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# Investment differences between public and private firms: Evidence from U.S. tax returns ☆

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ABSTRACT

Using tax data, we compare the investment behavior of public and private firms for a representative sample of all U.S. corporations. We find that while both types of firms invest similarly in physical capital, public firms out-invest private firms in R&D. Compared to observationally-similar private firms, public firms invest roughly 50% more in R&D relative to their asset bases. Further, public firms dedicate 7.4 percentage points more of their investments to R&D than private firms. This stronger public firm R&D investment is muted when shareholder earnings pressures are heightened, but not so much as to overcome the baseline investment advantage.



## 1. Introduction

Economists have long debated the role that financial markets play in facilitating investment and innovation, both of which are important drivers of economic growth (e.g., Levine, 2005). While public ownership engenders investment frictions relative to private firms due to agency costs and regular required financial disclosures, it may also facilitate investment by distributing idiosyncratic risk among many smaller investors. The net impact of these forces on the relative investment of public and private firms is an empirical question. Yet, the evidence on whether and how investment differs by ownership status is sparse, in large part due to an imbalance of data availability. Whereas public firm investment is easily observed thanks to frequent, mandatory financial disclosures, private firms face no similar requirements. What is currently known about private firms typically comes from selected samples of accounting data, case studies, or Census data on manufacturing firms. As a result, the broad investment differences between public and private firms are neither easily measured nor well understood.

This paper provides compelling new evidence on the relative investment of public and private firms based on a representative sample of firms drawn from administrative tax data. We exploit the rich investment detail reported in the tax data to compare investment across asset classes and within the total investment portfolio. Overall, we show that public firms invest more heavily in R&D, arguably the riskiest of asset classes. [1] We find that R&D investments, scaled by lagged total assets, are approximately 50% higher for public firms relative to a set of observationally-similar private firms. Moreover, we show that public firms direct greater resources towards innovation investments: 7.4 percentage points

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[1] In the U.S. R&D is subsidized through the Research and Experimentation (R&E) tax credit. We use these terms interchangeably.

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0047-2727/

more of their total investments are dedicated to R&D than comparable private firms. Public firms, however, do not have a similar advantage in physical capital investment, where we find an indistinguishable difference between public and private firms. In addition, we find a negative relationship between a measure of investor pressures to meet short-run performance goals and both the investment levels and investment priority of long-term assets for public firms. While seemingly consistent with concerns over public firm short-termism, these reductions are not large enough to overcome the baseline investment advantages for the vast majority of public firms.

Our preferred analysis compares the investments of public firms to those of a set of observationally-similar private firms. To do this, we employ a regression-based analysis of investment behavior that holds constant important observable characteristics that are likely correlated with public ownership and investment behavior. To enhance comparability, we also focus on similarly-sized firms and employ the re-weighting method of DiNardo et al. (1996), which ensures that the size distribution of private firms closely resembles that of public firms within each industry-year pair. This approach is important because public and private firms differ substantially along a host of dimensions that complicate direct comparisons. Nevertheless, our results are robust to using the full sample of firms where the investment advantages of public firms are even larger.

Our paper directly relates to the scarce, but growing, literature that examines how public ownership affects investment. Many studies focus on firms that change ownership status through an initial public offering (IPO) or leveraged buyout (LBO), largely finding evidence that public ownership is related to agency problems. [2] After an IPO, firms exhibit declines in patent quality (Bernstein, 2015), and profitability or productivity (Degeorge and Zeckhauser, 1993; Jain and Kini, 1994; Mikkelson et al., 1997; Pagano et al., 1998; Chemmanur et al., 2010). Similarly, after going private, firms register more important patents (Lerner et al., 2011) and reduce managerial perks (Edgerton, 2012). While insightful into how investment changes when ownership status changes, these studies may not be representative of differences by ownership status over a longer horizon. For example, firms may go public because of positive shocks to their view of future profitability, and experience subsequent reduced post-IPO profitability due to mean reversion (Pastor et al., 2009).

Stepping away from the IPO and LBO environments, the evidence is mixed. Studies using industry-specific data offer conflicting results; for example, Sheen (2016) finds that private chemical companies better time their investments, while Gilje and Taillard (2016) find public natural gas producers respond more quickly to changes in gas prices and investment opportunities. Using U.S. Census data on all non-farm establishments, Maksimovic et al. (2019) find that public firms grow faster and are more responsive to positive demand shocks than private firms. In contrast, Asker et al. (2015) find that public firms from Compustat invest less and are less sensitive to investment opportunities than a matched sample of private firms from Sageworks, which compiles data from accounting agencies for a non-random sample of firms. Overall, this line of research compares public and observationally-similar private firms, without an exogenous source of variation in ownership status. Importantly, the only two cross-industry studies are unable to analyze R&D – Census data do not separately report R&D, and Sageworks excludes R&D completely – which is precisely the investment component that drives the larger public firm investment that we document.

All told, the existing evidence contrasting public and private firm investment is limited both by the sample of firms and by the types of investments considered. We fill these gaps by providing empirical facts using tax data that offer three key improvements over previously used data sources. First, tax data are constructed to be representative of the entire U.S. corporate sector. Second, the information in tax returns constitutes a mandatory disclosure that is consistently reported across ownership type. Finally, tax data contain rich detail that allows us to construct precise investment measures of both tangible and intangible capital. In this way, the tax data are uniquely situated to provide empirical evidence comparing investment behavior across ownership forms.

Our findings shed some light on the potential implications of the many recent policies aimed at increasing corporate investment, particularly among smaller firms. For example, the U.S. tax code provides generous investment tax subsidies through Section 179 expensing limits and R&D tax credits. These subsidies have become increasingly more generous for small businesses thanks to an active legislative agenda since 2003. [3] Because smaller firms tend to be privately held, our findings suggest that these policies may help narrow the investment gap we document between public and private firms. Extending subsidies for physical capital and R&D investment to small businesses is not just a U.S. policy priority (OECD, 2003). For example, the UK provides more generous tax subsidies for R&D expenses to small and medium-sized enterprises to boost private sector total factor productivity (Guceri and Liu, 2019).

Our results also suggest that recent regulatory changes may have implications for aggregate corporate investment. The Securities and Exchange Commission's 2019 adoption of Securities Act Rule 163B allows all private firms to "test-the-waters" before filing their IPO registration, easing the path to public status. On the other hand, regulatory policies like the 2002 Sarbanes–Oxley Act that raise compliance burdens for public firms may potentially lead smaller public firms to de-register and discourage smaller private firms from going public. To the extent that the differences we observe between public and private firm investment result from public status, our analysis will inform the effect of these regulatory changes on overall investment levels.

Ultimately, our findings are observational, and the comparisons we draw are between firms that chose public ownership and firms that chose to remain private. Nonetheless the new facts we establish – that public firms invest more than private firms across a broad spectrum of industries, particularly in innovation – settle this outstanding question for which the extant literature reports competing answers using more limited data. By establishing these basic facts, we hope to set the stage for a more informed policy debate.

## 2. IRS corporate tax data

We create a panel of the IRS Statistics of Income (SOI) corporate tax return files between 2005 and 2015. [4] In each year, the SOI corporate sample includes a stratified random sample of roughly 100,000 corporations, largely drawn from IRS Form 1120 (C corporations) and Form 1120-S (S corporations). The sampling procedure is designed to maintain the integrity of the panel across years; once a corporation is sampled, it is likely to remain the sample unless it ceases operations or experiences a large size shock. Sampling

[2] An exception is Bharath et al. (2010), which finds no evidence that manufacturing firms experience productivity gains after going private.

[3] Changes to Section 179 have been included in the 2003 Jobs and Growth Tax Relief Reconciliation Act, the 2004 American Jobs Creation Act, the 2007 Small Business and Work Opportunity Act, the 2008 Economic Stimulus Act, the 2009 American Recovery and Reinvestment Act, the 2010 Small Business Jobs Act, the 2012 American Tax Payer Relief Act, the 2014 Tax Increase Prevention Act and the 2015 Protecting Americans from Tax Hikes Act and the 2017 Tax Cuts and Jobs Act.

[4] We also collect 2004 tax data to scale variables by lagged data.

weights ensure that the sample is representative of the relevant population of corporate firms.

The tax data are collected to calculate tax liability, and their definitions are regulated by the Internal Revenue Code (IRC). As such, comparisons to other data sources is difficult. For example, what constitutes taxable income is not necessarily congruous with reported earnings on financial disclosures. A large accounting literature compares tax reporting data with financial reporting data (e.g., Manzon and Plesko, 2001; Hanlon and Heitzman, 2010; Green and Plesko, 2016), finding important deviations in common measures of income, investment, and size that are related to differences between "book" and "tax" accounting standards and differences in membership of consolidated reporting groups. Despite these differences, there are unambiguous advantages of the tax data for our purposes. The uniformity of the tax code aligns reporting incentives for public and private firms, and the IRS sampling strategy provides a representative sample of corporations, both public and private. This latter point is of particular importance in light of the limited and inconsistent data otherwise available for private firms.

### 2.1. Identifying public firms

Because the IRS does not collect information on public ownership directly, we identify public firms using a multi-step process. We start with information reported on Schedule M-3, a required disclosure for firms with more than $10 million in assets. [5] We deem a firm to be public if it answers affirmatively to either of the following questions on Schedule M-3: (1) whether the firm files a form 10-K with the Securities and Exchange Commission (SEC), and (2) whether any of the tax filer's voting stock is publicly traded. Next, we collect all taxpayer identifier numbers (EINs) for corporations in Compustat between 2004–2015 and match them to corporations in the SOI sample. These data are important because roughly 13% of public firms would fall below the Form M-3 filing threshold based on Compustat. Finally, we use data on IPOs between 1996 and 2015 from Thompson Financial's SDC New Issues Database to clean our data. [6] This database provides information on all firms that go public, including IPO dates. We use these data to verify the public status gleaned from the M-3 and Compustat and to ensure that we assign public status to the correct years, as Compustat often contains data for years just before a firm goes public.

Fig. 1 illustrates the accuracy in our public firm identification method. The number of U.S. domestic companies in Compustat and our public firm count based on tax data are shown as circles and diamonds, respectively. The correlation coefficient between the two series is 0.97. In our empirical analyses, we restrict attention to non-financial C and S corporations due to the special organizational and tax status of financial firms, shown in square markers. [7]

### 2.2. Investment measures

Where tax data shine compared to alternative sources is in measures of investment. We use two corporate tax forms to construct our investment measures. First, we calculate physical capital investments based on depreciation allowances reported on Form 4562, summing over all property placed in service during the tax year. Second, R&E investment is constructed using qualified research expenditures (QRE) reported on Form 6765, which are expenses incurred to discover knowledge that is technological in nature for a new or improved business purpose. [8] For our empirical analysis, we normalize investment by lagged total assets. We also present firm-specific allocations of investment among long-term physical capital, and R&E expenditures. Long-term physical capital investment includes physical capital with at least a 10-year depreciation allowance, and residential and non-residential property. We provide a detailed description of all of the key variables used in our analyses in Appendix A.

There are two important aspects of the measurement of R&D to note. First, QREs differ from broader definitions of R&D that are captured in other databases, such as Compustat. Specifically, R&D conducted abroad and domestic investments that fail to meet the experimental or technological criteria are ineligible for the credit, but might otherwise be considered R&D. For comparison, we find that among the matched set of public firms between the SOI corporate sample and Compustat, QREs are roughly 54% of R&D expenditures reported in Compustat, on average, during our period. [9]

Second, it is reasonable to consider the potential incentives for firms to relabel non-qualified research as QREs. [10] While the tax code, itself, does not create differential re-labelling incentives for public and private firms, differences could arise due to the interaction of tax and financial reporting, which generally subjects public firms to stronger financial disclosure requirements. Re-labelling can be classified among reporting behaviors seen as "tax aggressive," because it is done purely to reduce tax liability. The adoption of the financial accounting standard known as "FIN 48" [11] in 2007 was aimed at reducing tax-aggressiveness and may affect the re-labelling behavior of public firms. FIN 48 requires that firms disclose any aggregate tax positions deemed to be risky – for example, any pure relabeling, which might be challenged by the IRS. This change was accompanied by the introduction of IRS Form UTP (Uncertain Tax Position), on which firms report such positions to the tax authority. These reporting requirements, which were in place for much of our period of analysis, should serve to reduce tax aggressiveness and relabeling by public firms (Blouin et al., 2007, 2014; Henry et al., 2016; Balakrishnan et al., 2019).

## 3. Mean comparisons of public and private firms

The tax data allow us to compare the investment behavior of public and private firms in a way that is representative of the U. S. economy. Because much of what is currently known about these investment differences often draws on data from a particular industry, we first present the distribution of public firms and private firms across industries, defined by 2-digit North American Industry Classification System (NAICS) codes in Panel A of Fig. 2. Our data show that public firms have a significant economic presence across industries. While the manufacturing industry contains the most public firms—roughly 1,300 per year on average—panel B shows that assets held by public firms are widely distributed across industries. This underscores the importance of comparing the investments of public and private firms across all industries.

The tax data reveal that in addition to accounting for the vast majority of the number of U.S. corporations, privately-held firms comprise a significant portion of economic activity in the corporate

[5] Some firms file this form voluntarily; most have met the reporting threshold in a previous period.

[6] We thank Christine Dobridge and Andrew Whitten for providing their sample of firms from the SDC matched EINs from Edgar.

[7] Holding companies and firms with negative total assets are excluded.

[8] Some firms may opt to not complete Form 6765 in years when they will not earn a tax credit. As such, our data may be censored with a firm-specific threshold, similar to the materiality threshold of financial filings. Robustness checks that use only firms that complete Form 6765 each year yield statistically indistinguishable results.

[9] Rao (2016) finds this ratio is 37% for the 1980s.

[10] Rao (2016) finds that tax credits increase tax measures of R&D more than measures from financial disclosures, consistent with re-labeling but also the intended redirection of research from non-qualified to qualified activities.

[11] ASC 740–10, *Accounting for Uncertainty in Income Taxes*; adopted in 2007 by the Financial Accounting Standards Board (FASB).

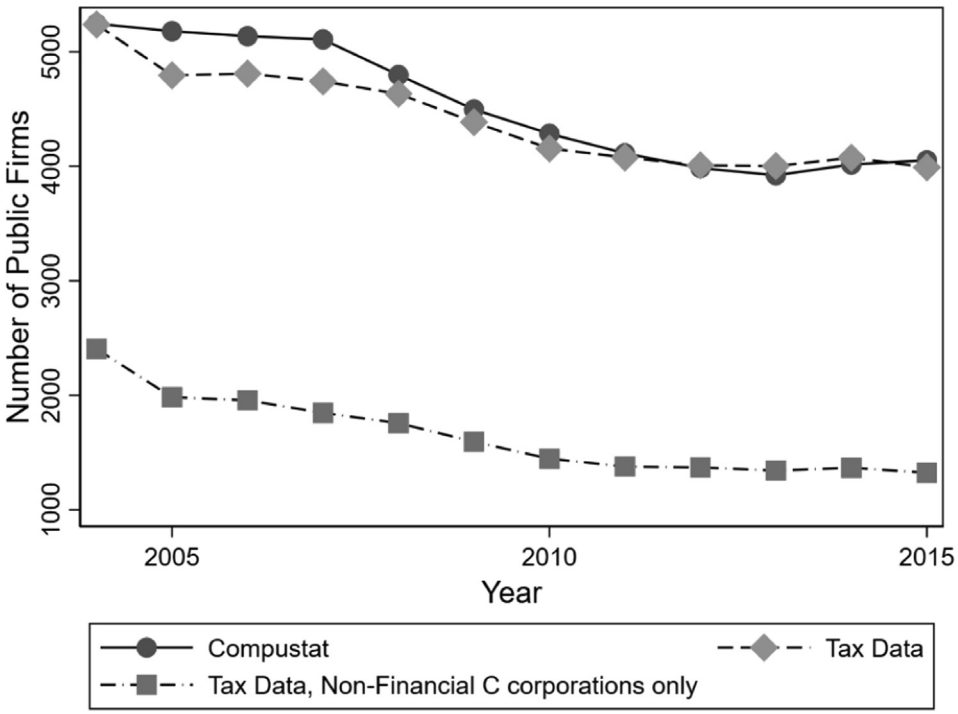



**Fig. 1.** Comparison of Public Firms Identified in Tax Data and Compustat. *Notes:* The figure presents counts of U.S. public firms based on Compustat and tax return data. The circles represent counts of firms in Compustat that are incorporated in the U.S. that issue common stock and have a CRSP share code of 10 or 11. The diamonds represent counts of public C corporations in tax return data, determined using the methodology outlined in Section 2.1. The square series restricts the public corporations in tax return data to exclude financial corporations and holding companies..

sector. Private firms account for 68% of total salaries (including deductible executive compensation), 60% of gross receipts, and 74% of operating profits. Columns (1) and (2) of Table 1 report key income and expense measures for public and private firms, respectively. [12] Unsurprisingly, private firms are considerably smaller than public firms: the average private firm earns $1.8 million in gross receipts and holds $1.1 million in total assets, whereas the average public firm earns $480 million in gross receipts and holds $633 billion in total assets. At the same time, there is substantial variation underlying these distributions, and there is a subsample of private firms that, like public firms, are quite large. Our analysis comparing the investment activity of a matched sample of public and private firms will up-weight these firms to compare more similar distributions of public and private firms.

Panel B shows that on average, public firms vastly out-invest private firms for all investment categories, but this in part reflects that public firms are also much larger. Scaling by lagged total assets in Panel C presents a very different picture. Now, private firms appear to invest *more* on average than public firms across all investment measures. Panel D compares investment budgets and reveals that public firms dedicate a larger share of their investment portfolio towards long-term assets—14% in long-term physical capital compared to 5%, and 24% in R&D compared to 0.3%.

The large disparity in total assets between public and private firms, in part, drives the very high investment to asset ratios of some private firms. As such, our preferred estimation sample restricts our sample to firms with assets between $1 million and $1 billion and revenues between $0.5 million and $1.5 billion. These cut-offs follow Yagan (2015) and focus on more comparable public and private firms. [13] This estimation sample comprises roughly 2.1 million firm-years, representing a population of about 1.2 million S corporation and 922,000 C corporation firm-years. [14]

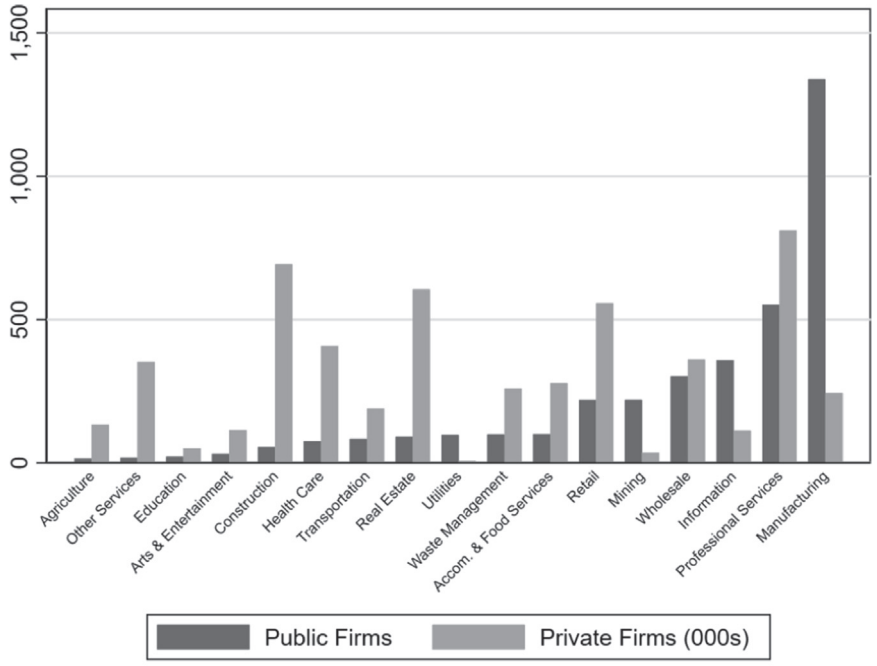
Columns (3) and (4) of Table 1 report summary statistics for this restricted sample. While the level of investment is still an order of magnitude larger among public firms, scaled investment and investment allocations are much more comparable. Scaled investment is also similar across ownership type—public firms edge out private firms in terms of total investment by 1% while private firms invest approximately 1% more in physical capital. Investment allocations towards long-term physical capital are close as well. Even in these unconditional means, the key distinction is that public firms dedicate substantially more of their investment dollars to R&E, and invest more than three times as much in R&E in normalized levels than their private counterparts.

These simple comparisons of unconditional mean investment measures ignore any underlying differences between public and private firms. In the next section, we compare the investment decisions of public firms to a set of observationally-similar private firms in a regression framework, which allows us to, at a minimum, hold important observable characteristics constant across the two ownership types. There is surely remaining selection into public ownership that depends on unobservable factors. Nevertheless, these comparisons allow us to analyze the extent to which the mean differences between public and private firms documented here change after controlling for differences in observable characteristics.

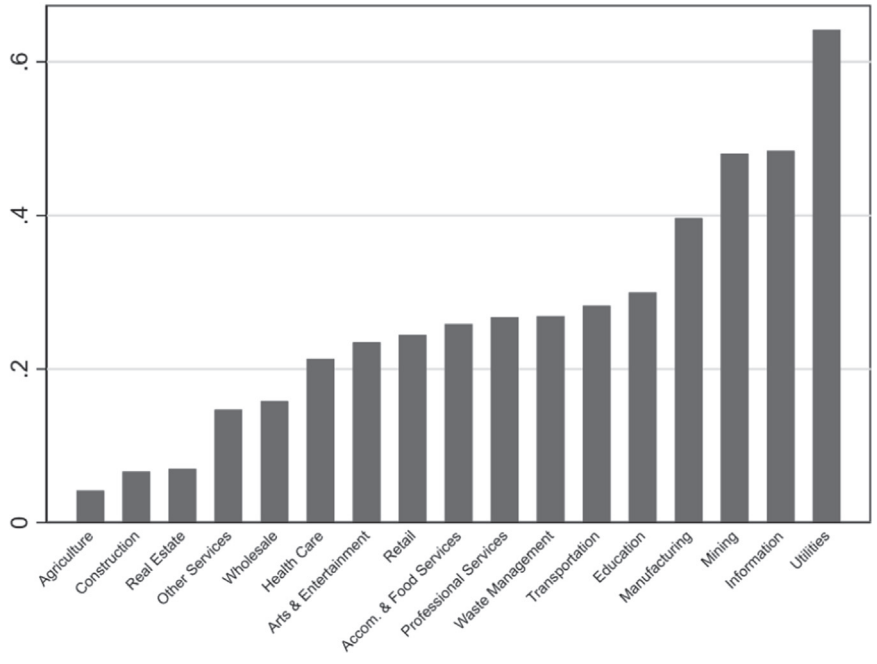
[12] All income variables are measured in 2004 dollars using the CPI and are winsorized at the 99th percentile.

[13] We exclude a firm if it ever falls outside of this range during our sample period.

[14] On average, firms that satisfy these sample restrictions account for 41% of total assets, 43% of physical capital, and 26% of R&D per year. After these restrictions, approximately 4.5% (or 0.8% of the SOI-weighted sample) of firm-years are defined to be public – 1,984 in 2005 and declining to 1,324 by 2015.




(a) Public and Private Firm Counts, by Industry




(b) Share of Assets in Public Firms, by Industry

**Fig. 2.** Select Comparisons of Public and Private Firms. *Notes:* Panel A presents counts of public and private firms in tax return data by two-digit industry code. Panel B presents the average share of total assets in each industry that are owned by public firms between 2005 and 2015. Source: SOI Corporate Sample, 2005–2015. The sample comprises non-financial C and S corporations.

## 4. Regression analysis of investment behavior

To compare the investment choices of public and private firms, conditional on a set of observable characteristics, we estimate regressions of the following form:

$$Y_{it} = \alpha + \beta \text{Public}_{it} + X'_{it}\Phi + \delta_j + \mu_t + \epsilon_{it}. \quad (1)$$

In this specification, $Y_{it}$ is the investment measure of interest for firm $i$ in tax year $t$ and $\text{Public}_{it}$ is a binary indicator for being a public firm. The vector $X$ contains a number of firm characteristics, includ-

**Table 1**
Summary Statistics: 2005–2015.

| | Full Sample | | Estimation Sample | |
|---|---|---|---|---|
| | Public (1) | Private (2) | Public (3) | Private (4) |
| *Panel A: Select Firm Characteristics* | | | | |
| Gross receipts | 480,107 | 1,797 | 177,226 | 23,393 |
| | (656,939) | (23,603) | (220,646) | (59848) |
| Interest paid | 13,242 | 23 | 3,649 | 262 |
| | (20,803) | (626) | (8,385) | (1,572) |
| Net income | 5,719 | 58 | 4,717 | 775 |
| | (129,524) | (2,880) | (29,869) | (5,044) |
| Total assets | 632,543 | 1,087 | 185,559 | 12,401 |
| | (827,371) | (24,549) | (198,748) | (40,699) |
| Age | 25 | 13 | 25 | 26 |
| | (22) | (12) | (21) | (18) |
| S Corp (%) | 0.00 | 0.71 | 0.00 | 0.58 |
| Multinational (%) | 0.62 | 0.003 | 0.58 | 0.04 |
| *Panel B: Select Investment Details* | | | | |
| Total investment | 25,438 | 54 | 10,794 | 664 |
| | (35,084) | (1,123) | (17,327) | (3,462) |
| Physical capital | 17,798 | 47 | 7,156 | 569 |
| | (26,977) | (909) | (13,454) | (2,925) |
| R&E expenditures | 11,165 | 8 | 3,541 | 97 |
| | (35,526) | (728) | (9,361) | (1,971) |
| *Panel C: Investment (Share of Lagged Total Assets)* | | | | |
| Total investment | 0.15 | 0.31 | 0.07 | 0.06 |
| | (0.3) | (0.46) | (0.09) | (0.12) |
| Physical capital | 0.11 | 0.27 | 0.04 | 0.05 |
| | (0.25) | (0.39) | (0.07) | (0.1) |
| R&E expenditures | 0.16 | 0.37 | 0.02 | 0.006 |
| | (0.44) | (0.67) | (0.06) | (0.05) |
| *Panel D: Investment (Share of Total Investment)* | | | | |
| Long-term physical capital | 0.14 | 0.05 | 0.13 | 0.14 |
| | (0.23) | (0.17) | (0.22) | (0.25) |
| R&E expenditures | 0.24 | 0.003 | 0.24 | 0.03 |
| | (0.36) | (0.05) | (0.35) | (0.15) |
| N | 34,747 | 766,260 | 16,239 | 312,334 |
| Weighted N | 40,475 | 57,320,440 | 19,429 | 2,124,599 |

*Note*: This table reports SOI-weighted means and standard deviations of key firm characteristics and investment measures contained in the tax data. Columns (1) and (2) summarize the SOI corporate sample and columns (4) and (5) summarize the estimation sample. The estimation sample includes firms that report total assets between $1 million and $1 billion, and report gross receipts between $0.5 million and $1.5 billion in each year that they file a tax return between 2004–2015. All columns are restricted to non-financial C and S corporations. Financial measures converted to thousands of 2004 dollars based on CPI. All data are winsorized at the 99th percentile.
Source: U.S. Internal Revenue Service, Office of Tax Analysis, Statistics of Income (SOI) Corporate tax return files.

ing: a quadratic control for firm age, [15] lagged total asset deciles, and binary indicators for S-corporations and multinational corporations. Because some firms may choose to lease equipment rather than investing in their own, we include deductible interest payments paid by the firm as an additional control. Moreover, as public and private firms may face different replacement costs of capital, we include two measures of investment opportunities that have been used in the finance literature: profit margin and sales growth. [16] Finally, in regressions where the dependent variable is the share of total investment, we also include a dummy indicating that a firm has zero total investment; in these cases, the dependent variable is set equal to zero. The vector $\delta_j$ contains two-digit NAICS code industry fixed effects, and the vector $\mu_t$ contains year fixed effects. Our framework thus yields within-industry comparisons, controlling non-parametrically for the evolution of average investment rates across all firms. Standard errors are clustered at the firm level.

Table 2 presents estimates of the coefficient of interest, $\beta$, and reveals how the investment behavior of public firms differs from that of comparable private firms, on average. Columns (1)–(3) report results for investment variables scaled by lagged total assets (total investment, physical capital, and R&E expenditures, respectively). Columns (4) and (5) report results for firm-level investment allocations towards long-term physical capital and R&E expenditures, respectively.

We begin by comparing conditional investment using the full sample of public and private firms in Panel A. In contrast to the unconditional means reported in Section 3, once we control for important observable characteristics, it is public firms that invest more. Public firms invest 2.7 percentage points more than private firms, or 9% relative to a mean private investment of 31% (Table 1 panel C, col. 2). Outsized R&E investments drive this overall investment advantage: public firms invest 0.8 percentage points more in physical capital but 3.5 percentage points more in R&E. In addition, public firms devote a greater share of their investment portfolio to long-term physical capital (11.5 percentage points) and R&E expenditures (14.2 percentage points). All told, in the full sample, public firms invest more than private firms in terms of both scaled investment expenditures and investment portfolio allocations towards long-term physical capital and R&E expenditures.

[15] Maksimovic et al. (2019) find that controlling for initial firm conditions rather than just contemporaneous variables reverses erroneous conclusions that private firms are more responsive to growth opportunities in prior studies.

[16] A common measure of investment opportunities – Tobin's $q$ – is measured as the ratio of a firm's market value to the replacement value of its capital, and is incalculable for private firms. However, Blanchard et al. (1993) find that fundamentals better predict investment than proxies for Tobin's $q$.

**Table 2**
Public vs private investment.

| | Share of Lagged Total Assets | | | Share of Total Investment | |
|---|---|---|---|---|---|
| | Total Investment (1) | Physical Capital (2) | R&D (3) | Long-Term Physical Capital (4) | R&D (5) |
| *Panel A: Full Sample Comparison* | | | | | |
| Public | 0.0270 | 0.0077 | 0.0350 | 0.115 | 0.142 |
| | (0.0051) | (0.0040) | (0.0073) | (0.0063) | (0.0064) |
| Observations | 618,482 | 618,482 | 618,482 | 618,482 | 618,482 |
| R-squared | 0.147 | 0.143 | 0.150 | 0.187 | 0.069 |
| *Panel B: Matching Analysis* | | | | | |
| Public | 0.0037 | −0.00004 | 0.0033 | 0.064 | 0.074 |
| | (0.0020) | (0.0016) | (0.0014) | (0.0082) | (0.0077) |
| Observations | 328,554 | 328,554 | 328,554 | 328,554 | 328,554 |
| R-squared | 0.069 | 0.087 | 0.034 | 0.118 | 0.170 |
| *Panel C: Matching Analysis, Excluding S-Corporations* | | | | | |
| Public | 0.0040 | 0.0005 | 0.0034 | 0.0640 | 0.0730 |
| | (0.0021) | (0.0017) | (0.0015) | (0.0083) | (0.0078) |
| Observations | 199,899 | 199,899 | 199,899 | 199,899 | 199,899 |
| R-squared | 0.062 | 0.085 | 0.028 | 0.128 | 0.172 |
| *Panel D: Heterogeneity by Stock Price Sensitivity* | | | | | |
| Public | 0.0041 | 0.00025 | 0.0034 | 0.066 | 0.076 |
| | (0.00014) | (0.00013) | (0.00004) | (0.00041) | (0.00055) |
| Public x ERC | -0.028 | -0.021 | -0.0068 | -0.213 | -0.124 |
| | (0.0094) | (0.0088) | (0.0028) | (0.024) | (0.035) |
| Observations | 326,673 | 326,673 | 326,673 | 326,673 | 326,673 |

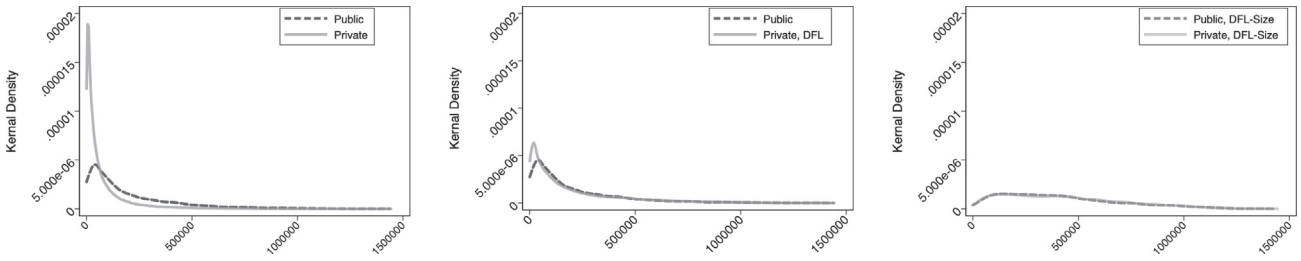
*Note*: The dependent variable in columns (1)–(3) is equal to total investment, physical capital investment, and R&E expenditures, respectively, scaled by lagged total assets. All specifications control for a 4th degree polynomial in firm age, profit margin, interest paid, tangible asset deciles, a multinational dummy, and S Corp dummy. All models include year and 2-digit NAICS code fixed effects, and an unreported constant. Panels A is weighted by SOI sampling weights, Panels B, C, and D are weighted by Size-DFL weights where size is equal to the average of gross receipts over the previous two lagged years. Standard errors clustered by EIN in Panels A, B, and C, and standard errors are bootstraped in Panel D. Data are winsorized at the 99th percentile.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.
Source: U.S. Internal Revenue Service, Office of Tax Analysis, Statistics of Income (SOI) Corporate tax return files.

In our preferred specification, we employ the re-weighting methodology of DiNardo et al. (1996) (DFL) to construct a set of private firms that are observationally similar to public firms. [17] The goal of the DFL procedure is to re-weight the data so that the distribution of observable characteristics for the target group (i.e., private firms) is the same as the distribution of observable characteristics for the base group (i.e., public firms). Panel A of Fig. 3 shows the right-skewed distribution of public firms, and the mass of relatively small private firms. For this reason, we additionally restrict attention to the estimation sample, which drops the very largest and smallest firms of any ownership type. To implement DFL re-weighting, we bin firms by industry code and tax year, and construct weights so that the size distribution of private firms more closely matches that of public firms, where "size" is the two-year average of lagged gross receipts. [18]

We illustrate the effect of DFL re-weighting in Panel B of Fig. 3. Small private firms are down-weighted and large private firms are up-weighted so that the distribution of private firms more closely mimics that of public firms within industry-year. For our regression analysis, we weight by the product of the DFL weight and firm size, so that the estimates are representative of U.S. economic activity. Panel C shows the effect of these estimation weights, where the distributions of public and private firms are now virtually identical.

In Panel B of Table 2, we find that comparing public firms to observationally-similar private firms dampens the estimated investment differences across ownership types, but continues to show that public firms invest substantially more in innovation. [19] Public firms invest 0.3 percentage points (50%) more in normalized R&E expenditures, and allocate 7.4 percentage points more of their investment portfolio towards R&E than observationally-similar private firms. [20] Public firms also allocate 6.4 percentage points more of their investment portfolio towards long-term physical capital. Outside of R&E, we do not find strong evidence that investment levels differ between public and private firms with reasonable precision. The overall investment advantage of public firms is only marginally significant now and the difference in physical capital investment between public and private firms is statistically insignificant. Our estimates are robust to merely imposing the size-based restrictions, though the estimated investment differences are larger in this case. Importantly, because we control for S corporation and MNC status, our identification strategy essentially compares domestic public firms and private C corporations. There may remain concerns about the role that S corporations play in our empirical strategy, however, given that they face a different tax regime than

[17] This DFL procedure is similar to Yagan (2015), which re-weights S corporations to make their within-industry size distributions comparable to C corporations.
[18] When unavailable, we use the one-year lagged value.
[19] In the paper closest to ours, Asker et al. (2015) conclude that private firms invest substantially more than public firms. In Appendix B, we explore the potential explanations for the differences in our results. Importantly, we find that methodological differences do not explain differences in our results.
[20] We find consistent results if we use a measure of R&D intensity, defined as R&E scaled by lagged gross receipts. In this case, public firms have a 1.2 percentage point advantage in R&D intensity over private firms.




(a) Unweighted (b) DFL-Weighted (c) DFL×Size-Weighted

**Fig. 3.** Distribution of public and private firms by size: gross receipts. *Notes:* Financial measures are converted to thousands of 2004 dollars based on CPI. DFL weights were generated within 2-digit industry by year to match public and private firms based on firm size as measured by average gross receipts. Source: SOI Corporate Sample, 2005–2015.

C corporations. Panel C of Table 2 shows the our baseline results are robust to the exclusion of S corporations from the estimation sample. [21]

Lastly, we assess heterogeneity in the investment advantage of public firms with respect to the degree of shareholder pressures they face to improve short-term financial performance. One of the primary concerns surrounding public ownership is that such pressures may cause public firm managers to forgo profitable, long-term investment opportunities. These concerns are strengthened by the survey responses of public firm CEOs who report a preference for short-term investment because shareholders undervalue long-term projects (Poterba and Summers, 1995), even stating that they would avoid initiating a profitable project to meet short-run earnings forecasts (Graham et al., 2005). [22] Such sentiments suggest that short-term biases should be stronger for public firms whose future share prices are more responsive to current performance measures (Stein, 1989).

We follow the accounting literature and proxy for shareholder short-term performance pressures using earnings response coefficients (ERCs), which measure the responsiveness of stock prices to earnings surprises. [23] The intuition behind this measure is that the more sensitive share prices are to meeting earnings expectations, the greater the pressure may be to forego long-term investments in lieu of short-term performance. These ERCs are estimated at the industry-year level using public firms and capture the average responsiveness of equity prices to differences between a firm's expected and actual earnings per share. [24] We augment Eq. (1) as follows:

$$Y_{it} = \gamma_0 + \gamma_1 \text{Public}_{it} + \gamma_2 \text{ERC}_{jt} + \gamma_3 \left[\text{ERC}_{jt} \times \text{Public}_{it}\right] + X'_{it}\Phi + \delta_j + \mu_t + \epsilon_{it}. \quad (2)$$

where firms are indexed with $i$ and industries are indexed with $j$. In this regressions, $\gamma_1$ measures the average difference between public and private firms when there is little to no pressure from investors (i.e., $ERC = 0$) while $\gamma_3$ captures how the investment differential between public and private firms changes as stock prices become more responsive to earnings surprises. Because ERC and ERC × Public are generated regressors, we bootstrap the standard errors on their estimated coefficients.

Results from estimating Eq. (2) are presented in Panel D of Table 2. The estimates show that when stock prices are unresponsive to earnings news shocks, normalized public firm investment levels and the share of investments dedicated to longer-term assets are larger than that of private firms ($\widehat{\gamma_1} > 0$), although this is only marginally statistically significant for physical capital levels. As short-term performance pressures increase, these higher investment rates and shares are mitigated ($\widehat{\gamma_3} < 0$), the latter suggesting a shift away from investments in those assets that depreciate slowly and may take time to generate returns. However, for the vast majority of industry-years, these reduced investments are not so large as to overcome the baseline investment advantage of public firms. At the 90th percentile of the ERC distribution (0.06) public firms still out-invest private firms in all investment measures except for the normalized level of physical capital.

These results inform recent rhetoric and policy proposals aimed at curbing short-termism. The European Commission and U.S. policymakers have considered granting additional voting rights to long-term investors, while Jamie Dimon, Warren Buffett, and others, have led efforts among business leaders to promote a long-term focus on investment. To the degree these concerns are merited, they are not so acute as to render public firms less able to invest than private firms.

## 5. Conclusion

Many factors may contribute to differing investment choices between public and private firms. On the one hand, public firms may face lower costs of capital because their investor bases consist of small shareholders who can more easily diversify idiosyncratic risks. This may be particularly important for R&D, where public equity and debt markets may more readily finance such highly uncertain investment that are not backed with assets. In fact, this access to capital for investment opportunities may be a main driver for going public (Brau and Fawcett, 2006). On the other hand, agency problems or short-termist pressures may cause public firms to forego profitable longer-term investment opportunities. The accounting literature documents numerous examples of "real earnings management," where public firm managers sacrifice cash flows or alter real decisions to improve their accounting earnings or short-run stock prices (Erickson et al., 2004), potentially reducing their real spending on activities like R&D to avoid reporting accounting losses (Baber et al., 1991; Dechow and Sloan, 1991). We answer the empirical question of how these competing forces translate into heterogeneous investment patterns among public and private firms.

By virtue of its uniform treatment of corporations, tax reporting provides a unique portal into the investment choices of public and private firms. These data – constructed to be representative of the universe of U.S. corporations, and subject to consistent reporting

[25] Bernstein (2015) addresses this endogeneity by instrumenting for the decision to IPO using a measure of stock market performance. In results not shown, we re-examine this strategy and find that the identifying assumptions are invalid in our time period.

standards across ownership status – allow for investment comparisons that can be taken as broadly applicable to the U.S. economy. Our findings clearly show that compared to a set of observationally-similar private firms, public firms invest more relative to their assets and that this advantage stems largely from an outsized commitment to R&D. That public firms invest more in R&D than private firms suggests that diversified, public ownership somehow facilitates these risky, un-collateralized investments particularly well. And, while we find evidence that shareholder pressures reduce this investment advantage some among firms with particularly sensitive share prices, such pressures are not so strong as to outstrip these higher investments by public firms.

Ultimately, any examination of the relative investment behavior of public and private firms raises important questions about identification and causality. Our results do not arise from an experiment, natural or otherwise, nor do we explicitly model the structural parameters that govern the decision to take a firm public. Indeed, the ideal experiment would randomly assign public ownership to a subset of corporations and, only then, compare investments by ownership status. [25] Our analysis compares firms that have chosen to be public or private and, as such, cannot escape the confounding effects of unobserved factors that are correlated with public ownership and impact investment decisions. It remains unclear whether public status *causes* a firm to invest more. For example, it could instead be the case that when a firm is poised to expand its R&D program, it opts to go public in order to access more cost-effective financing for these projects. Our estimates are consistent with either interpretation.

The observational facts reported here are nonetheless a useful starting point. The naive comparisons of average total investment suggest that normalized investment for private firms is *larger* than public firms, consistent with some earlier work on the topic. These statistics, coupled with salient anecdotes of large public firms delisting in order to focus on long-term investment beg the casual reader to associate public ownership with agency costs and stalled investment. To the contrary, we use a new, compelling data source to establish that it is in fact public firms that invest more than comparable [9]private firms. While a causal estimate of the effect of public status on investment will best inform policy, we hope that a new understanding of the observed patterns will help motivate this vein of work.

## Appendix A. Tax variable descriptions

- **Gross receipts**: Sales revenues is captured by gross receipts, reported on Line 1a of Form 1120 and 1120-S.
- **Interest paid**: Interest deductions are reported on Line 18 of Form 1120 and 1120-S.
- **Net income**: Net income is reported on Line 28 of Form 1120 and 1120-S.
- **Total assets**: Total balance sheet assets are reported on Line 15 on Schedule L.
- **Salaries paid**: Salaries paid is the sum of officer compensation (Line 12) and salaries and wages (Line 13) on Form 1120 and 1120-S.
- **Operating profit**: Operating profits is the sum of gross receipts, executive compensation, interest paid, charitable contributions, depreciation and the domestic production activities deduction, less the cost of goods sold and total deductions.
- **Total revenue**: Total revenue is reported on Line 1c on Form 1120 and 1120-S.
- **Profit margin**: Profit margin is the ratio of operating profit to revenue.
- **Sales growth**: Sales growth as the year-on-year percent change in gross receipts.
- **Firm age**: The difference between the tax year and the date of incorporation, reported on Form 1120 Box C or Form 1120-S Box E.
- **Multinational**: The multinational indicator variable equals one if a firm has foreign tax credits, or has an information return of U.S. persons with respect to certain foreign corporations (Form 5471) or partnerships (Form 8865) attached to the corporate tax return.
- **NAICS industry codes**: Reported on Schedule K of Form 1120 and Schedule B of Form 1120-S
- **Physical capital expenditures**: Physical capital expenditures is computed as the sum of the value of property placed in service, reported in line 19 of Form 4562, special depreciation allowances reported on line 14 of Form 4562, and ADS property reported on line 20 of Form 4562. The value of property placed in service includes property that depreciates at 3, 5, 7, 10, 15, 20 and 25 years, residential and nonresidential investment.
- **R&E expenditures**: Qualified research expenditures are reported on Form 6765. Over our sample period, there are several alternative methods from which firms can choose to compute QREs that are eligible for the credit: (1) the regular credit method (Line 9); (2) the alternative simplified credit method (Line 53); and (3) the alternative incremental credit method (Line 28). We take the maximum value of QREs across these methods.

## Appendix B. Comparison to Asker et al. (2015)

The paper in the existing literature that is arguably closest to our is Asker et al. (2015)–hereafter AFL. AFL combine data on public firms from Compustat with data from Sageworks, which is comprised of accounting data from a non-random sample of private firms that are clients of a set of national and regional accounting firms. In contrast to our study, the authors estimate that public firms invest *less* than a matched sample of private firms. In this Appendix, we explore the two key possible explanations for our differing conclusions.

First, differences in data sources could explain, at least in part, the differences between our results and theirs. Measures of firm investment, sales, and assets could differ simply due to differences in how these variables are collected. These differences could arise between tax data and Compustat, Sageworks, or both. In addition, the definitions and reporting procedures for various income and investment measures may differ between Compustat and Sageworks. Most importantly, the Sageworks data do not include R&D expenditures, and so measures used to compare investments between public and private firms are derived only from capital expenditures; yet, R&D is precisely the category of investments that drive the larger investment by public firms that we document. Our results for physical capital relative to the share of lagged total assets (column 2 in Table 2) is the most comparable to the main investment measure used in AFL. Our point estimate in Panel B is negative, consistent with their finding, though economically small and statistically insignificant.

The second main difference is methodological. AFL implement a single nearest-neighbor propensity score matching strategy, whereas we use DFL-weighting methodology on a subsample of firms that meet the size restrictions following Yagan (2015). The goal of both of our approaches is to construct within-industry samples of public and private firms that are observationally similar in their size distributions. However, the single nearest-neighbor matching approach uses a significantly smaller

[25] Bernstein (2015) addresses this endogeneity by instrumenting for the decision to IPO using a measure of stock market performance. In results not shown, we re-examine this strategy and find that the identifying assumptions are invalid in our time period.

**Table B.1**
Public vs private investment: single nearest-neighbor matching.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | Share of Lagged Total Assets | | | Share of Total Investment | |
| | Total Investment | Physical Capital | R&D | Long-Term Physical Capital | R&D |
| Public | 0.014 | 0.001 | 0.013 | 0.081 | 0.109 |
| | (0.002) | (0.001) | (0.001) | (0.007) | (0.007) |
| Observations | 54,227 | 54,227 | 54,227 | 54,227 | 54,227 |
| R-squared | 0.059 | 0.057 | 0.103 | 0.178 | 0.218 |

*Note*: The dependent variable in columns (1)–(3) is equal to total investment, physical capital investment, and R&E expenditures, respectively, scaled by lagged total assets. All specifications control for a 4th degree polynomial in firm age, profit margin, interest paid, tangible asset deciles, a multinational dummy, and S Corp dummy. All models include year and 2-digit NAICS code fixed effects, and an unreported constant. Standard errors clustered by EIN. Data are winsorized at the 99th percentile.
Source: U.S. Internal Revenue Service, Office of Tax Analysis, Statistics of Income (SOI) Corporate tax return files.

sample because public firms, which represent a small share of U. S. firms, are matched to exactly one private firm in each year, and multiple public firms may be matched to the same private firm.

Table B.1 reports results when we use the weighting scheme of AFL. We match public firms to a single nearest-neighbor based on total assets in the base year, here 2005, within the two-digit NAICS code and maintain the same public–private firm match throughout our analysis whenever possible. If the private firm leaves the sample (perhaps due to sampling or a change in private firm status), the public firm is re-matched to a new private firm. Across the board, point estimates are consistent with our baseline analysis. Public firms invest more than private firms in total investments as a fraction of lagged total assets (column 1), driven by R&D investments (column 3). Column 2 is most comparable to AFL, and while the sign flips to positive as compared to column 2 of Table 2, it remains statistically insignificant at any conventional level of significance. These results suggest that differences in methodology likely do not drive the differences in our results; these more likely come from compositional differences in estimation samples or differences in the measurement of investments.

## Appendix C. Methodological details of short-termism analysis

Theory suggests that short-term biases in investment decisions should be stronger for public firms whose future share prices are more responsive to current performance measures (Stein, 1989). Following the accounting literature, we proxy for this share price sensitivity using earnings response coefficients (ERCs). In this Appendix, we describe how we compute ERCs.

ERCs are the estimates of $\eta_1$ from the following regression:

$$\mathrm{AR}_{it} = \eta_0 + \eta_1 \mathrm{UE}_{it} + \varepsilon_{it}. \quad (3)$$

In this regression, *AR*, represents abnormal stock returns, defined as the three-day stock return centered around an earnings announcement date less the three-day return on the S&P 500. We compute *AR* using data from the Compustat-CRSP merged database containing dates of quarterly earnings announcements and the CRSP daily stock file. The variable *UE* represents unexpected earnings, defined as the difference between the actual earnings per share ($\mathrm{EPS}_{it}$) and the analyst consensus prediction of $\mathrm{EPS}_{it}$. The consensus prediction is calculated as the median outstanding analyst EPS prediction prior to an earnings announcement using data from Thomson Reuters Institutional Brokers' Estimate System.

Eq. (3) is estimated using public firms at the industry-year level. If $\widehat{\eta_1} = 0$, then there is no statistical relationship between stock prices and earnings news, but as $\widehat{\eta_1}$ increases, stock prices become more sensitive to earnings news. In this way, ERCs represent the responsiveness of share prices to earnings surprises, and proxy for the average extent of shareholder pressures that public firms in a particular industry and year face. To reasonably assume that firms do not have direct control over the industry-level ERC, we focus on industry-year pairs that contain at least 10 observations.[26] We apply this industry-year specific *ERC* to private firms to represent the shareholder pressures these private firms would face if they were public.

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[26] This is the same restriction used in Asker et al. (2015).

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