\left(\frac{\text{INTAN}_i}{\text{AT}_i}\right) + \mu_i + \eta_t + \varepsilon_{i,t},$$

where μ_i and η_t denote firm and time fixed effects, respectively. They use a measure of Q similar to Q^{alt}. By including firm-level fixed effects, the implication is that firms decrease tangible investment as they increase their share of intangibles. Second, Döttling and Perotti (2017) consider the change in net PP&E normalized by operating cash flows as their measure of tangible investment, and include only industry fixed effects. They find that high-intangible firms invest less in tangible assets, relative to other firms in the same industry. Döttling, Gutiérrez, and Philippon (2017) confirm the results of Döttling and Perotti (2017) with a sample of European firms.

45. Log transforming all measures of Q substantially improves the fit of Q^{alt}, but has a limited effect on Q^{used} and Q^{tot} (in fact, it decreases the fit for Q^{tot}).

46. We note that the positive coefficient on Q^{tot} is sensitive to log transformations (that is, it is negative and significant when regressing net investment on $\log(Q^{tot})$); but Q^{tot} exhibits a much higher t statistic than $\log(Q^{tot})$. The positive coefficient on Q^{used} remains even when using logs.

Table 11. Firm-Level Regressions: Measurement Error for Intangibles[a]

	Net CAPX/PP&E							
	After 1980 (1)	*After 1980* (2)	*After 1980* (3)	*After 1980* (4)	*After 1980* (5)	*After 1980* (6)	*After 1980* (7)	*After 1980* (8)
Q^{used} $(t-1)$	0.074***			0.218***			0.103***	
	[84.810]			[50.108]			[50.807]	
Q^{alt} $(t-1)$		0.000***			0.000***			
		[6.238]			[3.154]			
Q^{tot} $(t-1)$			0.076***			0.207***		0.098***
			[105.324]			[65.656]		[71.389]
Intangible assets $(t-1)$	–0.048***	–0.165***	–0.035***	0.158***	–0.103***	0.123***	–0.028**	–0.049***
	[–4.145]	[–13.804]	[–3.113]	[7.574]	[–6.214]	[5.724]	[–2.338]	[–4.103]
Estimation method	Ordinary least squares			Cumulant estimator			Cumulant estimator	
Age controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Industry demeaned	Yes	No	No	Yes	No	No	Yes	No
Firm demeaned	No	Yes	No	No	Yes	No	No	Yes
No. of observations	116,351	113,527	115,473	116,351	113,527	115,473	116,351	115,473
ρ^2	0.139	0.082	0.171	0.258	0.0747	0.330	0.205	0.246

Sources: Compustat; Peters and Taylor (2017); authors' calculations.

a. The data are annual. *t* statistics are shown in brackets. Statistical significance is indicated at the ***1 percent, **5 percent, and *10 percent levels.

Philippon (2017) and Döttling and Perotti (2017). Industry-level investment may therefore decrease as high-intangible firms account for a larger share of the market.[47]

Our results yield two conclusions. First, Q^{alt} does not appear to be a valid proxy for Q in the presence of high-intangible firms; instead, either Q^{tot} or Q^{used} should be used. Both these measures exhibit similar results and broadly similar levels of significance. Second, Q^{used} appears like a reasonable and stable proxy for Q.

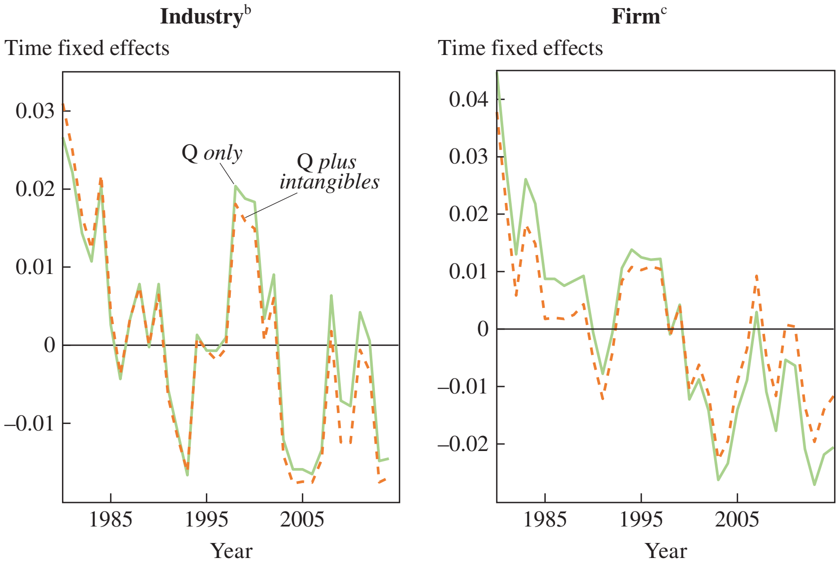
TAKEAWAY ON INTANGIBLE INVESTMENT The industry-level evidence suggests that high-intangible industries exhibit lower "measured" investment; and the firm-level evidence suggests that high-intangible firms invest less in the cross section. What portion of the underinvestment can be explained by the rise of intangibles? We estimate this by adding measures of intangible intensity to regressions similar to those underlying figure 8. For industry-level results, we use the same regression as in figure 8 and add the share of intangible investment as a predictor variable. For firm-level results, we move from firm- to industry-level fixed effects (given the results in table 9) and add the firm-level ratio of intangibles to assets to the regression.

Figure 12 shows the results, where we have recentered the fixed effects at zero for readability. The rise of intangibles appears to explain between a quarter and a third of the observed investment gap. It is particularly important to note that adding intangibles not only increases the time effects after 2000 but also decreases them before 1990—suggesting that part of the long-term drop in investment is in fact driven by the rise in intangibles. Our estimate of the impact of intangibles is broadly consistent with that of Alexander and Eberly (2016).

Even after controlling for intangible investment, however, large and persistent negative time effects remain after 2000—time effects that are correlated with increased concentration and increased quasi-indexer ownership. Corporations have reduced investment in both tangible and intangible assets since 2000, suggesting that other factors are at play. We conclude that the rise in intangibles accounts for some—a quarter to a third—but not all of the observed underinvestment.

47. In unreported tests, we confirm that out conclusions are robust to using CAPX/AT, instead of net investment as the dependent variable; as well as using the Center for Research in Security Prices–Compustat merged sample instead of the full Compustat sample.

Figure 12. Time Fixed Effects from Intangible Asset Regressions, 1980–2015[a]



Sources: U.S. Bureau of Economic Analysis; Compustat; authors' calculations.

a. The figure shows time fixed effects from an errors-in-variables panel regression. The regressions include controls for firm age, and all variables are demeaned.

b. The left panel shows the time fixed effects from an errors-in-variables panel regression of industry net investment on median *Q*.

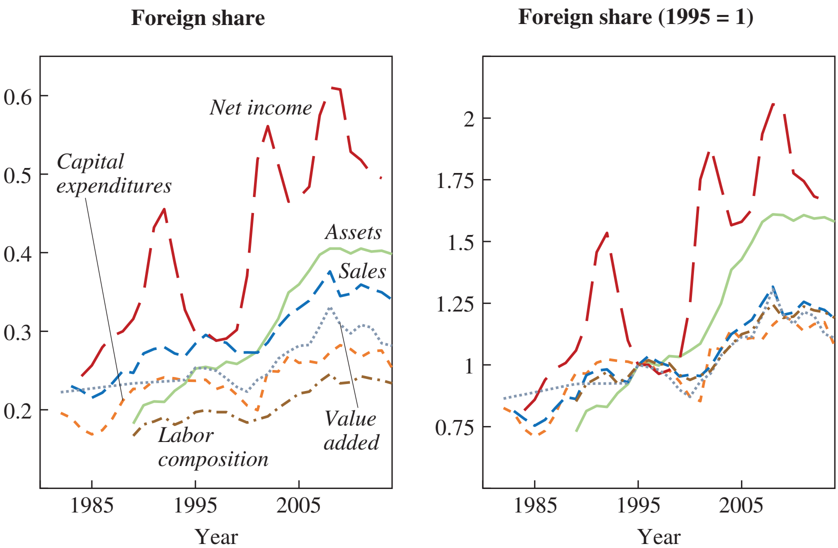
c. The right panel shows the time fixed effects from an errors-in-variables panel regression of (CAPX+R&D)/AT on firm-level *Q*.

V.C. Globalization

The U.S. National Accounts measure output and investment by U.S.-owned as well as foreign-owned firms in the United States. They do not include investment in China by a U.S. retail company, for example. This may induce a gap between *Q* and U.S. investment if U.S. firms with a high *Q* and growing foreign activities are investing more abroad, or if foreign firms are investing less in the United States. We test this hypothesis in two ways, first by examining aggregate trends and then by estimating cross-sectional regressions.

AGGREGATE TRENDS Figure 13 shows the share of total assets, sales, net income, value added, and labor compensation accounted for by majority-owned foreign affiliates of U.S. multinational enterprises (MNEs), as a percentage of total (U.S. and foreign) quantities. The left panel shows the raw time series, and the right panel normalizes all quantities to 1 as of 1995.

Figure 13. Foreign Share of Multinational Enterprise Accounts, 1982–2014



Source: U.S. Bureau of Economic Analysis.

(See the online appendix for the details of the data.) As shown, the share of foreign income increased drastically in 2000 and now accounts for half of total MNE income. This is a well-known and widely discussed fact—for related evidence, see the work of Gabriel Zucman (2014) and Fatih Guvenen and others (2017), among others.

If higher foreign profits are driven by higher foreign activity, this could create a gap between worldwide *Q* and U.S. investment. However, the evolution of the remaining quantities suggests otherwise. CAPX, sales, value added, and labor compensation—all likely better measures of foreign economic activity than profits—increased only slightly, and by very similar amounts. Assets increased with foreign profits, a fact likely related to the MNEs' growing cash holdings. Combined, these trends suggest that rising foreign profits are primarily driven by changes in accounting policies rather than a true shift in economic activity. They are, therefore, unlikely to explain declining U.S. investment.[48]

48. More broadly, the evolution of these quantities may have first-order implications for the U.S. National Accounts. If a large portion of corporate profits actually originates in the United States but is booked overseas, U.S. output would be understated, which in turn would affect virtually all macroeconomic statistics. This is an interesting area for future research.

CROSS-SECTIONAL REGRESSIONS The aggregate results are confirmed by panel regressions. Table 12 shows the results of industry- and firm-level regressions. Columns 1 to 4 are based on industry data. Column 1 replicates our base industry-level results. Column 2 adds the industry-level average share of foreign profits measured in Compustat. Columns 3 and 4 add the share of foreign income and CAPX measured in the BEA's MNE data. Column 5 is based on firm-level data.

As shown in table 12, the coefficients on both measures of foreign income are negative and significant in industry-level regressions, while the coefficient on foreign CAPX is negative but insignificant. This is as expected, because industries with larger foreign activities are likely to invest less in the United States (relative to *Q*). By contrast, the coefficient in firm-level regressions (which consider consolidated investment irrespective of location) is positive and insignificant. Firm-level results suggest that underinvestment is unrelated to foreign activity. Perhaps more important, the coefficients on quasi-indexer ownership and the modified Herfindahl index values remain properly signed and significant for all but column 4, which is nearly significant. And this is true despite a shortened period (post-1999) and the coarser segmentation used in columns 3 and 4 due to data limitations (which are discussed in the online appendix).

Combined, these results suggest that our conclusions are robust to controlling for foreign activity; and the decline in U.S. investment is not (entirely) explained by rising globalization.

V.D. Debt Issuance and Investment by Highly Rated Firms

According to the safe asset scarcity hypothesis, the value of being able to issue safe assets increased after the Great Recession. This should increase the value of very safe firms (those rated AA to AAA), but, to the extent that safety cannot be readily scaled up, it would not increase their physical investment to the same extent that it increases their value. This might then account for relatively low investment despite a high *Q*. Note that at some broad, abstract level, this is an example of decreasing returns to physical scale.

To better determine whether this hypothesis is supported by the data, this subsection discusses the valuation and investment patterns of those firms rated AA to AAA and those rated below AA. To mitigate endogeneity problems, we assign firms to rating groups based on their 2006 ratings, before the Great Recession. The year 2006 was chosen because safe asset scarcity is understood to be a post–Great Recession effect.

Table 12. Regression Results: Globalization[a]

	Industry net investment rate				*Firm net CAPX/PP&E*
	After 1990 (1)	*After 1990 (2)*	*After 1999 (3)*	*After 1999 (4)*	*After 1990 (5)*
Median log Q ($t-1$)	0.163***	0.144***	0.1263***	0.1296**	0.219***
	[16.812]	[16.411]	[2.6258]	[2.5644]	[39.341]
Mean share of quasi-indexer owners ($t-1$)	–0.118***	–0.127***	–0.1971***	–0.1973***	–0.121***
	[–3.068]	[–3.786]	[–3.0730]	[–3.0488]	[–6.776]
Modified Herfindahl index ($t-1$)	–0.056**	–0.045**	–0.0497*	–0.0461	–0.072***
	[–2.394]	[–2.087]	[–1.6797]	[–1.5879]	[–2.690]
Mean share of foreign profits ($t-1$)[b]		–0.065***			
		[–3.278]			
Share of foreign income ($t-1$)[c]			–0.0038*		
			[–1.8636]		
Share of foreign CAPX ($t-1$)				–0.001	
				[–0.071]	
Share of foreign profit ($t-1$)					0.004
					[1.037]
Foreign data source	n.a.	Compustat	BEA	BEA	Compustat
Age controls	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry demeaned	Yes	Yes	Yes	Yes	No
Firm demeaned	No	No	No	No	Yes
No. of observations	1,110	1,110	416	435	77,731
ρ^2	0.390	0.380	0.542	0.533	0.264

Sources: Compustat; U.S. Bureau of Economic Analysis; authors' calculations.

a. The data are annual. t statistics are shown in brackets. Statistical significance is indicated at the ***1 percent, **5 percent, and *10 percent levels.

b. Foreign profits are set to zero if missing.

c. The share of foreign income is a centered three-month moving average.

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 (and investment, to a lesser extent) of highly rated firms should increase relative to that of other firms. We regress the 2014 market value on the 2006 market value and an indicator for firms rated AA to AAA:

$$\text{(16)} \qquad \log\left(MV_{i,2014}\right) = \beta_0 + \beta_1 \log\left(age_i\right) + \beta_2 \log\left(assets_{i,2006}\right) + \beta_3 \log\left(MV_{i,2006}\right) + \beta_4 \mathbb{I}\left\{\text{AAA}-\text{AA}_{i,2006}\right\} + \varepsilon_i .$$

We include industry fixed effects in some regressions; and we run a similar regression for capital (PP&E) and assets to test for higher (cumulative) capital expenditures or balance sheet growth. Table 13 summarizes the results. As shown, the coefficient on the indicator for firms rated AA to AAA is not significant and, if anything, it is negative. In unreported tests, we find positive results at the height of the Great Recession (2009 and 2010), but not in later years. The AAA premium did exist immediately after the Great Recession, but it was short-lived, and cannot account for valuation and investment after 2010.

Let us move on to investment patterns. 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.[49] At least until 2012, both groups seemed to be increasing assets at roughly the same rate. By contrast, 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, we follow Murray Frank and Vidhan 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:[50]

$$\text{(17)} \qquad DEF = DIV + INV + \Delta WC - IntCF.$$

49. Conclusions are qualitatively similar excluding R&D expenses from the net investment calculation.

50. The following Compustat items are used: DIV = DIV; INV = CAPX + IVCH + AQC – SPPE –SIV – ICSTCH – IVACO; ΔWC = –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.

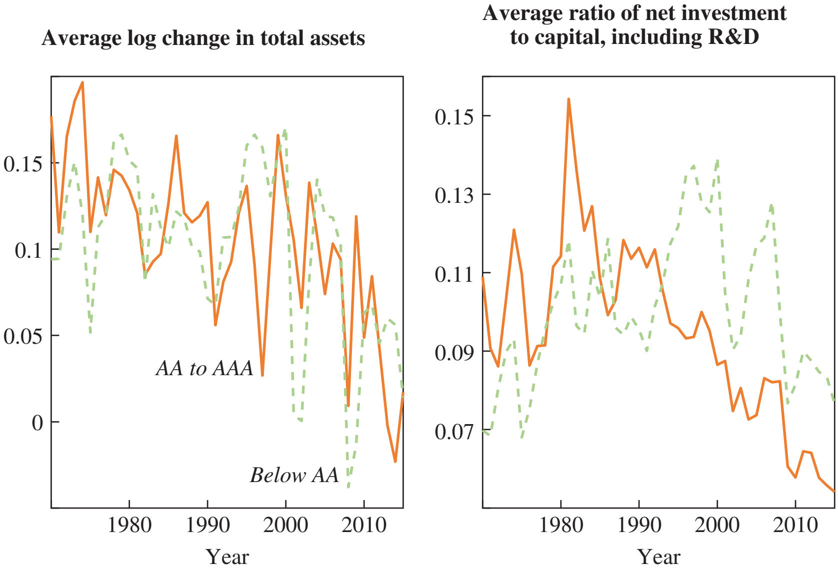
Table 13. Safe Asset Scarcity: Valuation Test[a]

	Log(market value) (2014)		*Log(PP&E) (2014)*		*Log(assets) (2014)*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
AA to AAA rated (2006)	–0.079	–0.241	–0.362	–0.224	–0.205	–0.274
	[–0.34]	[–1.03]	[–0.94]	[–0.65]	[–0.98]	[–1.31]
Log(market value) (2006)	0.036	0.021	0.192**	0.170**	0.032	0.034
	[0.70]	[0.40]	[2.27]	[2.22]	[0.70]	[0.73]
Log(assets) (2006)	1.034***	1.001***	0.373***	0.459***	0.546***	0.552***
	[25.75]	[24.17]	[5.60]	[7.55]	[15.27]	[14.98]
Log(age) (2006)	–0.008	0.030	0.748***	0.613***	0.455***	0.443***
	[–0.20]	[0.73]	[11.36]	[10.09]	[12.90]	[12.04]
Industry fixed effects	No	Yes	No	Yes	No	Yes
No. of observations	1,795	1,795	1,781	1,781	1,795	1,795
R^2	0.850	0.858	0.721	0.793	0.873	0.879

Sources: Compustat; authors' calculations.

a. The data are annual. *t* statistics are shown in brackets. Statistical significance is indicated at the ***1 percent, **5 percent, and *10 percent levels.

Figure 14. Assets and Investment by Firm Rating, 1970–2015[a]

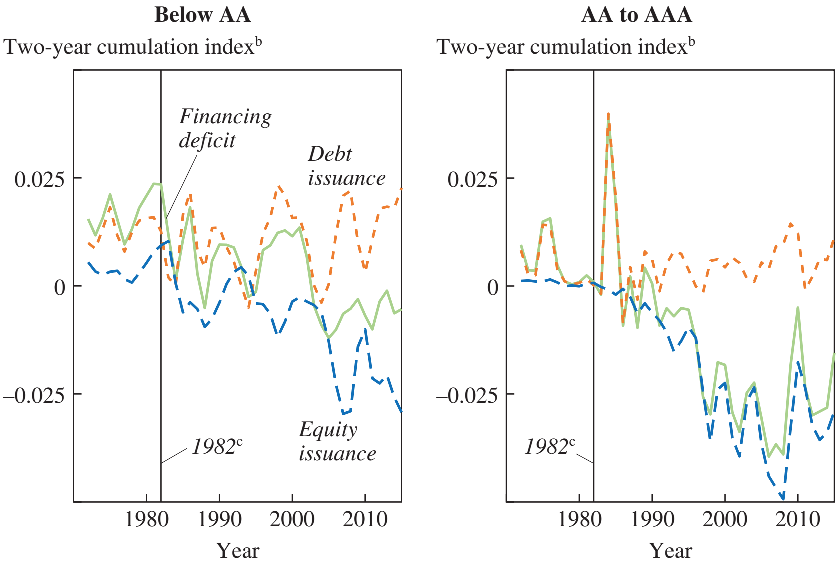


Source: Compustat.
a. Firms are mapped to categories based on 2006 ratings.

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

Figure 15 shows the two-year cumulative financing deficit, debt, and equity issuance by rating group, normalized by total assets. We highlight 1982, when the U.S. Securities and Exchange Commission issued rule 10b-18, 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

Figure 15. Uses and Sources of Financing by Firm Rating, 1972–2015[a]



Source: Compustat.
a. Firms are mapped to categories based on 2006 ratings.
b. The values are two-year cumulations normalized by total assets.
c. This line at 1982 highlights the passing of the U.S. Securities and Exchange Commission's rule 10b-18, which allows companies to repurchase their shares on the open market without regulatory limits.

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. The increase in buybacks is much less pronounced for lower-rated firms until the mid-2000s. In fact, until about 2000 lower-rated firms maintained a positive finance deficit, which was financed primarily with debt.

The improving finance deficit and associated buybacks may be driven by increasing profits or by decreasing investments. Table 14 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 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 has been particularly pronounced for highly rated firms, from about 11 percent in the 1970s and 1980s to only 6 percent in the 2000s.

Table 14. Funds Flow and Financing as a Percent of Total Assets, by Firm Rating[a]

		Years						
	Rating and field	*1970–79*	*1980–89*	*1990–94*	*1995–99*	*2000–04*	*2005–09*	*2010–15*
	AA to AAA							
(1)	Cash dividends	3.7	3.9	4.3	4.7	4.5	4.2	4.0
(2)	Investments	9.7	11.9	8.4	7.9	7.3	6.2	6.2
(3)	Change in working capital	1.6	–0.3	0.5	1.4	1.4	0.8	0.1
(4)	Internal cash flows	14.2	15.8	13.8	15.6	16.3	15.7	13.0
	Financing deficit (1 + 2 + 3 – 4)	0.7	0.1	–0.7	–1.9	–2.7	–3.0	–2.3
(5)	Net debt issues	0.6	0.2	0.4	0.3	0.4	1.1	0.6
(6)	Net equity issues	0.1	–0.1	–1.1	–2.2	–3.1	–4.1	–2.9
	Net external financing (5 + 6)	0.7	0.1	–0.7	–1.9	–2.7	–3.0	–2.3
	Below AA							
(1)	Cash dividends	2.6	2.5	2.1	1.8	1.3	1.7	2.0
(2)	Investments	10.7	12.2	7.8	9.3	6.8	7.4	7.8
(3)	Change in working capital	1.8	0.9	0.8	2.0	1.9	1.5	1.4
(4)	Internal cash flows	13.4	14.0	10.1	11.7	9.8	11.3	11.7
	Financing deficit (1 + 2 + 3 – 4)	1.5	1.1	0.4	1.0	0.2	–0.7	–0.6
(5)	Net debt issues	1.2	1.1	0.2	1.6	0.6	1.3	1.7
(6)	Net equity issues	0.3	0.0	0.2	–0.7	–0.4	–2.1	–2.4
	Net external financing (5 + 6)	1.5	1.1	0.4	0.9	0.2	–0.8	–0.7

Sources: Compustat; authors' calculations.

a. The data are annual. Values are based on the average of yearly cumulative totals across all firms in each category. Firms are mapped to categories based on 2006 ratings.

VI. Interpretation of Macroeconomic Trends

Recent work in the macroeconomics literature has studied the slow U.S. recovery following the Great Recession. Fernald and others (2017) (henceforth, FHSW), in particular, use a quantitative, growth-accounting decomposition to study the output shortfall. According to their calculations, the shortfall is almost entirely explained by slower TFP growth and decreased labor force participation. Focusing on the capital stock, they argue, "Although investment was low during this recovery relative to earlier recoveries, capital growth was not low relative to output growth: By 2016, the capital–output ratio was in line with its long-term trend" (p. 32).

Our goal in this section is to test how FHSW's growth-accounting decomposition would deal with an increase in markups. We agree, of course, that slow TFP growth and decreased labor input are important explanations for the slow recovery, but this does not mean that there is no room for other explanations. In particular, changes in competition and corporate governance might explain some of the decline in TFP and labor supply.

To tease out the effect of increased market power on growth-accounting decompositions, we generate 100 simulations of an economy under increasing markups using the model of Jones and Philippon (2016), which is briefly described in the online appendix. We assume a change in the steady-state markup from 20 percent to 35 percent over 100 quarters.[51] We use the simulations to study the contribution of alternative macroeconomic series to aggregate output under the following two decompositions (see FHSW for their derivation):

$$(18)\qquad \Delta \log(Y_t) = \Delta \log(TFP_t) + \alpha_t \Delta \log(K_t) + (1 - \alpha_t)\Delta \log(N_t),$$

and

$$(19)\qquad \Delta \log(Y_t) = \frac{\Delta \log(TFP_t)}{1 - \alpha_t} + \frac{\alpha_t}{1 - \alpha_t}\Delta \log\left(\frac{K_t}{Y_t}\right) + \Delta \log(LQ_t),$$

where α_t denotes the capital share of output and LQ_t denotes labor quality. We model only total labor N_t, so in our simulated data $\Delta\log(LQ_t) = 0$. All other definitions are standard.

51. This is comparable in size to the estimate given by Jones and Philippon (2016). The model is calibrated and the shocks are estimated using a Kalman filter, taking into account the zero lower bound on nominal interest rates.

Each simulation includes estimates for the growth of output, consumption, labor, and capital, as well as shocks to economy-wide TFP (among others). Using the simulated series, we estimate each of the components in equations 20 and 21. We report results using the change in measured TFP, defined as

$$\Delta \log(TFP_t) = \Delta \log(Y_t) - \bar{\alpha}_t \log(K_t) - (1 - \bar{\alpha}_t)\Delta \log(N_t), \tag{20}$$

where $\bar{\alpha}_t = (\alpha_t + \alpha_{t-1})/2$.[52] This definition follows Fernald (2014) (which is used by FHSW), but two items are worth highlighting. First, Fernald (2014) carefully controls for changes in utilization when computing TFP. This issue is moot in the simulated data because our model does not include variable utilization. Second, Fernald (2014) maintains the assumption of zero profits. He estimates the factor shares using BLS output data, excluding taxes. This approach implies that any profit above and beyond the rental cost of capital is included in the capital share. To mirror this approach, we reestimate α_t every period as $W_t N_t / Y_t$.[53]

We follow FHSW to decompose the simulated series into trend, cyclical, and residual (that is, irregular) components (μ_t, c_t, and z_t, respectively):

$$y_t = \mu_t + c_t + z_t. \tag{21}$$

The only difference between our decomposition and that of FHSW is that we use employment as our basis for Okun's law instead of unemployment

52. We use the average capital share across adjacent periods rather than the time t capital share to (roughly) account for the increase in the capital share with market power. This is the standard approach, but note that it can be substantially biased in periods of rising capital shares, as simulated here (and observed in recent years). In fact, the change in measured TFP could be written as

$$\begin{aligned} \Delta \log(TFP_t) &= \Delta \log(Y_t) - [\alpha_t \log(K_t) - (\alpha_t - \Delta\alpha_t)\log(K_{t-1})] \\ &\quad - \{[1-\alpha]\log[N_t] - [1 - (\alpha_t - \Delta\alpha_t)]\log[N_{t-1}]\} \\ &= \Delta \log(Y_t) - \alpha_t \Delta \log(K_t) - (1-\alpha_t)\Delta \log(N_t) - \Delta\alpha_t \left[\log\left(\frac{K_{t-1}}{N_t}\right)\right], \end{aligned}$$

where the last term captures changes in capital shares.

53. Estimating labor shares based on the Cobb–Douglas production structure yields similar results. Namely, for a given elasticity of substitution ε_t, the implied markup is $\mu_t = \varepsilon_t/(1 - \varepsilon_t)$ and the corresponding labor share is $s_t^N = (1 - \alpha)/\mu_t$. The "measured" capital share of output including profits is then $\hat{\alpha}_t = 1 - (1 - \alpha)/\mu_t$.

(Okun 1962). The decomposition proceeds as follows. First, c_t is estimated using a generalized Okun's law

$$c_t = \sum_{j=-p}^{q} \beta_j \Delta n_{t+j} = \beta(\mathbf{L})\Delta n_t, \tag{22}$$

where we use total labor n as our basis for calculations. β_j is estimated through a simple OLS regression with two forward and backward lags ($p = q = 2$). Substituting equation 22 into 21, we obtain the Okun's law residual (which includes the long-run trend μ_t),

$$y_t - \beta(\mathbf{L})\Delta n_t = \mu_t + z_t. \tag{23}$$

Next, we estimate μ_t as a long-run, smoothed value of y_t after removing the cyclical part; namely,

$$\hat{\mu}_t = \kappa(L)\left(y_t - \hat{\beta}(\mathbf{L})\Delta n_t\right), \tag{24}$$

where $\kappa(L)$ is a biweight filter with a truncation parameter of 60. Note that this trend/cycle/irregular decomposition preserves additivity.

The basic results are shown in table 15, along with FHSW's results for comparison. Columns 1 and 2 show the median and standard deviation across 100 simulations of the generalized Okun's law coefficient $\beta(1)$. Row 1 shows that an increase in employment of 1 percent leads to an increase in output of 0.68 percent—as expected, given the use of $\alpha = 0.33$. The increase is explained by a mixture of TFP and labor N_t (rows a and c). Similarly, row 2 shows that output per unit of labor decreases by 0.32 percent when employment increases by 1 percent. This is driven by a drop in *K*/*Y*, which is partly compensated for by a rise in TFP (rows d and e). The behavior of *K*/*Y* is relevant. FHSW note that, in theory, slower TFP growth should raise the steady-state capital–output ratio—but this is not what the data show. The capital–output ratio has been fairly smooth since the 1970s. In the benchmark model, the channel from TFP growth to *K*/*Y* is via the interest rate and the cost of capital. Lower trend growth leads to a lower interest rate, which lowers the cost of capital and increases *K*/*Y*. We have indeed observed a decrease in the real interest rate and in the cost of funds, but it did not seem to translate into a clear increase in *K*/*Y*. The lack of growth in the capital–output ratio may

Table 15. Macroeconomic Estimates

	Generalized Okun's law coefficient[a]				Standard deviation of components						Median R^2 from Okun's law regression[c]	Gap to trend at t = 100	
	Our estimate		FHSW		Our estimate (simulation median)			FHSW (actual)					
	Median	SD	Coefficient[b]	SD	Cycle (c)	Trend (μ)	Irregular (z)	Cycle (c)	Trend (μ)	Irregular (z)		Median	SD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1)[d] Y (a + b + c)	0.68	0.08	2.02	0.20	1.19	0.08	1.22	2.51	0.54	2.12	0.48	0.00	0.01
(a) TFP	0.09	0.08	0.50	0.19	0.32	0.08	1.20	1.24	0.24	2.27	0.06	0.00	0.01
(b) αK_t	0.01	0.01	0.09	0.06	0.03	0.06	0.13	0.20	0.19	0.32	0.04	0.00	0.01
(c) $(1-\alpha)N_t$	0.58	0.01	1.43	0.14	0.97	0.00	0.04	1.54	0.26	1.24	1.00	0.00	0.00
(2) Y_t/N_t (d + e + f)	–0.32	0.08	–0.28	0.22	0.61	0.08	1.22	0.77	0.37	2.23	0.20	0.00	0.01
(d) $TFP/(1-\alpha)$	0.16	0.14	0.75	0.29	0.54	0.13	2.09	1.88	0.35	3.41	0.06	0.00	0.02
(e) $K/Y \times \alpha/(1-\alpha)$	–0.48	0.06	–0.90	0.09	0.84	0.09	0.90	1.30	0.07	1.09	0.46	0.00	0.01
(f) Labor quality	n.a.	n.a.	–0.13	0.05	n.a.	n.a.	n.a.	0.37	0.05	0.99	n.a.	n.a.	n.a.

Sources: Fernald and others (2017), table 2; authors' calculations.

a. FHSW report the coefficient β(1)/4, while we report the coefficient β(1). In both cases, the coefficient measures the per period increase in output relative to a percentage point change in the unemployment rate (for FHSW) or the employment rate (for us). The standard deviations of the components are for annualized quarterly growth rates reported in percentage points.

b. The signs are flipped in this column because FHSW use unemployment but we use employment.

c. We only report the R^2 from our regression of each variable on employment because FHSW report R^2 for regressions on factors, which follows a different method.

d. FHSW decompose output per capita, while we decompose total output with a fixed population.

therefore be driven by other factors, such as an increase in market power or the rise of superstar firms.

To compare our coefficients with those of FHSW, first recall that we use employment but they use unemployment as the basis for Okun's law, so we flip the signs of their estimates to make the comparison easier. The volatility of log changes in employment and unemployment are not the same, which might also explain the differences in magnitudes. Also, note that FHSW consider output per capita under the first decomposition, versus total output (with fixed population) in our case. Nonetheless, we find common patterns in the relative contribution and volatility of the coefficients. Our trend component is much less volatile than that of FHSW, as expected, because we simulate detrended series except for the rise in market power. Of the remaining series, some of our components appear less volatile (for example, irregular components), but they are almost always of the same order of magnitude.

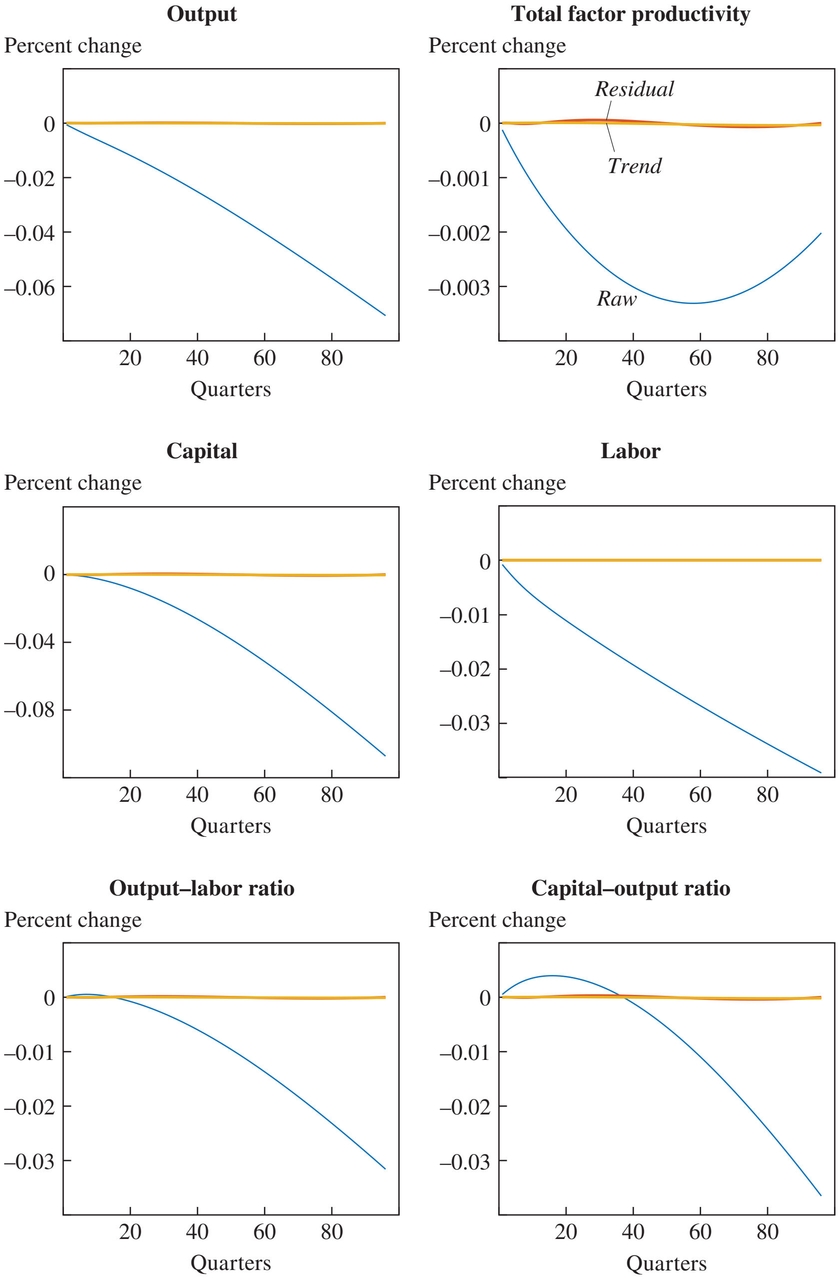
Columns 5, 6, and 7 show our primary measure of interest: the median and standard deviation of cumulative gaps between cycle-adjusted and long-run trends for each measure. As shown, there is not much room for trends once we adjust for the cycle; median gaps are essentially zero, and the corresponding standard deviations are also quite small. Thus, it appears that the trend/cycle/irregular decomposition of FHSW absorbs the rise in market power. The decomposition does not seem able to separately identify deviations from trend in K/Y driven by (long-term) changes in market power.

To further study the dynamics, figures 16 and 17 show the cumulative changes in output, measured TFP, capital, labor, the output–labor ratio, and the capital–output ratio for a simulation with no shocks (except the rise in market power) and for a simulation with shocks, respectively. For each series, we include the raw, cyclically adjusted, and trend series. Several items are worth highlighting.

First, as shown in figure 16 (that is, the simulation without shocks), the rise of market power pushes output, capital, and labor productivity down. Measured TFP goes down a little, but the magnitude of the decline is small. Looking at the cycle- and trend-adjusted series, we see that the entire decrease is captured by the Okun's law decomposition; both the residual and trend are essentially zero. This is because employment moves with market power, along with all the other series. So employment can "explain" all the trends, even though in fact the only parameter affecting the simulated economy is the level of the markup.

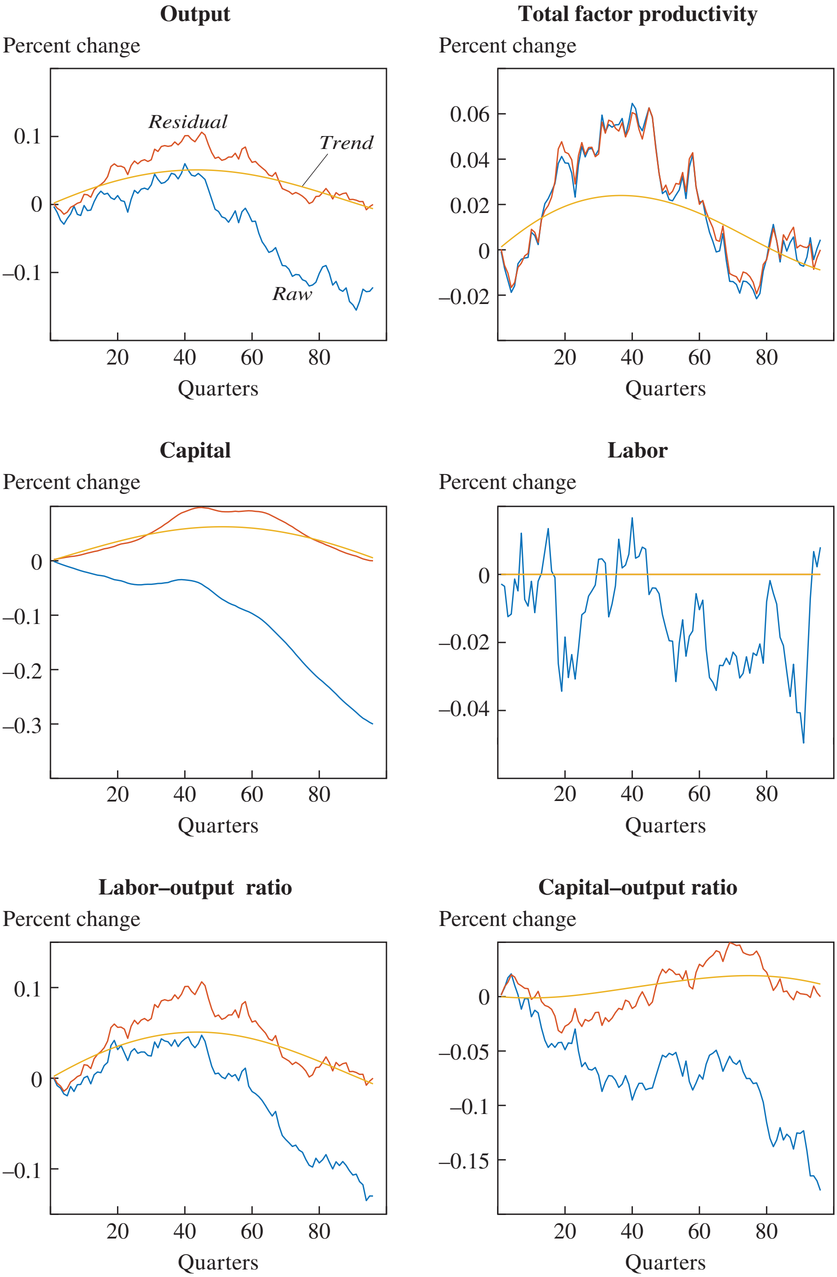
Moving to figure 17, which adds stochastic shocks, we find substantial additional variation in the trends. Of particular importance, the decrease in

Figure 16. Sample Simulations: Cumulative Changes with Only Market Power[a]



Source: Authors' calculations.
a. We assume a change in the steady-state markup from 30 to 35 percent over 100 quarters.

Figure 17. Sample Simulations: Cumulative Changes with Shocks[a]



Source: Authors' calculations.

a. We assume a change in the steady-state markup from 30 to 35 percent over 100 quarters.

employment driven by the rise in market power accounts for a large part of the decreases in all series; the cycle- and trend-adjusted series are much closer to zero than the actuals. This is particularly true for the capital–output ratio, which remains at about zero over the full period (this is fairly consistent across all simulations). The actual series, however, drops well below the trend, as observed in the data (obviously, this is true in some but not all simulations).

Focusing on the period with the largest output drop (about the 40th–60th simulation period), the reduction in output leads to an increase in the capital–output ratio relative to the trend, and a decrease in measured TFP relative to the trend. This is in line with the results of FHSW, who allocate the output shortfall to lower TFP while noting that the capital–output ratio remains in line with the trend.

It is particularly important that these patterns are consistent across simulations. For example, let us define the crisis trough as the last period in a given simulation that exhibits a cumulative drop of output greater than 8 percent over 10 or fewer periods, and the postcrisis period as the (at most) 28 quarters following the trough; we then compute the average quarterly gap between the (cumulative) cycle-adjusted and trend series for TFP and the capital–output ratio over the postcrisis period in each simulation. This gives an estimate of the gap to the trend following a crisis under rising markups. The median average gap to the trend in TFP is –0.35 percent, while the median gap for the capital–output ratio is +0.13 percent (that is, TFP is below the trend, while the capital–output ratio is above it). A total of 29 percent of the average simulation gaps are positive for TFP, compared with 71 percent for the capital–output ratio. These results suggest that even in the presence of rising markups, the output gap following a crisis can appear to be in TFP rather than the capital–output ratio—which is consistent with the findings of FHSW.

Overall, we conclude that growth-accounting decompositions may confound a rise in market power with a decrease in TFP or labor supply. FHSW's results are therefore consistent with our hypothesis that changes in market power and corporate governance explain some of the economy's weakness.

VII. Conclusion

Private fixed investment in the United States has been lower than expected since the early 2000s. This trend started before 2008, but the Great Recession made it more striking. Investment 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 *along with* low values of Tobin's *Q*, and guides us to theories that predict low investment *despite* a high *Q*. We test eight such theories, and find consistent support for decreased competition, tightened corporate governance and increased short-termism, and rising intangibles in our industry- and firm-level data sets. The rise of intangibles explains between a quarter and a third of the investment gap, but leaves large and persistent residuals after 2000. These residuals are explained by decreased competition and tightened corporate governance or increased short-termism. Finally, we show that standard growth-accounting decompositions may be unable to separately identify deviations from the trend in output or investment driven by long-term changes in market power. A rise in market power might therefore be responsible for some of the decline in measured TFP growth and labor supply.

If our conclusions are correct, they suggest that U.S. policymakers should focus on increasing competition in the market for goods and services. Related research (Grullon, Larkin, and Michaely 2017; Döttling, Gutiérrez, and Philippon 2017; Gutiérrez and Philippon 2017a) suggests a role for reducing barriers to entry and product market regulations, as well as improving antitrust enforcement.

ACKNOWLEDGMENTS We are grateful to our discussants, Robert Hall and Xavier Giroud, and to Janice Eberly for many helpful comments and discussions. We also thank Viral Acharya, Olivier Blanchard, Ricardo Caballero, Charles Calomiris, Emmanuel Farhi, Glenn Hubbard, Boyan Jovanovic, Ralph Koijen, Holger Mueller, Tano Santos, Alexi Savov, Martin Schmalz, Philipp Schnabl, René Stulz, Toni Whited, and the seminar participants at Columbia University, New York University, and the Brookings Institution for stimulating discussions.

References

Abel, Andrew B., and Janice C. Eberly. 1994. "A Unified Model of Investment under Uncertainty." *American Economic Review* 84, no. 5: 1369–84.

———. 2012. "Investment, Valuation, and Growth Options." *Quarterly Journal of Finance* 2, no. 1: article 1250001.

Acharya, Viral, and Guillaume Plantin. 2017. "Monetary Easing and Financial Instability." Working paper. http://pages.stern.nyu.edu/~sternfin/vacharya/public_html/pdfs/MEFI24.pdf

Aghion, Philippe, Stefan Bechtold, Lea Cassar, and Holger Herz. 2014. "The Causal Effects of Competition on Innovation: Experimental Evidence." Working Paper no. 19987. Cambridge, Mass.: National Bureau of Economic Research.

Aghion, Philippe, John Van Reenen, and Luigi Zingales. 2013. "Innovation and Institutional Ownership." *American Economic Review* 103, no. 1: 277–304.

Alexander, Lewis, and Janice Eberly. 2016. "Investment Hollowing Out." Paper presented at the 17th Annual Jacques Polak Research Conference, International Monetary Fund, Washington, November 3.

Alfaro, Laura, Thorsten Beck, and Charles Calomiris. 2015. "Foreign Bank Entry and Entrepreneurship." Working paper. https://www0.gsb.columbia.edu/faculty/ccalomiris/papers/Foreign%20Bank%20Entry%20and%20Entrepreneurship.pdf

Almeida, Heitor, Vyacheslav Fos, and Mathias Kronlund. 2016. "The Real Effects of Share Repurchases." *Journal of Financial Economics* 119, no. 1: 168–85.

Al-Ubaydli, Omar, and Patrick A. McLaughlin. 2015. "RegData: A Numerical Database on Industry-Specific Regulations for All United States Industries and Federal Regulations, 1997–2012." *Regulation & Governance* 11, no. 1: 109–23.

Appel, Ian R., Todd A. Gormley, and Donald B. Keim. 2016a. "Passive Investors, Not Passive Owners." *Journal of Financial Economics* 121, no. 1: 111–41.

———. 2016b. "Standing on the Shoulders of Giants: The Effect of Passive Investors on Activism." Working Paper no. 22707. Cambridge, Mass.: National Bureau of Economic Research.

Asker, John, Joan Farre-Mensa, and Alexander Ljungqvist. 2014. "Corporate Investment and Stock Market Listing: A Puzzle?" *Review of Financial Studies* 28, no. 2: 342–90.

Autor, David, David Dorn, Lawrence F. Katz, Christina Patterson, and John Van Reenen. 2017a. "Concentrating on the Fall of the Labor Share." *American Economic Review* 107, no. 5: 180–85.

———. 2017b. "The Fall of the Labor Share and the Rise of Superstar Firms." Working Paper no. 23396. Cambridge, Mass.: National Bureau of Economic Research.

Azar, José, Sahil Raina, and Martin C. Schmalz. 2016. "Ultimate Ownership and Bank Competition." Working paper. https://ssrn.com/abstract=2710252

Azar, José, Martin C. Schmalz, and Isabel Tecu. 2016. "Anti-Competitive Effects of Common Ownership." Working paper. https://ssrn.com/abstract=2427345

Bachmann, Rüdiger, Ricardo J. Caballero, and Eduardo M. R. A. Engel. 2013. "Aggregate Implications of Lumpy Investment: New Evidence and a DSGE Model." *American Economic Journal: Macroeconomics* 5, no. 4: 29–67.

Barkai, Simcha. 2017. "Declining Labor and Capital Shares." Job market paper. http://home.uchicago.edu/~barkai/doc/BarkaiDecliningLaborCapital.pdf

Bena, Jan, Miguel A. Ferreira, Pedro Matos, and Pedro Pires. 2017. "Are Foreign Investors Locusts? The Long-Term Effects of Foreign Institutional Ownership." *Journal of Financial Economics* 126, no. 1: 122–46.

Bernanke, Ben S. 1983. "Irreversibility, Uncertainty, and Cyclical Investment." *Quarterly Journal of Economics* 98, no. 1: 85–106.

Bernanke, Ben, and Mark Gertler. 1989. "Agency Costs, Net Worth, and Business Fluctuations." *American Economic Review* 79, no. 1: 14–31.

Bessen, James. 2016. "Accounting for Rising Corporate Profits: Intangibles or Regulatory Rents?" Law & Economics Working Paper no. 16-18. Boston: Boston University School of Law.

Blonigen, Bruce A., and Justin R. Pierce. 2016. "Evidence for the Effects of Mergers on Market Power and Efficiency." Working Paper no. 22750. Cambridge, Mass.: National Bureau of Economic Research.

Brainard, William C., and James Tobin. 1968. "Pitfalls in Financial Model-Building." *American Economic Review* 58, no. 2: 99–122.

Buca, Andra, and Philip Vermeulen. 2015. "Corporate Investment and Bank-Dependent Borrowers during the Recent Financial Crisis." Working Paper no. 1859. European Central Bank.

Bushee, Brian J. 1998. "The Influence of Institutional Investors on Myopic R&D Investment Behavior." *Accounting Review* 73, no. 3: 305–33.

———. 2001. "Do Institutional Investors Prefer Near-Term Earnings over Long-Run Value?" *Contemporary Accounting Research* 18, no. 2: 207–46.

Bussière, Matthieu, Laurent Ferrara, and Juliana Milovich. 2015. "Explaining the Recent Slump in Investment: The Role of Expected Demand and Uncertainty." Working Paper no. 571. Banque de France.

Caballero, Ricardo J. 1999. "Aggregate Investment." In *Handbook of Macroeconomics, Volume 1B*, edited by John B. Taylor and Michael Woodford. Amsterdam: North-Holland.

Caballero, Ricardo J., and Eduardo M. R. A. Engel. 1999. "Explaining Investment Dynamics in U.S. Manufacturing: A Generalized (*S*, *s*) Approach." *Econometrica* 67, no. 4: 783–826.

Caballero, Ricardo J., and Emmanuel Farhi. Forthcoming. "The Safety Trap." *Review of Economic Studies*.

Chang, Yen-Cheng, Harrison Hong, and Inessa Liskovich. 2015. "Regression Discontinuity and the Price Effects of Stock Market Indexing." *Review of Financial Studies* 28, no. 1: 212–46.

Chen, Brian S., Samuel G. Hanson, and Jeremy C. Stein. 2017. "The Decline of Big-Bank Lending to Small Businesses: Dynamic Impacts on Local Credit and

Labor Markets." Working Paper no. 23843. Cambridge, Mass.: National Bureau of Economic Research.

Council of Economic Advisers. 2016. "Benefits of Competition and Indicators of Market Power." Issue Brief. https://obamawhitehouse.archives.gov/sites/default/files/page/files/20160414_cea_competition_issue_brief.pdf

Crane, Alan D., Sébastien Michenaud, and James P. Weston. 2016. "The Effect of Institutional Ownership on Payout Policy: Evidence from Index Thresholds." *Review of Financial Studies* 29, no. 6: 1377–408.

Cummins, Jason G., Kevin A. Hassett, and Stephen D. Oliner. 2006. "Investment Behavior, Observable Expectations, and Internal Funds." *American Economic Review* 96, no. 3: 796–810.

Davis, Steven J., John Haltiwanger, Ron Jarmin, and Javier Miranda. 2006. "Volatility and Dispersion in Business Growth Rates: Publicly Traded versus Privately Held Firms." *NBER Macroeconomics Annual* 21: 107–80.

Decker, Ryan, John Haltiwanger, Ron Jarmin, and Javier Miranda. 2014. "The Role of Entrepreneurship in US Job Creation and Economic Dynamism." *Journal of Economic Perspectives* 28, no. 3: 3–24.

———. 2016. "Where Has All the Skewness Gone? The Decline in High-Growth (Young) Firms in the U.S." *European Economic Review* 86: 4–23.

De Loecker, Jan, and Jan Eeckhout. 2017. "The Rise of Market Power and the Macroeconomic Implications." Working Paper no. 23687. Cambridge, Mass.: National Bureau of Economic Research.

Dixit, Avinash K., and Robert S. Pindyck. 1994. *Investment under Uncertainty*. Princeton University Press.

Döttling, Robin, Germán Gutiérrez, and Thomas Philippon. 2017. "Is There an Investment Gap in Advanced Economies? If So, Why?" In *Proceedings of the ECB Forum on Central Banking: Investment and Growth in Advanced Economies*. Sintra: European Central Bank.

Döttling, Robin, Tomislav Ladika, and Enrico C. Perotti. 2017. "The (Self-)Funding of Intangibles." Working paper. https://ssrn.com/abstract=2863267

Döttling, Robin, and Enrico C. Perotti. 2017. "Secular Trends and Technological Progress." Working paper. https://ssrn.com/abstract=2996998

Erickson, Timothy, Colin Huan Jiang, and Toni M. Whited. 2014. "Minimum Distance Estimation of the Errors-in-Variables Model Using Linear Cumulant Equations." *Journal of Econometrics* 283, no. 2: 211–21.

Erickson, Timothy, and Toni M. Whited. 2000. "Measurement Error and the Relationship between Investment and *q*." *Journal of Political Economy* 108, no. 5: 1027–57.

———. 2006. "On the Accuracy of Different Measures of *q*." *Financial Management* 35, no. 3: 5–33.

Faccio, Mara, and Luigi Zingales. 2017. "Political Determinants of Competition in the Mobile Telecommunication Industry." Working Paper no. 23041. Cambridge, Mass.: National Bureau of Economic Research.

Fazzari, Steven M., R. Glenn Hubbard, and Bruce C. Petersen. 1988. "Financing Constraints and Corporate Investment." *Brookings Papers on Economic Activity*, no. 1: 141–95.

Fenn, George W., and Nellie Liang. 2001. "Corporate Payout Policy and Managerial Stock Incentives." *Journal of Financial Economics* 60, no. 1: 45–72.

Fernald, John. 2014. "A Quarterly, Utilization-Adjusted Series on Total Factor Productivity." Working Paper no. 2012-19. Federal Reserve Bank of San Francisco.

Fernald, John G., Robert E. Hall, James H. Stock, and Mark W. Watson. 2017. "The Disappointing Recovery of Output after 2009." *Brookings Papers on Economic Activity*, Spring: 1–58.

Fichtner, Jan, Eelke M. Heemskerk, and Javier Garcia-Bernardo. 2017. "Hidden Power of the Big Three? Passive Index Funds, Re-Concentration of Corporate Ownership, and New Financial Risk." *Business and Politics* 19, no. 2: 298–326.

Fink, Laurence D. 2014. "Encouraging a Focus on Long-Term Growth Strategies." Letter to corporate executives, March 21. https://www.blackrock.com/corporate/en-us/literature/press-release/ldf-letter-corporates-2014.pdf

Frank, Murray Z., and Vidhan K. Goyal. 2003. "Testing the Pecking Order Theory of Capital Structure." *Journal of Financial Economics* 67, no. 2: 217–48.

Furman, Jason. 2015. "Business Investment in the United States: Facts, Explanations, Puzzles, and Policies." Speech given at the Progressive Policy Institute, Washington, September 30.

Gilchrist, Simon, and Charles P. Himmelberg. 1995. "Evidence on the Role of Cash Flow for Investment." *Journal of Monetary Economics* 36, no. 3: 541–72.

Gilchrist, Simon, and Egon Zakrajšek. 2012. "Credit Spreads and Business Cycle Fluctuations." *American Economic Review* 102, no. 4: 1692–720.

Giroud, Xavier, and Holger M. Mueller. 2010. "Does Corporate Governance Matter in Competitive Industries?" *Journal of Financial Economics* 95, no. 3: 312–31.

———. 2011. "Corporate Governance, Product Market Competition, and Equity Prices." *Journal of Finance* 66, no. 2: 563–600.

Gomes, Joao F. 2001. "Financing Investment." *American Economic Review* 91, no. 5: 1263–85.

Gomme, Paul, B. Ravikumar, and Peter Rupert. 2011. "The Return to Capital and the Business Cycle." *Review of Economic Dynamics* 14, no. 2: 262–78.

Gompers, Paul, Joy Ishii, and Andrew Metrick. 2003. "Corporate Governance and Equity Prices." *Quarterly Journal of Economics* 118, no. 1: 107–56.

Grullon, Gustavo, Yelena Larkin, and Roni Michaely. 2017. "Are U.S. Industries Becoming More Concentrated?" Working paper. https://ssrn.com/abstract=2612047

Gutiérrez, Germán. 2017. "Investigating Global Labor and Profit Shares." Working paper. https://ssrn.com/abstract=3040853

Gutiérrez, Germán, and Thomas Philippon. 2017a. "Declining Competition and Investment in the U.S." Working Paper no. 23583. Cambridge, Mass.: National Bureau of Economic Research.

———. 2017b. "How the US Lost Its Competitive Edge." Working paper.

———. Forthcoming. "Ownership, Governance and Investment." *American Economic Review*.

Guvenen, Fatih, Raymond J. Mataloni Jr., Dylan G. Rassier, and Kim J. Ruhl. 2017. "Offshore Profit Shifting and Domestic Productivity Measurement." Working Paper no. 23324. Cambridge, Mass.: National Bureau of Economic Research.

Hall, Robert E. 2001. "The Stock Market and Capital Accumulation." *American Economic Review* 91, no. 5: 1185–202.

———. 2003. "Corporate Earnings Track the Competitive Benchmark." Working Paper no. 10150. Cambridge, Mass.: National Bureau of Economic Research.

———. 2004. "Measuring Factor Adjustment Costs." *Quarterly Journal of Economics* 119, no. 3: 899–927.

———. 2014. "Quantifying the Lasting Harm to the U.S. Economy from the Financial Crisis." *NBER Macroeconomics Annual* 29: 71–128.

Haltiwanger, John, Ron Jarmin, and Javier Miranda. 2011. "Historically Large Decline in Job Creation from Startup and Existing Firms in the 2008–2009 Recession." Business Dynamics Statistics Briefing no. 5. Kansas City, Mo.: Kauffman Foundation.

Harford, Jarrad, Sattar A. Mansi, and William F. Maxwell. 2012. "Corporate Governance and Firm Cash Holdings in the US." *Journal of Financial Economics* 87, no. 3: 535–55.

Hassett, Kevin A., and R. Glenn Hubbard. 1997. "Tax Policy and Investment." In *Fiscal Policy: Lessons from Economic Research*, edited by Alan J. Auerbach. MIT Press.

Hayashi, Fumio. 1982. "Tobin's Marginal *q* and Average *q*: A Neoclassical Interpretation." *Econometrica* 50, no. 1: 213–24.

Hennessy, Christopher A., and Toni M. Whited. 2007. "How Costly Is External Financing? Evidence from a Structural Estimation." *Journal of Finance* 62, no. 4: 1705–45.

International Monetary Fund. 2015. "Private Investment: What's the Holdup?" In *World Economic Outlook: Uneven Growth*, April. Washington.

Jensen, Michael C. 1986. "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers." *American Economic Review* 76, no. 2: 323–29.

Jolls, Christine. 1998. "Stock Repurchases and Incentive Compensation." Working Paper no. 6467. Cambridge, Mass.: National Bureau of Economic Research.

Jones, Callum, and Thomas Philippon. 2016. "Secular Stagnation of Investment?" Working paper. http://pages.stern.nyu.edu/~tphilipp/papers/Q_ZLB.pdf

Jorgenson, Dale W. 1963. "Capital Theory and Investment Behavior." *American Economic Review* 53, no. 2: 247–59.

Kaplan, Steven N. 2017. "Are U.S. Companies Too Short-Term Oriented? Some Thoughts." Working Paper no. 23464. Cambridge, Mass.: National Bureau of Economic Research.

Kaplan, Steven N., and Per Stromberg. 2009. "Leveraged Buyouts and Private Equity." *Journal of Economic Perspectives* 23, no. 1: 121–46.

Kisin, Roni. 2011. "The Impact of Mutual Fund Ownership on Corporate Investment: Evidence from a Natural Experiment." Working paper. https://ssrn.com/abstract=1828183

Kleiner, Morris M., and Alan B. Krueger. 2013. "Analyzing the Extent and Influence of Occupational Licensing on the Labor Market." *Journal of Labor Economics* 31, no. 2, pt. 2: S173–S202.

Kose, M. Ayhan, Franziska Ohnsorge, Lei Sandy Ye, and Ergys Islamaj. 2017. "Weakness in Investment Growth: Causes, Implications and Policy Responses." Policy Research Working Paper no. 7990. Washington: World Bank.

Lazonick, William. 2014. "Profits without Prosperity." *Harvard Business Review* 92, no. 9: 46–55.

Lee, Dong, Han Shin, and René M. Stulz. 2016. "Why Does Capital No Longer Flow More to the Industries with the Best Growth Opportunities?" Working Paper no. 22924. Cambridge, Mass.: National Bureau of Economic Research.

Lewis, Christine, Nigel Pain, Jan Strasky, and Fusako Menkyna. 2014. "Investment Gaps after the Crisis." Economics Department Working Paper no. 1168. Paris: Organization for Economic Cooperation and Development.

Martin, Roger L. 2015. "Yes, Short-Termism Really Is a Problem." *Harvard Business Review*, October (digital article). https://hbr.org/2015/10/yes-short-termism-really-is-a-problem

Mongey, Simon. 2017. "Market Structure and Monetary Non-Neutrality." Job market paper. http://www.simonmongey.com/uploads/6/5/6/6/65665741/mongey_market_structure_monetary_nonneutrality_draft.pdf

O'Brien, Daniel P., and Steven C. Salop. 2000. "Competitive Effects of Partial Ownership: Financial Interest and Corporate Control." *Antitrust Law Journal* 67, no. 3: 559–614.

Okun, Arthur M. 1962. "Potential GNP: Its Measurement and Significance." Paper no. 190. New Haven, Conn.: Yale University, Cowles Foundation for Research in Economics. https://www.scribd.com/document/347717593/Potential-GNPIts-Measurement-and-Significance

Panousi, Vasia, and Dimitris Papanikolaou. 2012. "Investment, Idiosyncratic Risk, and Ownership." *Journal of Finance* 67, no. 3: 1113–48.

Peters, Ryan H., and Lucian A. Taylor. 2017. "Intangible Capital and the Investment–*q* Relation." *Journal of Financial Economics* 123, no. 2: 251–72.

Rajan, Raghuram G., and Luigi Zingales. 1998. "Financial Dependence and Growth." *American Economic Review* 88, no. 3: 559–86.

Richardson, Scott. 2006. "Over-Investment of Free Cash Flow." *Review of Accounting Studies* 11, nos. 2–3: 159–89.

Schmalz, Martin C. 2017. "Common Ownership Concentration and Corporate Conduct." Working paper. https://ssrn.com/abstract=3046829

Schmidt, Cornelius, and Rüdiger Fahlenbrach. 2017. "Do Exogenous Changes in Passive Institutional Ownership Affect Corporate Governance and Firm Value?" *Journal of Financial Economics* 124, no. 2: 285–306.

Terry, Stephen J. 2017. "The Macro Impact of Short-Termism." Job market paper. http://people.bu.edu/stephent/files/MIFET_LATEST_DRAFT.pdf

Thomas, Julia K. 2002. "Is Lumpy Investment Relevant for the Business Cycle?" *Journal of Political Economy* 110, no. 3: 508–34.

Tobin, James. 1969. "A General Equilibrium Approach to Monetary Theory." *Journal of Money, Credit and Banking* 1, no. 1: 15–29.

van Binsbergen, Jules H., and Christian C. Opp. 2017. "Real Anomalies." Working Paper no. 23238. Cambridge, Mass.: National Bureau of Economic Research.

Vashakmadze, Ekaterine, Gerard Kambou, Derek Chen, Boaz Nandwa, Yoki Okawa, and Dana Vorisek. 2017. "Regional Dimensions of Recent Weakness in Investment: Drivers, Investment Needs and Policy Responses." Policy Research Working Paper no. 7991. Washington: World Bank.

Woodcock, Ramsi. 2017. "Per Se in Itself: How Bans Reduce Error in Antitrust." Working paper. https://ssrn.com/abstract=2896453

Wurgler, Jeffrey. 2011. "On the Economic Consequences of Index-Linked Investing." In *Challenges to Business in the Twenty-First Century*, edited by Gerald Rosenfeld, Jay W. Lorsch, and Rakesh Khurana. Cambridge, Mass.: American Academy of Arts and Sciences.

Zucman, Gabriel. 2014. "Taxing across Borders: Tracking Personal Wealth and Corporate Profits." *Journal of Economic Perspectives* 28, no. 4: 121–48.

Comments and Discussion

COMMENT BY

XAVIER GIROUD In recent decades, the link between corporate investment and Tobin's Q—as a measure of investment opportunities—has become weaker. This trend, which is clearly visible in the authors' figure 3, has been confirmed in related work by Dong Lee, Han Shin, and René Stulz (2016, figure 4), who find that industries with a higher Q have higher investment until the mid-1990s, but not thereafter. Taken at face value, this trend indicates a growing disconnect between corporate investment and investment opportunities.

In this paper, Germán Gutiérrez and Thomas Philippon provide an in-depth examination of the reasons underlying this trend. The paper is a tour de force that provides a thorough review of the various theories that might be at work, and systematically examines each of them, using a wealth of data at the firm and industry levels. In a nutshell, the authors find empirical support for three main explanations: (i) the rise in intangibles, (ii) a decrease in competition, and (iii) an increase in short-termism or a tightening in corporate governance. Here, I discuss each of these three explanations.

THE RISE IN INTANGIBLES The authors find that the rise in intangibles (as measured using data from Compustat) explains about one-third of the drop in the investment-Q sensitivity. This finding is intuitive, because not accounting for intangible investments—which have increased substantially over the years—would leave out an important component of "investment" when estimating investment-Q sensitivities.

More generally, the role of intangibles illustrates the fact that properly measuring investment-Q sensitivities has become more challenging over the years, which might explain why traditional measures of investment-Q sensitivities might no longer be informative. Although intangibles are a first-order consideration, they only represent one aspect of this measurement issue. Other aspects might be important as well. In particular, the economy has gone through major structural changes over the decades. During the period considered by the authors, perhaps the most significant change was the U.S. economy's transition from the so-called old economy into the "new economy"—that is, from a manufacturing-based economy into a technology- and information-based economy, an evolution that is often associated with the dot-com bubble of the late 1990s. Interestingly, it was precisely around the time of the dot-com bubble that the link between investment and Tobin's *Q* became weaker.

This structural shift has disrupted the business model of many companies, and also the very notion of an "industry." Let me give an example. Kodak used to be a leader in the photographic film manufacturing industry. But its business model was disrupted by new technologies and the introduction of smartphones, which contributed to its bankruptcy filing in 2012 (Mui 2012). At the time, Kodak was surviving by aggressively suing other companies for patent infringement (including Samsung, Apple, BlackBerry, and HTC), essentially acting as a "patent troll" (Spector, Mattioli, and Brickley 2012). How this evolution maps into investment-*Q* sensitivities is nontrivial. In the early years, the traditional measurement of the investment-*Q* sensitivity seems appropriate—Kodak invests in physical capital that contributes to the manufacturing of cameras and film-related products, and such physical investment likely responds to investment opportunities (that is, industry *Q*) in the photographic film manufacturing industry. In the later years, this exercise is trickier. In particular, how should we factor in the disruptions through new technologies and the introduction of smartphones? And how should we account for Kodak's patent-trolling activities? Patent trolling by itself is not an industry, according to standard industry classifications—such as the Standard Industrial Classification and North American Industry Classification System codes—and hence the industry *Q* of this sector is not well defined.

In short, as this example illustrates, measuring investment-*Q* sensitivities has become increasingly more difficult over the years, which could explain the weaker investment-*Q* sensitivities observed in the data, for reasons going beyond the consideration of intangible investments. This trend is likely to continue in future years, with the emergence of the "gig economy" (for example, Uber and Airbnb) and further disruptions to traditional business models.

DECREASE IN COMPETITION The second mechanism proposed by the authors is the increase in industry concentration over the years. The main idea is that, as competition declines, firms face weaker incentives to invest, which may result in underinvestment compared with their investment opportunities. The authors provide a series of high-level stylized facts consistent with this interpretation. In addition, in a companion paper (Gutiérrez and Philippon 2017), the authors use identification schemes to establish a causal link between the decrease in competition and underinvestment. More specifically, they exploit variation in Chinese imports—using the identification strategy of David Autor, David Dorn, and Gordon Hanson (2013)—to mitigate the endogeneity of competition.

Although these findings are informative, one caveat is that most of the authors' analysis relies on Compustat-based measures of competition (such as the Herfindahl index, based on Compustat sales). This caveat is not innocuous because recent decades have witnessed a trend toward fewer firms going public (and more firms staying private or switching back from public to private). This trend—"the disappearing public firm," which has been documented by, among others, Gustavo Grullon, Yelena Larkin, and Roni Michaely (2017)—could confound some of the results, because it would lead to an overstatement of the increase in concentration when concentration is computed only on the basis of public firms.

The authors do use a Census-based measure of competition in the appendix, and they find that, based on this measure, the competition channel appears less significant, which could be reflective of the arguments given above. In any event, this point deserves further investigation. More comprehensive data covering both public and private firms—such as the business data of the U.S. Census Bureau—may help shed light on this issue.

INCREASE IN SHORT-TERMISM The short-termism hypothesis proposed by the authors is more controversial. Indeed, we know very little about the prevalence of short-termism, and whether short-termism has increased over the years. Although anecdotal accounts abound with statements suggesting that short-termism is on the rise and is a first-order concern—for example, in the 2016 U.S. presidential campaign, candidate Hillary Clinton urged companies to escape the "tyranny" of short-termism (Epstein 2015)—such claims are hard to verify empirically.[1]

What we do know is that short-termism seems to hinder corporate success. Theoretically, this prediction can be seen in Jeremy Stein's (1989) model of managerial myopia, where managers with a preference for the short run (for example, due to career concerns, short-term compensation, or pressure to meet analysts' earnings forecasts) have an incentive to

1. For a discussion of this point, see Flammer (forthcoming).

inefficiently boost short-term earnings at the expense of long-term earnings. Empirically, the survey done by John Graham, Campbell Harvey, and Shiva Rajgopal (2005) confirms that 78 percent of the surveyed executives would sacrifice projects with positive net present value if adopting them resulted in the firm missing quarterly earnings expectations. Relatedly, a recent article by Caroline Flammer and Pratima Bansal (2017) exploits the quasirandom assignment of long-term incentives to study how short-termism affects firm performance and long-term investments. Specifically, they exploit the passage of close call shareholder proposals advocating the use of long-term compensation—intuitively, whether a proposal is approved with 50.1 percent of the votes, or rejected with 49.9 percent of the votes, is essentially random, which provides a quasirandom assignment of long-term incentives to companies. Using this setup, they find that the adoption of long-term incentives leads to an increase in firm value, operating performance, and long-term investments (such as investments in innovation and stakeholder relationships), suggesting that companies underinvest in long-term projects absent proper incentives.

Although the existing evidence indicates that short-termism hurts companies' performance and their ability to invest in long-term projects, little is known about the evolution of short-termism over time. Strictly speaking, what the authors show is that the growth in quasi-indexer ownership—which the authors argue may contribute to short-termism—helps explain the weakening of the investment-Q sensitivity over the years. However, whether this evolution reflects a trend toward more short-termism remains to be established.

CONCLUSIONS Gutiérrez and Philippon provide a rich and detailed examination of the potential explanations underlying the trend toward a weaker link between corporate investment and Tobin's Q. The three proposed mechanisms—(i) the rise in intangibles, (ii) a decrease in competition, and (iii) an increase in short-termism or a tightening in corporate governance—are reasonable, yet more research is needed to support them and rule out potential confounding factors. In this vein, this comment provides avenues that future research could pursue.

REFERENCES FOR THE GIROUD COMMENT

Autor, David H., David Dorn, and Gordon H. Hanson. 2013. "The China Syndrome: Local Labor Market Effects of Import Competition in the United States." *American Economic Review* 103, no. 6: 2121–68.

Epstein, Jennifer. 2015. "Hillary Clinton Calls for Investors to Escape 'Tyranny' of 'Short Termism.'" Bloomberg, July 23.

Flammer, Caroline. Forthcoming. “Long-Term Executive Compensation as a Remedy for Corporate Short-Termism.” *Seattle University Law Review*.

Flammer, Caroline, and Pratima Bansal. 2017. “Does Long-Term Orientation Create Value? Evidence from a Regression Discontinuity.” *Strategic Management Journal* 38, no. 9: 1827–47.

Graham, John R., Campbell R. Harvey, and Shiva Rajgopal. 2005. “The Economic Implications of Corporate Financial Reporting.” *Journal of Accounting and Economics* 40, nos. 1–3: 3–73.

Grullon, Gustavo, Yelena Larkin, and Roni Michaely. 2017. “Are U.S. Industries Becoming More Concentrated?” Working paper. https://ssrn.com/abstract=2612047

Gutiérrez, Germán, and Thomas Philippon. 2017. “Declining Competition and Investment in the U.S.” Working Paper no. 23583. Cambridge, Mass.: National Bureau of Economic Research.

Lee, Dong, Han Shin, and René M. Stulz. 2016. “Why Does Capital No Longer Flow More to the Industries with the Best Growth Opportunities?” Working Paper no. 22924. Cambridge, Mass.: National Bureau of Economic Research.

Mui, Chunka. 2012. “How Kodak Failed.” *Forbes*, January 18.

Spector, Mike, Dana Mattioli, and Peg Brickley. 2012. “Can Bankruptcy Filing Save Kodak?” *Wall Street Journal*, January 20.

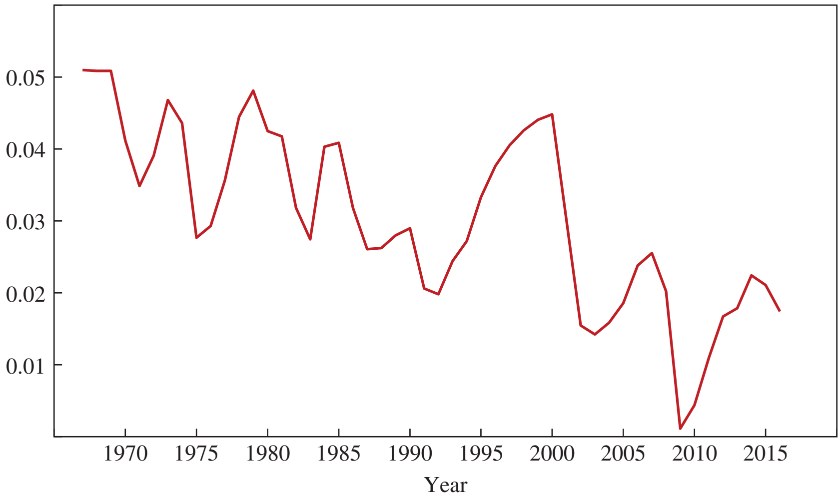
Stein, Jeremy C. 1989. “Efficient Capital Markets, Inefficient Firms: A Model of Myopic Corporate Behavior.” *Quarterly Journal of Economics* 104, no. 4: 655–69.

COMMENT BY

ROBERT E. HALL In wide-ranging detail, Germán Gutiérrez and Thomas Philippon make the case that capital formation has been weak in the United States during the past decade, despite the remarkable growth of values in the stock market. A wedge has entered Brainard and Tobin’s *Q* theory of capital adjustment. In a second round of study, Gutiérrez and Philippon make the case that this wedge is market power. I am completely convinced by the first case and reasonably convinced by the second. The paper draws most of its supporting evidence from micro data on publicly traded firms in Compustat. Most of my comment considers supporting evidence from aggregate data and from the research of other investigators on rising market power.

The ratio of investment, net of replacement investment, to the capital stock—the net investment ratio—is a good overall indicator of capital formation. Under modern income-accounting conventions, investment includes the creation of intellectual property. My figure 1 shows the ratio for U.S. corporations since 1967. Net capital formation declined from a

Figure 1. Ratio of Corporate Net Investment to Capital, 1967–2016



Source: U.S. Bureau of Economic Analysis.

high level in the late 1960s through the early 1990s, skyrocketed during the tech boom of the late 1990s, and has remained at low levels since the tech crash. It nearly touched zero during the recession that began at the end of 2007. Its value now that the economy has recovered is still far below historical averages.

Net investment depends on the economy's growth rate. The investment booms of the 1960s and 1990s occurred during periods of unusually high growth of real GDP. Low current investment is partly the result of forces that have slowed the recovery from the recession, primarily slow productivity growth and shrinkage of the labor force (Fernald and others 2017). But Gutiérrez and Philippon diagnose a structural shift that has discouraged capital formation beyond its response to slowing growth. They exploit the simple bivariate structural relation between business values recorded in the stock market, and the flow of investment, as formulated by William Brainard and James Tobin (1968).

With x denoting the investment–capital ratio, Brainard and Tobin's model of investment adjustment hypothesizes quadratic adjustment costs in that ratio. The firm imputes a value Q to a newly created unit of installed capital. Relative to its capital stock, the firm's payoff from a unit of investment is $Q \times x$. Its cost, also relative to its existing capital, is one unit of output to be converted to installed capital, plus the quadratic adjustment cost. Its objective is

$$\max_x \left(Qx - x - \frac{\gamma}{2} x^2 \right). \tag{1}$$

The first-order condition is

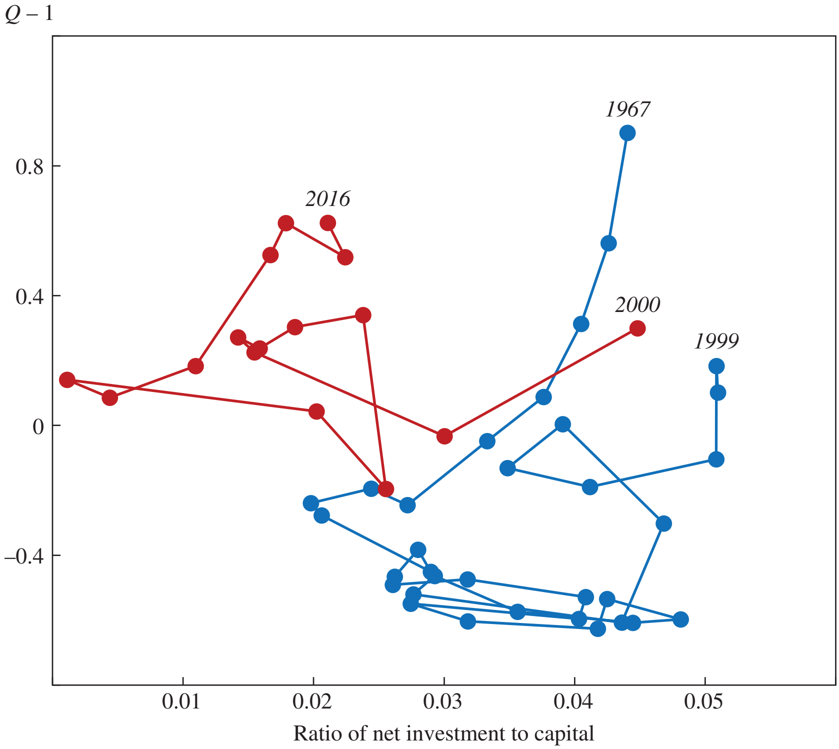
$$x = \frac{1}{\gamma}(Q - 1). \tag{2}$$

In times when the economy is strong and firms are earning rents from their installed capital, Q is above 1 and net investment is positive. This equation is a structural relationship, not a causal one. It says that two things happen when demand for output is unexpectedly high—Q is high, and x is high. A complete model of investment includes a demand function for capital along with the Q equation. But as Gutiérrez and Philippon demonstrate, the simple Q equation is a really useful tool for determining the sources of low investment. If Q is above 1 but investment is low, firms are finding capital to be scarce, presumably because product demand is strong; but some force is impeding investment. If investment were low because product demand is low, Q would fall below 1.

My figure 2 shows the combinations of Q and the net investment ratio x since 1967. The calculation of Q is based on data for all corporations in the Financial Accounts of the United States. It shows that 1967 was strong by both indicators—Q was well above 1, and the investment–capital ratio was substantially positive. In the immediately following years, the economy softened, Q eventually dropped below 1, and the investment ratio fell in half. Then followed almost two decades of Q mystery, with Q consistently below 0.5 but investment at normal to strong levels. Starting in 1990, Q began to rise and eventually surpassed 1, late in the tech boom. When the tech crash occurred, investment collapsed, but Q did not fall below 1. The financial crisis resulted in a further collapse of investment, but only a transitory fall in Q. The recovery saw increases in both Q and x, so the Brainard–Tobin relationship was reestablished, but the relationship moved far to the left, with low investment but high Q.

My figure 2 provides unambiguous support for Gutiérrez and Philippon's conclusion of the first section of their paper—some force is holding back investment, even though the stock market thinks that corporations are extremely valuable. Product demand is strong, but high rents are accom-

Figure 2. Brainard and Tobin's *Q* and the Net Investment Ratio, 1967–2016



Sources: U.S. Bureau of Economic Analysis; author's calculations.

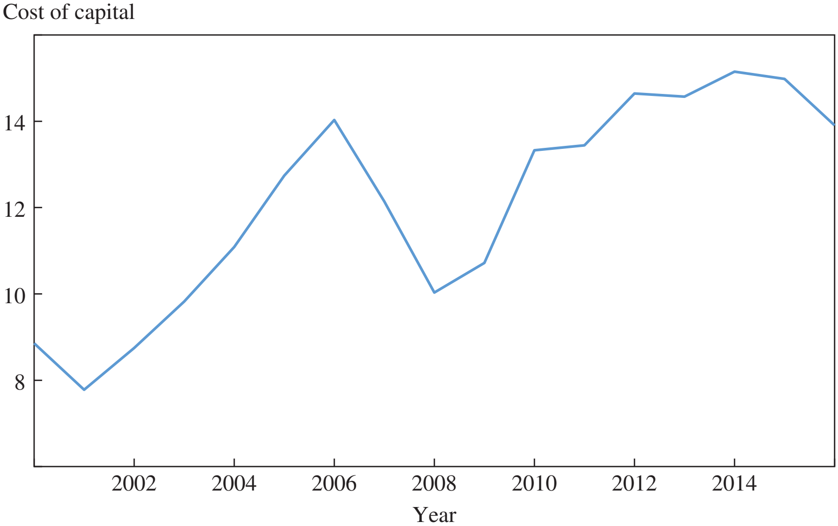
panying strong demand, instead of there being expansion through high investment. Some kind of change is occurring that acts as a wedge, an influence that countervails the attraction of investing in times when the stock market suggests a high payoff from expansion.

One way to get some ideas about the wedge is to reverse engineer capital demand. The first-order condition for the choice of the capital stock equates the marginal revenue product of capital to the rental price of capital:

$$\frac{1-\alpha_n}{\mu} A\left(\frac{n}{k}\right)^{\alpha_n} = r + \delta. \tag{3}$$

Here μ is the markup of price over marginal cost, α_n is the elasticity of the production function with respect to employment (which is not necessarily

Figure 3. The Implied Cost of Capital with a Competitive Product Market, 2000–16



Sources: U.S. Bureau of Economic Analysis; author's calculations.

constant over time), n is labor input, k is the capital stock, r is the cost of capital relevant to the investment decision, and δ is the rate of depreciation.

My figure 3 shows the result of this calculation under the hypothesis of a competitive product market, that is, with $\mu = 1$. The implied cost of capital rose sharply before the recession, fell during the financial crisis, and then grew through 2014. The high level of the implied cost of capital in the later years is particularly indicative of a large wedge, because both real interest rates and the expected real return in the stock market were at low levels in those years. Growth of the markup ratio over the period starting in 2001 could explain the rise in the cost of capital. That is, market power could be the wedge. The presence of such a wedge is Gutiérrez and Philippon's conclusion in the second section of their paper.

Gutiérrez and Philippon put most of their emphasis supporting rising markups on demonstrating, convincingly in my opinion, that rising product market concentration indicates rising markups of price over cost. Though they mention other approaches—attempts to measure the residual elasticity of demand facing individual firms, and attempts to measure marginal cost directly—the authors appear to believe that the approach based on measuring concentration is the most reliable.

Old papers of mine (Hall 1986, 1988, 1990) pursued the idea of measuring marginal cost, and thus the price–cost ratio, using data on the production side. The starting point is the log linearization of the change in output, which was introduced by Robert Solow (1957):

$$\Delta \log Q = \alpha_n \Delta \log n + \alpha_k \Delta \log k. \tag{4}$$

Solow measured the elasticities α_n and α_k as the corresponding factor shares, based on the assumption of competition, where the first-order condition for profit maximization implies the equality of elasticities and shares. In the presence of market power in the output market, factor shares understate the values of the αs:

$$\mu s_n = \alpha_n \quad \text{and} \quad \mu s_k = \alpha_k. \tag{5}$$

Thus,

$$\Delta \log Q = \mu (s_n \Delta \log n + s_k \Delta \log k). \tag{6}$$

With the addition of a random disturbance, interpreted as Hicks-neutral technical change, and the choice of a suitable set of instrumental variables, one can estimate the markup parameter μ. In my work, μ tended to be about 1.2, but subsequent research in this framework that corrected for changes in factor utilization pushed μ down to close to 1.

Recently, Jan De Loecker and Frederic Warzynski (2012) and De Loecker and Jan Eeckhout (2017) have revived production-based markup measurement in a related setup. They observe that the first-order condition for cost minimization with respect to labor (or another variable factor) is

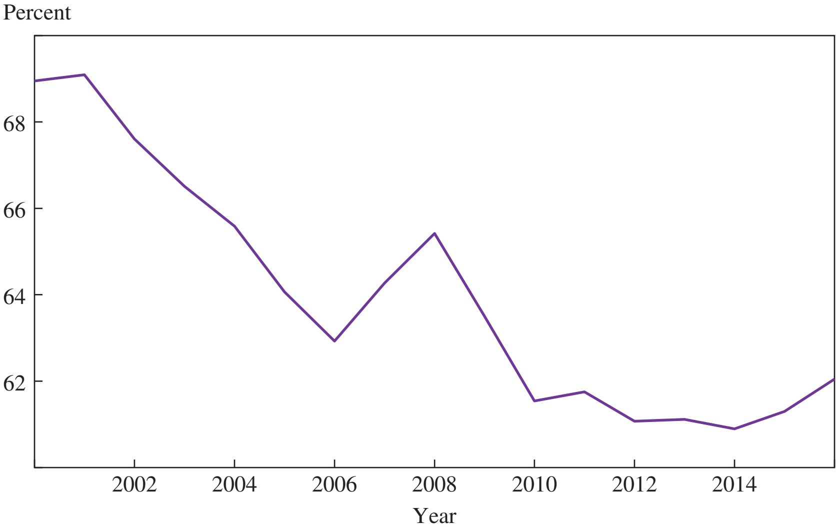
$$\mu s_n = \frac{\partial \log Q}{\partial \log n}. \tag{7}$$

They apply methods of modern production function estimation (Olley and Pakes 1996) to determine the marginal product of labor. Their estimate of the markup ratio μ is the ratio of the share to the marginal product, stated as an elasticity.

My earlier idea was to obtain the marginal product of labor from the actual change in output, adjusted for the contribution of capital:

$$\frac{\partial \log Q}{\partial \log n} \doteq \frac{\Delta \log Q - \alpha_k \Delta \log k}{\Delta \log n}. \tag{8}$$

Figure 4. Labor's Share of National Income for the Business Sector, 2000–16



Source: John Fernald (frbsf.org/economic-research/files/quarterly_tfp.xlsx).

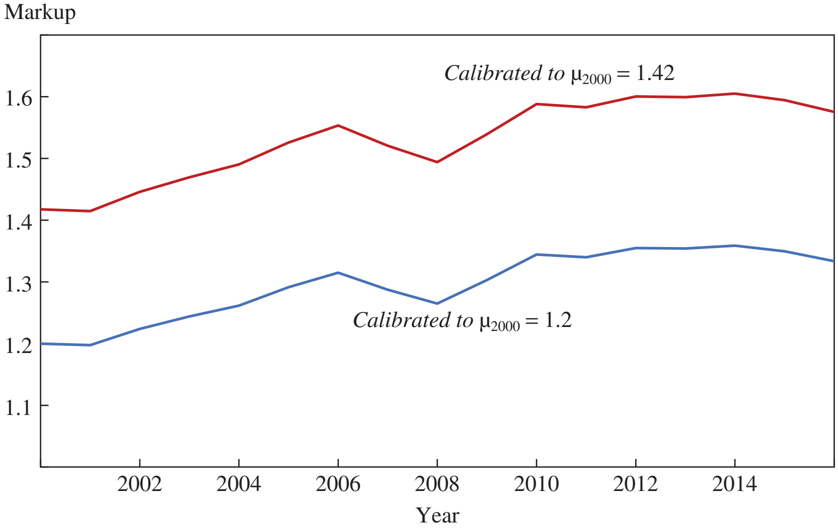
De Loecker and Warzynski (2012) discuss the relation between their method and the earlier method at length. They find substantial increases in the ratio of price to marginal cost over the entire period since 1980, with higher-than-usual growth in recent years.

Many researchers have commented on the decline in labor's share of national income over the past two decades or so. The possibility that a rising level of markups accounts for the decline has emerged as a leading candidate explanation. Gutiérrez and Philippon add a lot to that case. My figure 4 shows the share for the business sector, starting in 2000, from John Fernald's productivity spreadsheet.

The hypothesis that a rising general markup ratio explains all the decline in the labor share results in a straightforward estimate of the ratio, on the further assumptions that the labor elasticity is constant at α_n and that the initial level of the markup ratio is known. The share is $s_t = \alpha_n/\mu_t$. I calibrate α_n from the assumed markup in 2000: $\mu_{2000} = 1.2$. The implied markup is

$$\mu_t = \mu_{2000} \frac{s_{2000}}{s_t}. \tag{9}$$

Figure 5. The Markup of Price over Cost, 2000–16



Source: Author's calculations.

My figure 5 shows the result of the calculation. Resetting the assumed initial value to 1.42 results in a measure that is similar to De Loecker and Eeckhout's (2017), except in the years after 2014.

REFERENCES FOR THE HALL COMMENT

Brainard, William C., and James Tobin. 1968. "Pitfalls in Financial Model Building." *American Economic Review* 58, no. 2: 99–122.

De Loecker, Jan, and Jan Eeckhout. 2017. "The Rise of Market Power and the Macroeconomic Implications." Working Paper no. 23687. Cambridge, Mass.: National Bureau of Economic Research.

De Loecker, Jan, and Frederic Warzynski. 2012. "Markups and Firm-Level Export Status." *American Economic Review* 102, no. 6: 2437–71.

Fernald, John G., Robert E. Hall, James H. Stock, and Mark W. Watson. 2017. "The Disappointing Recovery of Output after 2009." *Brookings Papers on Economic Activity*, Spring: 1–58.

Hall, Robert E. 1986. "Market Structure and Macroeconomic Fluctuations." *Brookings Papers on Economic Activity*, no. 2: 285–322.

———. 1988. "The Relation between Price and Marginal Cost in U.S. Industry." *Journal of Political Economy* 96, no. 5: 921–47.

———. 1990. "Invariance Properties of Solow's Productivity Residual." In *Growth/Productivity/Unemployment: Essays to Celebrate Bob Solow's Birthday*, edited by Peter Diamond. MIT Press.

Olley, G. Steven, and Ariel Pakes. 1996. "The Dynamics of Productivity in the Telecommunications Equipment Industry." *Econometrica* 64, no. 6: 1263–97.

Solow, Robert M. 1957. "Technical Change and the Aggregate Production Function." *Review of Economics and Statistics* 39, no. 3: 312–20.

GENERAL DISCUSSION William Brainard was impressed by the paper, and by all the work that has been done on *Q* theory since he and James Tobin originally developed it in 1968.[1] He wondered whether, in recent years, *Q* has become a poorer measure of the incentives for investment than it used to be—which was none too good. He noted that the stock market is (possibly several years) forward looking—a firm's market valuation includes the valuation of profits from investments in the future. Although it is usually assumed that current *Q*s are a good proxy for marginal *Q* relevant to current investment decisions, there are reasons to wonder whether this is true for the recent past. Consider Tesla and Amazon: Their extraordinary valuation in the market has likely largely reflected profits on investments in the distant future. Those firms almost surely appear to be dramatically underinvesting according to an average *Q* investment equation. Brainard suggested this might be a more general phenomenon.

Brainard noted that the fact that roughly half the sample period used by Gutiérrez and Philippon is after the Great Recession is reason to believe that average *Q* overstates the incentives for investment for a significant portion of the period. During the unusually slow and long recovery, when many firms were operating below capacity, there may have been little reason for investment, even with stock market valuations anticipating eventual recovery. A *Brookings Paper* from 1980 written by Brainard, John Shoven, and Laurence Weiss explored possible explanations of the opposite puzzle—the low level of *Q* observed in the late 1970s given the fundamentals.[2] Taking into account time-varying risk discounts and other negative factors estimated from panel data, it required very pessimistic

1. James Tobin and William C. Brainard, "Pitfalls in Financial Model Building," *American Economic Review* 25, no. 2 (1968): 99–122.

2. William C. Brainard, John B. Shoven, and Laurence Weiss, "The Financial Valuation of the Return to Capital," *Brookings Papers on Economic Activity*, no. 2 (1980): 453–502.

assumptions about future rates of return on capital to explain firms' market values. Additionally, there was weak evidence suggesting that the pessimism was particularly large for firms that had a large fraction of future returns five and more years into the future.

Brainard noted that Gutiérrez and Philippon use time dummies in their regressions or separate regressions for different time periods at both the firm and industry levels. He noted that these variables likely absorb a large fraction of the time variation of firms' and aggregate investment, but added it would be useful to know what fraction of underinvestment is actually explained by the authors' explanatory variables.

Lawrence Katz also noted his appreciation of the paper, but expressed some concerns about how the authors test their hypothesis that globalization may explain low domestic U.S. investment. He emphasized that globalization has led to increasingly fragmented supply chains, whereby more production occurs at the facilities of subsidiaries and contractors that are located outside the United States. This means that it is not always clear where investment will and should show up in the data. Consider Apple, a company that provides much value, but contracts out the physical production of its products to Foxconn in Asia. Foxconn is the company that actually spends money on physical capital, and even though it is making products developed by a U.S. company for a U.S. company, this investment would likely not show up in the U.S. data. Katz suggested that the approximation the authors use to test this hypothesis—the percentage of foreign profits made by a firm—might not be a good measure for an increasingly complex global supply chain.

Furthermore, Katz drew attention to the authors' conclusion that passive or institutional ownership of companies leads to underinvestment, indicating that this relationship may not be causal. He referenced past work by J. Bradford DeLong that found firms owned by investment bankers tended to be more efficient and have higher valuations in the stock market.[3] He suggested the authors' finding may say something more about the type of company that passive and institutional investors prefer to own.

James Hines agreed with Katz's critique, and went so far as to suggest that the measurement issues associated with globalization could explain the *entirety* of underinvestment in the U.S. economy. He noted that the share of foreign profits in the U.S. corporate sector has roughly doubled

3. J. Bradford DeLong, "Did J. P. Morgan's Men Add Value? An Economist's Perspective on Financial Capitalism," in *Inside the Business Enterprise: Historical Perspectives on the Use of Information*, edited by Peter Temin (University of Chicago Press, 1991).

since 2000, a further indication of the increased role of globalization. Tobin's *Q* and the stock market take this increasing level of globalization into account, but the investment data from the National Income and Product Accounts only cover domestic investment; thus, Gutiérrez and Philippon are comparing *global Q* data with *domestic* investment data. Hines added that even though the authors attempt to study issues related to globalization by looking at firms with a high proportion of foreign profits, they do not do a good job of incorporating it into their model. Hines recommended adding an interaction term to the regression between firms with a high proportion of foreign profits and firms' individual *Q*s. This would give a sense of how much of each firm's *Q* can be attributed to foreign profits.

Gita Gopinath made note of the close relationship between underinvestment and the debate about low productivity in the United States. One theory underlying both issues is that there has been a structural decline in the ability to generate new ideas in the United States. She also noted that though productivity has been low recently, it is only low compared with the exceptionally high productivity growth of the 1990s. Similarly, price markups—a measure of market concentration—have trended downward since the 1980s. She was curious if there were similar trends in investment relative to productivity, and whether there is a more structural long-term trend driving underinvestment, because certain measures of market concentration have also come down.

Steven Davis suggested that increased regulation may be a significant factor in low U.S. investment, something he thinks was underemphasized by Gutiérrez and Philippon. First, he noted that the scale, scope, and complexity of the regulatory system have expanded tremendously in recent decades, which has raised the fixed costs of regulatory compliance and the up-front costs of learning how to navigate the regulatory system in any particular market or line of business. These aspects of the regulatory state favor larger businesses over smaller ones, and incumbents over upstarts, and also discourage successful, mature firms from expanding into new markets. In all these respects, an expansive regulatory state contributes to the greater concentration and reduced competition that Gutiérrez and Philippon link to low investment.

Second, Davis noted that investment in regulatory compliance is a form of intangible investment, which the authors measure in their paper. Much of the increase in intangible investment is likely due to firms spending money on regulatory compliance. Finally, he questioned the authors' measurement of regulation. He doubted that occupational licensing has much direct effect on investment, though it may undermine competition in labor and product markets. Any material effects of occupational licensing on investment are likely to work through the competition channel that the authors have already subsumed under other variables in their empirical specifications. The authors also use RegData to measure new regulations by industry.[4] Davis noted three flaws of RegData: (i) It does not weigh the importance of different regulations, (ii) it does not account for regulations that operate across industries, and (iii) it does not distinguish between regulations imposed on one industry that actually have an effect on another industry. For example, harsher regulations on banks could increase borrowing costs for industries and firms that disproportionately rely on banks for funding. A paper by Sandra Black and Philip Strahan, for example, finds that new business incorporations rose after the deregulation of branching restrictions on banks.[5]

Janice Eberly noted that if one were to break up investment data into investments that can easily be offshored versus those that cannot (such as phone towers in the telecommunications industry and drilling equipment in the energy industry), the decline in investments that cannot be easily offshored is less than the decline that can be easily offshored. This supports the hypothesis that firms may still be investing; but, due to globalization, it is not happening in the United States. She also noted that Gutiérrez and Philippon resolve some of the conflicts arising from the Spring 2017 *Brookings Paper* by John Fernald, Robert Hall, James Stock, and Mark Watson, which claimed that both capital and output had slowed in tandem, so there was no "investment puzzle," because the decline in investment could be explained by low overall growth.[6] However, during the general discussion of that paper, others had remarked that this observation implies a constant relationship between capital and output, something that was not consistent with the high levels of Q observed in the data. In other words, the returns on investment were high based on the stock market, but firms were still not investing. This critique implied that there was indeed an investment puzzle. Eberly noted that the research done by Gutiérrez and

4. Omar Al-Ubaydli and Patrick A. McLaughlin, "RegData: A Numerical Database on Industry-Specific Regulations for All United States Industries and Federal Regulations, 1997–2012," *Regulation & Governance* 11, no. 1 (2011): 109–23.

5. Sandra E. Black and Philip E. Strahan, "Entrepreneurship and Bank Credit Availability," *Journal of Finance* 57, no. 6 (2002): 2807–33.

6. John G. Fernald, Robert E. Hall, James H. Stock, and Mark W. Watson, "The Disappointing Recovery of Output after 2009," *Brookings Papers on Economic Activity*, Spring 2017: 1–58.

Philippon, particularly their empirical modeling, should resolve some of this conflict. The authors argue that monopolistic power drives down both investment and output. This explains why the capital–output ratio remains constant, and also why Tobin's Q can remain high while investment is declining.

Jay Shambaugh stated that the reason for falling output in some cases is already well known and does not need other extraneous explanations. For example, output growth has slowed because of falling labor force participation, as noted by Alan Krueger in his paper in the present volume, and because of the slowing growth of the working age population since the 2000s. Therefore, part of low investment is simply cyclical, and can be explained by low output growth arising from these factors. Increased market power does not need to explain all the decline in investment, just the portion unexplained by lower output.

John Haltiwanger sensed from the general reactions to the paper that there was doubt about the authors' empirical regression model. On one hand, the dependent variable in their regressions—firms' level of investment—may be mismeasured, because it may not be picking up intangible investment or investment that is more disintegrated due to globalization. On the other hand, there was concern about the mismeasurement of Q and whether omitted variables could actually be driving the apparent relation.

One possible solution, he suggested, would be to look at employment instead of investment. His own research suggests that trends in employment have been very similar to trends in investment. He found that after 2000, employment responded less to fundamental factors in the economy, such as total factor productivity. He believes a similar phenomenon is affecting investment. In addition, the distribution of productivity across different firms and sectors has also increased since 2000, as would be expected if investment and employment were less related to fundamental factors in the economy and were instead responding to something specific about individual firms. To really answer this question, identification of the proper variables remains a concern, because the variables currently used in the regression analysis may be biased or mismeasured. He recommended looking at more data across sectors and regions, as well as different measures of market power and regulation, in order to expand variation in the data to properly identify the variables driving low investment.

Richard Cooper echoed the questions about globalization raised by Katz, Hines, and Eberly. Two things in particular concerned him. First, he noted that in Brainard and Tobin's original paper, the model used a closed economy, not one open to trade. He argued that the closed economy model is not valid today, given the increase in globalization, where Tobin's *Q* is determined by worldwide business activity and global rates of return. Gutiérrez and Philippon use data on investment and capital from the U.S. national accounts, which are likely mildly correlated but overall are disconnected from measures of Tobin's *Q*. Second, Cooper noted that investment has more or less declined all around the world since 2000, the one exception being China. However, much of the investment in China has been driven not by private businesses but by state-owned enterprises, which Cooper called an artificial source of investment. Excluding China, investment has declined almost everywhere. Therefore, any explanation for declining investment must be very diverse and address the trends in different countries separately, or create a single unifying explanation of low investment across countries. He found it unconvincing that more market concentration could explain low investment in every country.

Robert Hall disagreed with the objection that Tobin's *Q* does not reflect global factors. The Brainard–Tobin *Q* equation is a structural equation linking two endogenous variables—the investment–capital ratio and *Q*. Global factors and other driving forces move firms and industries along their *Q* equations, but do not shift those equations, in principle. In practice, this principle may fail, because *Q* may be measured for a different set of firms than are measured in the data on investment and capital. Such a failure could occur if *Q* is measured for multinational firms but investment is measured, as in the U.S. national accounts, only for domestic firms. Hall also noted that investment and capital in assessing the *Q* equation should not include activity related to mergers and acquisitions; all such activity already includes *Q*. The key distinction in *Q* theory is between the price of capital goods paid to their producers, and the market price of installed capital, as revealed in the stock market. That market price is the product of *Q* and the price paid to producers of investment goods, he concluded.

Building on Hall's comment, James Stock noted that the validity of Tobin's *Q* depends on whether one can accurately measure *marginal Q* using data on the *average Q* across the firm, the latter of which is what is actually reflected in the data. Hall responded that investment should not include activity related to mergers and acquisitions; all such activity takes place in the stock market, which should already be contained in Tobin's *Q*.

Thomas Philippon first responded to Brainard, noting that *Q* theory works well in the cross section of firms, but not in the aggregate data for overall investment. This is because the market knows whether it should value one firm over another, but not necessarily what the overall level of a firm's market value should be. This is consistent with the notion of the market "being confused." Philippon referenced remarks by Larry Summers in which he mockingly compared financial economists with so-called ketchup economists, who tend to compare the relationships between prices rather than assess the overall level of prices.[7] In that vein, *Q* theory tends to work well across firms but not in the aggregate.

With respect to Brainard's observation that, in the data, some firms may appear to be underinvesting because they have very high profits and a high *Q*, Philippon made two comments. First, he noted that the paper controls for intangible investment, which helps account for highly profitable firms to a degree, many of which make large, intangible investments. Second, the big question surrounding highly profitable firms with a high *Q* is why new firms do not enter the marketplace to reduce the monopolistic profits made by large firms. The paper addresses this question in its discussion of the theory of market concentration. On the question of measurement errors associated with Tobin's *Q*, Philippon noted that the paper uses new statistical techniques to control for measurement errors in *Q*, particularly the work of Timothy Erickson and Toni Whited.[8]

Next, Philippon addressed some of the issues raised about globalization. He agreed that it is important to consider globalization and the sources of foreign profits, but noted that he and Gutiérrez had tried several ways to measure this phenomenon. First, they include a variable for the percentage of profits from foreign sources retained by a firm, although Philippon conceded that this is an imperfect measure. Second, they focus on industries that are not particularly involved in globalization, for which their baseline results still hold. Third, he cited work he and Gutiérrez had done with Robin Döttling, in which they run the same analysis, but compare the United States with Europe.[9] They find that in Europe, which is exposed to the same globalization forces as the United States, market concentration did not increase, and there is no gap in investment unexplained by Tobin's *Q*. Therefore, the result that market concentration in the United

7. Lawrence H. Summers, "On Economics and Finance," *Journal of Finance* 40, no. 3 (1985): 633–35.

8. Timothy Erickson and Toni M. Whited, "Measurement Error and the Relationship between Investment and *q*," *Journal of Political Economy* 108, no. 5 (2000): 1027–57.

9. Robin Döttling, Germán Gutiérrez, and Thomas Philippon, "Is There an Investment Gap in Advanced Economies? If So, Why?" in *Proceedings of the ECB Forum on Central Banking: Investment and Growth in Advanced Economies* (Sintra: European Central Bank, 2017).

States explains underinvestment seems to hold, even controlling for globalization across other countries.

Philippon agreed with Katz's criticism that passive ownership of firms may not be a causal factor in underinvestment, but noted that some research in corporate finance is close to finding a causal link. A paper by Alan Crane, Sébastien Michenaud, and James Weston shows that institutional ownership causes an increase in payouts, such as dividends and share buybacks.[10] Such research looks at the change in the ownership structure of a firm when it drops out of large cap stock indexes. Because some investors are required to invest only in such indexes, this change in ownership should be totally independent of whether the firm dropping out of the index actually has good investment opportunities. In a related paper, Gutiérrez and Philippon try to control for this.

Philippon generally agreed with Gopinath's comments about productivity, but noted that *Q* theory should still work and should not depend on the source of the shock to investment, whether it is from a productivity shock or elsewhere.

Philippon agreed that regulation is an important factor. Other papers have found that regulation is a driver of underinvestment, but that limitations in the data make it hard to measure. His and Gutiérrez's paper with Döttling tried to measure regulation across countries, using product market regulation indexes from the Organization for Economic Cooperation and Development. Although these measures are also imperfect, they show that the United States has gone from having less regulation than any country in Europe in 1998 to having more regulation than any country in Europe today. The authors find that regulation and concentration both fit with the story of underinvestment in their model using Tobin's *Q*, and therefore they emphasize that regulation is indeed a big problem.

Philippon agreed with Eberly's comments about output and investment and with Haltiwanger's comments about employment. Regarding the issues of identification raised by Haltiwanger, Philippon again noted that in his and Gutiérrez's paper with Döttling, they try to look at other countries in Europe that had more varied experiences with debt concentration. A similar exercise in the present paper might alleviate some of the identification issues.

10. Alan D. Crane, Sébastien Michenaud, and James P. Weston, "The Effect of Institutional Ownership on Payout Policy: Evidence from Index Thresholds," *Review of Financial Studies* 29, no. 6 (2016): 1377–408.

Finally, Philippon emphasized that the paper does not conclude that market concentration and price markups are the only drivers of a slow economy. He simply noted that, if the level of markups is held fixed relative to some point in the past, capital and investment would be somewhere between 4 and 8 percent higher than current levels. This is significant, but is not huge compared with other major macroeconomic depressions, and does not account for other macroeconomic phenomena, such as the decline in labor force participation. However, the effect is nontrivial, and it accounts for a significant share of underinvestment and the decline in labor's share of income.