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The Long and the Short of It: Do Public and Private Firms Invest Differently?*

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Abstract

Using data from U.S. corporate tax returns, which provide a sample representative of the universe of U.S. corporations, we investigate the differential investment propensities of public and private firms. Re-weighting the data to generate observationally comparable sets of public and private firms, we find robust evidence that public firms invest more overall, particularly in R&D. Exploiting within-firm variation in public status, we find that firms dedicate more of their investment to R&D following IPO, and reduce these investments upon going private. Our findings suggest that public stock markets facilitate greater investment, on average, particularly in risky, uncollateralized investments. *JEL Codes:* G31, G34.
Keywords: Investment, public firms, corporate governance.

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1 Introduction

In the United States, large and liquid stock markets play an important role in channeling capital from savers to firms. This market-based system facilitates the financing of large, risky investments by distributing risks among many smaller investors, but may also have significant costs.[1] For example, small, dispersed shareholders may have little incentive to monitor and discipline a firm's managers when they stand to capture only a small share of the potential benefits, preferring to free-ride on the efforts of others (Stiglitz 1985). Stock market liquidity may also discourage shareholder monitoring by making it easier to simply exit by selling shares (Bhide 1993). Finally, in equilibrium, there may be too little monitoring, and managers may pursue objectives other than maximizing shareholder returns, such as consuming excessive perks (Jensen and Meckling 1976), building unnecessarily large empires (Jensen 1986), or merely living a quiet life (Bertrand and Mullainathan 2003).

Among the most prominent alleged shortcomings of public ownership is the short-term bias that it is said to induce. Under the so-called "myopia hypothesis," managers of public firms forgo profitable, long-term investment opportunities because of pressure from shareholders to improve short-term financial results.[2] The anecdotal examples of Michael Dell and Richard Branson taking their firms private ostensibly to invest more in long-term goals are oft-cited and loom large. In addition, CEOs of public firms 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

[1] An alternative system for financing capital investments is bank-financing, where banks play a primary role by collecting deposits from households and lending them to firms. This system is more prevalent in other developed economies, such as Germany and Japan. A large literature has debated the relative merits of bank-based and market-based financial systems, summarized in Allen and Gale (2001), Levine (2005).

[2] An August 15, 2015 article in the *The Economist* provides representative example. See http://www.economist.com/news/finance-and-economics/21661027-short-termism-may-be-caused-way-investors-employ-fund-managers-new.

short-run earnings forecasts (Graham, Harvey, and Rajgopal 2005). Here we compare the investment behavior of public and private firms to understand if the potential for short-termist thinking leads public firms to under-invest relative to private firms as prior empirical work suggests.

The main contribution of this paper is to utilize a previously untapped data source to show that public firms actually invest more than comparable private firms, a result that is largely driven by spending on research and development (R&D). We draw on the IRS Statistics of Income (SOI) corporate tax return files between 2004 and 2015, which provide a large, stratified random sample of firms that is representative of the universe of U.S. corporate tax returns.[3] These data offer several key advantages over data used previously in the literature. First, these data include both public firms, which are often the focus of studies of corporate behavior because their financial data are publicly available, and importantly, a representative sample of private corporations, whose financial data are typically unobserved or reported under different standards. This feature of the tax data mitigates the bias due to non-representative private firm selection that may have beset previous studies. Public and private corporations face identical legal requirements to report taxable income, dispatching the concern that observed differences in behavior might actually reflect differences in data collection or reporting. Further, we are able to examine differences in investment behavior at an aggregate level, rather than focusing on a particular industry. Finally, the rich information contained in tax returns allows us to not only examine total investment, but to also construct new investment measures that distinguish between short-term and long-term physical capital investment, and between long-term physical capital expenditures and R&D. These distinctions are key to understanding the investment differences between public

[3]We will use the term firm and corporation interchangeably throughout the paper. Both refer to Business Entities filing a Form 1120 or 1120-S with the IRS and therefore exclude partnerships or sole-proprietorships.

and private firms. These data reveal that while public firms account for 30 percent of gross receipts, they undertake 45 percent of total investment and 60 percent of R&D expenditures.

We employ two empirical strategies to examine differences in investment behavior between public and private firms. First, we compare the investment decisions of public firms with those of a comparison group of private firms, controlling for a number of factors. Because publicly-traded firms are among the largest, we focus on corporations with assets between between one million and one billion dollars, and revenue between 0.5 million and 1.5 billion dollars. Even in this range, public and private firms still differ systematically in observable characteristics. For this reason, we re-weight the sample using the method of DiNardo, Fortin, and Lemieux (1996) to generate groups with similar within-industry size distributions.

We find that public firms invest substantially more than private firms. Relative to physical assets, publicly-listed firms invest approximately 48.1 percentage points more than privately-held firms. While this elevated investment level comes from a greater commitment to both long- and short-term assets, it is predominantly driven by long-term assets: public firms invest 6.5 percentage points more in short-term assets, and 46.1 percentage points more in long-term assets than their private firm counterparts. It is not simply that public firms invest more relative to their asset base and thus out-invest private firms, they also direct a greater share of their investment portfolios to long-term assets. Public firms allocate 9 percentage points more of their total investment dollars to long-term assets than comparable private firms. The long-term investment advantage of pubic firms over private firms largely stems from their outsized investments in R&D. Public firms invest 39.2 percentage points more in R&D expenditures relative to physical assets, and dedicate 11 percentage points more of their investment budgets towards R&D than private firms. The access to capital investment and the ability to spread risks among many small shareholders appears to facilitate heavier investments in R&D, arguably the riskiest of asset classes. All of these results are robust to alternative weighting schemes, to less restrictive sample definitions, and to changing our treatment of bonus depreciation allowances.

We also examine whether public firms in industries where stock prices are more sensitive to earnings surprises — the firms that should feel the strongest short-termist pressure — exhibit smaller investment advantages over private firms. Estimates suggest that firms in industries that are more sensitive to earnings announcements pull back their investments in long-term physical assets and innovation but invest more in short-term assets and physical assets. The overall investment advantage of being public, however, swamps this secondary effect for even firms in the most sensitive of industries.

Our second empirical approach focuses on the subset of firms that we identify as undergoing an initial public offering (IPO) during our sample period. We exploit the within-firm variation in public status to examine how investment decisions change under different ownership structures. We find that public firms do not alter their short-term investment relative to physical assets following an IPO. These firms do, however, increase their long-term investments, and particularly investments in R&D: firms increase their R&D-to-physical asset ratios by 34.5 percentage points, and their R&D-to-total investment shares by 17.1 percentage points. Using an event study framework, we show that this increase in R&D expenditures occurs immediately upon IPO and persists for at least 10 years. We also examine changes in investment behavior following stock market delistings: results are less precise, but generally point to a reduction in R&D investments upon going private. Overall, the empirical patterns that we document could be due to firms going public in order to access equity-financing for risky R&D investment, rather than a causal impact of access to equity markets. This is consistent with Brau and Fawcett (2006), which documents that managers report an important reason for undergoing an IPO is that they believe that access to external capital will reduce their cost of capital, though this is not the predominant reason provided. Regardless, these estimates indicate that public firms invest more overall, more in long-term assets, and particularly more in R&D than private firms.

Our findings stand in stark contrast to much of the empirical literature that examines the agency problems associated with public firms and their implications for investment decisions. In theory, short-termism can arise even with rational managers and investors if imperfect monitoring prevents public shareholders from distinguishing between profitable investments and wasteful spending (Stein 1989). This managerial short-termism can manifest as either under-investment or over-investment in long-term projects, depending on the nature of the information asymmetry between shareholders and managers (Bebchuk and Stole 1993). The nature of differences in the investment decisions of public and private firms is ultimately an empirical question, with prior work focusing on the tendency of public firms to invest less than private firms.

The main empirical challenge in this literature has been the lack of publicly-available data on private firms to serve as a comparison group for public firms. Early work focuses on firms that undergo an IPO, as they also report financial data from the years just prior to going public. This literature consistently finds declines in profitability or productivity post-IPO (Degeorge and Zeckhauser (1993), Jain and Kini (1994), Mikkelson, Partch, and Shah (1997), Pagano, Panetta, and Zingales (1998), Chemmanur, He, and Nandy (2010)). While this evidence supports the notion that agency problems arise when firms disperse ownership, Pastor, Taylor, and Veronesi (2009) shows that performance declines can arise from a simple learning mechanism where positive shocks to a firm's view of its future profitability lead it to go public, then mean-reversion leads to profitability declines post-IPO.[4]

Recent papers have taken various clever approaches to compare public and private firm behavior. Sheen (2016) uses data from chemical industry trade reports and finds that private chemical producers better time their investments to take advantage of demand shocks. Lerner, Sorensen, and Stromberg (2011) use patent data to document that firms undergoing leveraged buyouts (LBOs) register more important patents after going private, while Bernstein (2015) uses similar patent data to document declines in patent quality post-IPO. Edgerton (2012) uses data from corporate jet registrations and finds that jet fleet sizes decline when firms are taken private in LBOs, consistent with managerial overconsumption of perks among public firms. In the paper most similar to ours, Asker, Farre-Mensa, and Ljungqvist (2015) combine Compustat data with data from Sageworks, which collects accounting data for a non-random sample of private firms that are clients of a set of national and regional accounting firms. They find that public firms invest less than a matched sample of private firms, and that public firms also exhibit less sensitivity of investment to measures of investment opportunities like sales growth or Tobin's q. Notably, the Sageworks investment measures exclude expenditures on R&D, which drives the larger investment by public firms that we document.

Overall, we read the balance of the existing evidence comparing public and private firms as consistent with the notion that private firms invest "better" in various ways—in more profitable projects, in more innovative patents, in fewer managerial perks, and less myopically. There are exceptions to this pattern, however. For example, Bharath, Dittmar, and

[4] Another related literature estimates the discount rates applied to earnings at various horizons implied by firm market valuations, with mixed results. Where Miles (1993) finds larger discount rates applied to earnings at longer horizons in data from the UK, Satchell and Damant (1995) provide an alternative explanation for these findings that does not rely on myopia. Abarbanell and Bernard (2000) do not find evidence of myopia in more recent U.S. data.

Sivadasan (2010) use Census data on manufacturers and find no evidence that establishments increase their productivity after going private. Gilje and Taillard (2016) use data from natural gas producers and find that public firms respond more quickly to changes in gas prices and investment opportunities. Our analysis builds on these latter findings and shows that for a representative sample of corporations spanning a broad set of industries, public firm invest more than private firms. These results suggest that firms with access to capital markets are able to invest more and in particular invest substantially more in R&D — arguably the hardest to collateralize, and most uncertain investments.

2 Data

We use the IRS Statistics of Income (SOI) corporate tax return files for tax years 2004 through 2015. For each year, the SOI corporate sample includes a stratified random sample of roughly 100,000 firms. The samples include C corporations, S corporations, Real Estate Investment Trusts (REITS) and Regulated Investment Companies (RICs).[5] Sampling weights are provided so that the corporate sample is representative of the population of corporate firms in any given year.[6] The sampling weights are a decreasing function of total assets and gross receipts. Larger firms are sampled at higher rates, and sampling weights equal one for all firms with at least $50 million in assets.

Tax return data offer three key advantages over data that have previously been used to examine the investment decisions of public and private firms. First, and perhaps most importantly, the SOI sample contains both public and private corporations; this allows us to construct investment measures that are reported consistently across public and private

[5] S Corporations, REITs and RICs are pass-through entities.

[6] The target population is active corporations that are organized for profit.

firms, effectively eliminating the concern that observed differences in investment behavior may reflect differences in reporting requirements. Second, the SOI data provide a large, random sample that allows us to construct a compelling comparison group of private firms to serve as a counterfactual for public firms. All firms must file tax returns and, as such, tax return data is not subject to selection. Further, because the SOI sample is representative of all U.S. firms, we are able to examine aggregate differences between public and private firms, rather than focusing on a particular industry. Finally, the rich detail in tax returns allows us to distinguish short-term from long-term investments, and long-term investments in physical assets from investments in innovation. These distinctions are unavailable in many other datasets and allow us to investigate the investment differences between public and private firms more broadly than has been previously possible.

To determine whether a firm is publicly traded, we rely on two data sources. First, we utilize IRS Form M-3, which was introduced in 2004 and must be filed by all firms with over $10 million in assets.[7] Form M-3 requires that firms answer two questions: (1) whether they file a form 10-K with the Securities and Exchange Commission (SEC), and (2) whether any of the firm's voting stock is publicly traded. We deem a firm to be publicly traded if it answers affirmatively to either of these questions. Second, we augment the tax data with the Compustat-CRSP (????) merged files, which contain accounting information for all publicly traded firms. This supplemental data source is particularly important because Form M-3 is unavailable for firms that fall below the $10 million filing threshold; for this reason, we cannot use the tax data to identify smaller firms that are publicly traded. Therefore, we also deem a firm to be publicly traded in year t if we match it to a record in Compustat-CRSP by

[7]Some firms that fall below the $10 million asset threshold opt to file this form. The majority of these are firms that are historically over $10 million in assets but then fall below this threshold in a particular year.

its employer identification number (EIN).[8] We identify 5,533 public firms in 2004, declining to 4,806 by 2014 – figures that are consistent with external counts of public firms listed on stock exchanges. Based on this match, we find that public firms account for 30 percent of gross receipts in the U.S., and they are responsible for 45 percent of total investment and 60 percent of R&D expenditures.

We collect several variables from Form 1120 for C corporations and Form 1120S for S corporations. In particular, we gather measures of firm size such as total assets, gross receipts, and total income in addition to measures of profitability such as net income. We generate an additional measure of profitability, profit margin, following Yagan (2015). Our primary outcome variables are related to investment measures, and we gather much of this information from the balance sheet, or Schedule L. A detailed description of the tax form line items that correspond to each of our variables is provided in the Data Appendix. We construct an indicator variable for a firm being a multinational corporation (MNC) that equals 1 if that firm meets any of the following three conditions: (1) has foreign tax credits; (2) has at least one Form 5471 (the information return of U.S. persons with respect to certain foreign corporations) attached to their tax return; and (3) has at least one Form 8865 (return of U.S. persons with respect to certain foreign partnerships) attached to their tax return. All income variables are converted to real 2004 dollars using the CPI, and all annual measures are consistent with the SOI year concept.[9]

To provide a baseline description of the firms included in SOI data, the upper panel of Table 1 reports summary statistics for the sample in 2005, 2010 and 2015. Firms age some-

[8] We account for IPO year as Compustat-CRSP often contains firm information in the years leading up to an IPO. Thus, if the corporate sample firm matches to Compustat-CRSP in the years prior to its IPO, we count this firm as private.

[9] This latter adjustment accounts for the fact that roughly 30% of C corporations when weighted by gross receipts have a tax year that does not correspond with a calendar year.

what over the sample period with the average age climbing from 12.0 years in 2005 to 14.6 years in 2015. Profit margins remain stable, whereas many other financial measures decline between 2005 and 2010, reflecting the impacts of the Great Recession, before recovering by 2015. The lower panel of Table 1 highlights the raw differences between public and private firms. Not surprisingly, public firms are older and larger than private firms on average. In our empirical analyses, we restrict attention to non-financial C and S corporations, excluding RICs and REITs, as is standard in the finance literature.[10] We also exclude observations with negative tangible capital assets.

We construct our measures of investment based on reported depreciation allowances and from reported expenditures on qualified research activities, as is required for claiming the Credit for Increasing Research Expenditures, otherwise known as the R&D tax credit.[11] Total property investments are obtained using depreciation allowances reported on Form 4562, summing over property placed in service during the tax year using the general depreciation system or special depreciation allowances.[12] Because property under the general depreciation system is reported by asset life, we are able to differentiate short-term from long-term investments. We consider short-term investment to include any physical property with 3, 5, and 7 year lives; long-term investment includes any physical investment category with at least a 10 year depreciation allowance, residential and non-residential property, and R&D expenditures. Because bonus depreciation is not reported by asset life, we allocate these investments based on a firm's average distribution of general depreciation allowances

[10]This restriction is made because of the special organizational and tax status of these firms.

[11]Expenditures on qualified R&D come from Form 6765 (Credit for Increasing Research Activities). Over our time period, there are several alternative methods among which firms can choose to compute expenditures that are eligible for the R&D tax credit. We take the maximum value of qualified research spending across these computations.

[12]General depreciation allowances are reported in line 19 of Form 4562, which includes property that depreciates at 3, 5, 7, 10, 15, 20 and 25 years, residential and nonresidential investment. Special depreciation allowances are reported on line 14 of Form 4562.

between 2005 and 2007, years in which bonus depreciation had temporarily expired.[13] We test the sensitivity of the results to this assumption and find that the estimates are robust to alternative treatments. We compute total investment as the sum of property investments and R&D expenditures.

To examine whether public firms invest differently than private firms overall, we compute the ratio of total investment to lagged total tangible capital assets, where tangible assets is defined as depreciable assets minus accumulated depreciation (Sch. L line 10a less Sch. L line 10b). We also compute a version based on total investment excluding R&D; this variable is comparable to that used in Asker, Farre-Mensa, and Ljungqvist (2015). We similarly compute these measures for short-term investments, long-term investments, and R&D spending only. To examine whether public firms commit a higher share of their investment portfolios to long-term assets, we compute the fraction of total investment that is considered long-term. Because decisions over R&D and physical property may be different, we also examine the intensity of R&D expenditures and non-R&D long-term asset expenditures as a share of total investment or of lagged depreciable assets separately. There can be large outliers due to small denominators, so we winsorize all of our shares variables at the 98th percentile.[14]

[13] A natural question is whether public and private firms responded differentially to the statutory changes in the treatment of bonus depreciation. However, because bonus depreciation allowances are reported lump-sum, we are unable to differentiate between the short-term and long-term investments to which bonus depreciation applied.

[14] The exception is that we winsorize the R&D shares variables at the 98th percentile of the positive distribution of values because there are numerous firms that do not undertake R&D expenditures. Winsorizing on the full distribution loses much of the variation in these variables.

3 Empirical Framework

In the ideal empirical design, public status would be randomly assigned across firms. Then, we could directly compare investments of public and private firms without concern for the confounding impact of unobserved characteristics or selection into public status. Of course, we cannot randomize, and as such, the credibility of our results hinges on the comparability of public firms and the set of private firms that serve as the their counterfactual. However, as is clear from Table 1, public and private firms differ vastly along a number of dimensions. We employ two empirical strategies to overcome these differences; we describe these in turn.

3.1 Matched Firm Distributions

Our first empirical strategy compares the investment decisions of public firms with those of an observationally similar set of private firms. To obtain comparable distributions of public and private firms, we use the re-weighting methodology of DiNardo, Fortin, and Lemieux (1996) (DFL).[15] When there are two distinct groups, the goal of DFL is to re-weight the data so that the distribution of observable characteristics for the target group is the same as the distribution of observable characteristics for the base group. This re-weighting will ultimately hold the observables across the two groups considered fixed. Because public firms are much larger than private firms, we focus on the set of firms with assets between one million and one billion dollars, and revenues between 0.5 million and 1.5 billion dollars. This restriction narrows our set of firms so that we construct a more compelling comparison group of private firms. These income cutoffs are the same as those used in Yagan (2015),

[15] The DFL procedure that we utilize is similar to Yagan (2015), which re-weights S corporations so that their within-industry size distributions are comparable to C corporations in order to test whether these groups of firms responded differentially to the 2003 dividend tax cuts. In contrast, Asker, Farre-Mensa, and Ljungqvist (2015) use nearest-neighbor matching to estimate an average "treatment effect" of being public.

but we additionally exclude a firm if it is ever observed to fall outside of these ranges over our sample period to protect the integrity of the panel. In Section 5.3, we show that our main conclusions are robust to using the full sample of firms. Our final estimation sample comprises roughly 2.7 million firm-years, representing a population of about 1.5 million S corporation and 1.1 million C corporation firm-years.[16]

To implement DFL, we first bin our sample of firms by their SOI industry code, and we use public corporations as our base group in each year. We then construct weights so that the distribution of firm size for the target group (i.e., private firms in industry j in year t) more closely matches the distribution of firm size in the base group (i.e., public firms in industry j in year t), where "size" is computed as the the average of one and two year lagged gross receipts.[17] The re-weighted data yields year-specific size distributions of public and private firms within the same industry group. Our final weights are computed as the product of the resulting DFL weight and firm size, so that the estimates are representative of the size of economic activity.

We illustrate the effect of using DFL weights in Figure 1. Panel (a) presents the unweighted distributions of average gross receipts for public and private firms. This figure highlights the differences underlying public and private firms: unlike public firms, there is a large mass of small, private firms. Panel (b) shows the effect of employing DFL weights: small private firms are down-weighted so that the distribution of private firms more closely mimics that of public firms. Note that, by definition, DFL weights are equal to one for public firms. In panel (c), we additionally weight both public and private firms by firm size. The two distributions are virtually identical. We use this DFL-size weights for our baseline

[16] Approximately 5% (or 0.8% of the SOI-weighted sample) of firm-years are defined to be public – roughly 2,400 in 2004 and declining to just under 1,700 by 2014.

[17] When gross receipts from two years prior is not available the one-year lagged value is used.

analysis, which yields distributions of public and private firms that are arguably comparable. We show, however, that our main results are robust to alternative weighting schemes.

Table 2 presents means and standard deviations for the sample of public and private firms using the DFL weights. The first four columns present summary statistics for the DFL-size weighted sample. Comparing the average investment behavior of public and private firms reveals a clear pattern that previews our regression results.[18] Public firms invest more than private firms in terms of total dollars, and as a share of total assets. In addition, public firms invest more in all asset classes, but especially in R&D. Public firms and private firms also display markedly different investment priorities. Private firms dedicate 25% of their investment dollars to long-term assets, whereas public firms dedicate 34% of their investment dollars to long-term assets. Public firms direct 18% of their investment budgets to R&D, compared to just 7% among private firms. For comparison, the rightmost panel shows summary statistics for the SOI-weighted private firm sample. Without re-weighting the data, the summary statistics reveal much larger differences in investment propensities across public and private firms. Even the weighted means, of course, mask underlying differences between public and private firms such as the industries in which they operate, profitability or debt levels that may also affect investment choices. To better control for these sources of heterogeneity, we utilize our regression framework.

We evaluate whether public and private firms invest differently by comparing the investment behavior of public firms relative to a comparable set of private firms. Specifically, we

[18]We separately report special depreciation allowances in this table. These are included in our total investment measures, but we have not allocated these allowances into short-term and long-term investments for purposes of reporting means and standard deviations. These amounts are allocated into our shares measures, however.

estimate regressions of the following form:

$$Y_{it} = \alpha + \beta PUBLIC_{it} + X'\gamma_{it} + \delta_j + \mu_t + \epsilon_{it}, \tag{1}$$

using DFL-size weights. In this specification, Y is an investment measure of interest, $PUBLIC$ is a binary indicator for being a public firm, and X contains a number of firm characteristics: a quadratic in firm age, lagged asset deciles, profit margin[19] and binary indicators for S-corporations and MNCs.[20] 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. In regressions where the dependent variable is computed as a 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 δ_j contains industry fixed effects, constructed using two-digit NAICS industry codes, and the vector μ_t contains year fixed effects. Thus, our framework yields within-industry comparisons, controlling non-parametrically for the evolution of average investment rates across all firms. The coefficient of interest, β, reveals how the investment behavior of public firms differs from that of comparable private firms, on average. Standard errors are clustered at the firm level.

3.2 Within-Firm Changes in Public Status

In the matched sample analysis we are drawing comparisons across firms that may differ along many dimensions. Despite DFL weighting and employing a number of controls, results from

[19] Profit margin is defined as the ratio of operating profit to revenue.

[20] Exactly balanced data means that controlling further for X is unnecessary because it is unrelated to the treatment variable, and so a simple difference in means on the matched data can estimate the causal effect; approximately balanced data require controlling for X with a model (such as the same model that would have been used without matching), but the only inferences necessary are those relatively close to the data, leading to less model dependence and reduced statistical bias than without matching.

the above analysis may still be attributable, at least in part, to differences in unobservable characteristics between public and private firms. We can, however, focus on a smaller set of firms that switch from private to public status during our sample period — the set of firms that issue an initial public offering (IPO) — to understand how access to public markets affects the investment decisions relative to the *same* firm's behavior when it was private.

We determine that a firm has gone public using a multi-step procedure. First, we use data from the Center for Research in Security Prices (CRSP) database, which provides information on IPO dates. Second, we use the Thomson-Reuters (2018) SDC database which tracks equity capital market new issues. Finally, we use the IRS data to verify that a firm is indeed public in each year after its IPO using our methodology described in Section 2. This verification will identify firms that are taken private again in the years after their IPOs. This procedure yields 617 IPOs between 2005 and 2014.[21]

We run regressions of the following form:

$$Y_{it} = \alpha_0 + \eta POST_{it} + X'\gamma_{it} + \delta_i + \mu_t + \epsilon_{it} \tag{2}$$

where i indexes firms, t indicates tax year, and $POST$ is an indicator variable set equal to one in year that a firm undergoes an IPO and after. Year fixed effects, μ_t, and firm fixed effects, δ_i, control non-parametrically for the overall evolution of R&D investment shares and unobserved time-invariant differences across firms, respectively. The vector X' includes a fourth degree polynomial in firm age, indicator variables for S-Corporations and MNCs, lagged physical asset deciles, profit margin, interest deductions, and a zero investment

[21] Our matched sample analysis focuses on a narrow band of assets and revenues to aid in the match quality of public and private firm size distributions. Here, we compare within-firm investment behaviors, so do not impose a similar size restriction. We exclude IPOs in 2015 because we do not have post-IPO years for these firms.

dummy. The regression is weighted by firm size. The coefficient of interest is η, which captures the change in investment choices following a change in public status.

To examine the evolution of investment choices through a firm's IPO, we also perform an event-study version of the above analysis as follows:

$$Y_{it} = \alpha_0 + \sum_{\tau=-8}^{-2} \eta_\tau + \sum_{\tau=0}^{10} \eta_\tau + X'\gamma_{it} + \delta_i + \mu_t + \epsilon_{it} \tag{3}$$

where τ denotes years relative to the IPO year. Because firms IPO in different years, we can separately identify the vector η_τ and year fixed effects. The vector X' includes the same controls as in Equation 2, except for the level of firm age. The parameters of interest are contained in the vector, η_τ. Coefficients where $\tau < 0$ correspond to years prior to a firm's IPO, while coefficients where $\tau > 0$ correspond to years after the IPO year; τ_0 corresponds to the IPO year.[22] The omitted category is η_{-1}, so that the estimated η_τ coefficients capture investment relative to that in the year just before a firm's IPO. The regression is weighted by firm size.

We provide summary statistics for firms included in the IPO sample in Table 3. Because we identify all firms that switch between private and public status across the full size distribution, firms in these analyses are larger along multiple dimensions than in our previous empirical design. Firms have more physical capital, and invest more when they are public than when they are private. Public firms are able to more easily issue publicly-traded debt, which may account for the dramatic growth in interest costs post-IPO. As a share of physical capital, firms invest more in long-term investment post-IPO on average and this disparity arises largely from differences in R&D spending. This pattern is mirrored in the rise in the

[22]Note, we lump 9 and 10 years prior to an IPO into the same category as 8 years prior due to the very small number of observations. Thus, we assume that years 8–10 prior to an IPO are equivalent, on average.

R&D investment budget share following an IPO. These means subsume any other differences in the firms we observe through a change in public status; our regression analysis will focus on within-firm comparisons to estimate the difference in investment spending associated with these changes.

3.3 Interpreting Estimated Coefficients

If short-termism leads public firms to invest less than private firms, we would expect $\beta < 0$ and $\eta < 0$. The accounting literature documents numerous examples where managers of public firms sacrifice cash flows or alter real decisions in order to improve their accounting earnings or short-run stock prices. For example, Erickson, Hanlon, and Maydew (2004) report that their sample of 27 firms paid a total of \$320 million in real cash taxes on earnings that were later alleged to be fraudulent. In what is known as "real earnings management" firms may also reduce their real spending on activities like R&D to avoid reporting accounting losses (Baber, Fairfield, and Haggard (1991), and Dechow and Sloan (1991)). Public firms may face other factors impeding investment such as weaker corporate governance due to small disparate shareholders relative to closely held private firms.

On the other hand, the advantages of being a public company may facilitate more or larger investments, leading public firms to out-invest similar private firms. For example, public firms may face lower costs of capital because their investor bases consist of small shareholders who can more easily diversify any idiosyncratic risk. Gilje and Taillard (2016) document that oil and gas firms report that they use their IPO to fund capital expenditures, and so the choice to become public may be strategically timed with anticipated investment increases. Additionally, public equity and debt markets may more readily finance highly uncertain investments not backed with assets, such as R&D.

Because public and private firms may differ on a host of dimensions, our estimates subsume a variety of factors affecting investment decisions. Like prior papers that examine how investment behavior differs between public and private firms, we cannot directly test for any of these competing theories in isolation. Our estimates assess whether, *on net*, the pressures against public firm investments (e.g., short-termism) dominate or are overcome by the potential benefits of access to equity capital markets.

4 Results

4.1 Matched Sample Results

Table 4 presents estimates of β from equation (1). In Panel A, our investment measures are scaled by the lag of physical assets. We find that public firms invest more than private firms overall: a publicly-listed company will invest roughly 48.4 percentage points more than a privately-held firm with a similar asset base (column 1). Relative to the average investment by private firms (Table 1), public firms invest 67% more in total investment than private firms. This result stands in contrast to Asker, Farre-Mensa, and Ljungqvist (2015), which finds investment patterns consistent with the short-termism of public firms.[23] However, as previously noted, our investment measure includes R&D, which they are unable to measure in their data. In column (2), we remove R&D from total investments and again find that public firms out-invest private firms. This advantage is muted, with public firms investing 7.6 percentage points more than their private counterparts. Columns (3) and (4) show that although public firms invest more in both short-term and long-term investment, this is much

[23]Note that Asker, Farre-Mensa, and Ljungqvist (2015) report that including R&D expenditures for public firms in their analysis does not close the investment gap between public and private firms.

more pronounced for long-term investments. On average, public firms out-invest private firms by more than 200% (46.1 percentage points) in long-term assets, but only 14.1% (6.5 percentage points) in short-term assets.

Because investments in innovation and long-lived physical assets differ substantially in risk profiles, the ability to diversify risk among many small shareholders may yield differential benefits across these types of assets. Column (5) shows that nearly the entire advantage in long-term investments by public firms comes through the R&D channel. Public firms out-invest private firms in R&D by nearly 200% on average (39.2 percentage points). Despite the earnings pressures that public firms may face, access to capital markets appears to make public firms particularly successful at financing riskier R&D investments.

Our results on long-term investment may reflect that public firms simply invest more than private firms, and thus out-invest private firms when it comes to long-term capital. Panel B shows that this is not the case: public firms commit a greater share of their total investments to long-term assets, and particularly to R&D. Public firms dedicate 35.2% (8.8 percentage points) more of their investment budgets to long-term assets, on average, than private firms. This higher share of long-term investment is driven almost entirely by a greater R&D investment share among public firms. Public firms invest 11.1 percentage points more of their investment budgets in R&D, a 159% increase relative to the average investment of private firms. These magnitudes of the investment intensities of public firms over private firms are quite large. However, public and private firms may differ along unobservable characteristics that may bias these estimates away from the true effect of being a public firm.

These estimates provide evidence on the investment advantage of public firms over private firms *on average*. However, investment differences by public status could vary systematically across industries. In theory, the short-term investment pressures that public firms face are a function of the degree to which future share prices react to current performance measures (Stein 1989). Prior work proxies for these myopic pressures using estimated earnings response coefficients (ERCs) that measure the responsiveness of stock prices to earnings surprises. Asker, Farre-Mensa, and Ljungqvist (2015) estimate ERCs at the industry-year level and find that as industries are more responsive to market reactions, public firms are less sensitive to market opportunities than private firms; however, these results are not statistically significant. Gilje and Taillard (2016) find that the oil and gas industry is less myopic, which may explain why they find that public firms invest more than private firms in their context.

To examine whether there is a relationship between the short-term pressures that public firms face and the extent to which they invest differentially from private firms, we estimate ERCs as in Asker, Farre-Mensa, and Ljungqvist (2015). We run regressions at the industry-year level, given by:

$$Abnormal\_Returns = \eta_0 + \eta_1 Earnings\_Surprise + \varepsilon, \tag{4}$$

where *Abnormal_Returns* is defined as the three-day stock return centered around an earnings announcement date less the three-day return on the S&P 500, and *Earnings_Surprise* is defined as the difference between the actual earnings per share (EPS) and the analyst consensus prediction of EPS. We compute *Abnormal_Returns* using data from the Compustat-CRSP merged database containing dates of quarterly earnings announcements and the CRSP daily stock file. The analyst consensus prediction over performance is calculated as the median outstanding analyst EPS prediction prior to an earnings announcement using data from Thomson Reuters Institutional Brokers' Estimate System (IBES). We focus on industry-years that contain at least 10 observations. The coefficient η_1 captures the relationship between stock prices and earnings news within an industry and year: if $\eta_1 = 0$, then there is no statistical relationship between stock prices and earnings news, but as η_1 increases, the more sensitive are prices to news over earnings. These estimates of η_1 are proxies for ERCs.

Using these estimates of ERCs, we add interaction terms into equation 1:

$$Y_{it} = \gamma_0 + \gamma_1 PUBLIC_{it} + \gamma_2 \widehat{ERC}_{jt} + \gamma_3 PUBLIC_{it} \times \widehat{ERC}_{jt} + X'\gamma_{it} + \delta_j + \mu_t + \epsilon_{it}. \quad (5)$$

Results from these regressions are presented in Table 5. Because $\widehat{ERC}$ and $\widehat{ERC} \times PUBLIC$ are generated regressors, we bootstrap the standard errors on their estimated coefficients. When $\eta_1 = 0$, when there should be no investment distortions due to short-termism, public firms invest more than private firms, on average. The coefficients on $PUBLIC$, which are quite similar to results in Table 4, indicate that when $ERC = 0$, public firms have an investment advantage over private firms in all investment measures.

The coefficients on $\widehat{ERC} \times PUBLIC$ suggest that short-term pressures are important; the exception is that this variable is not statistically significantly related to total investment as a share of lagged physical assets. As industries become more responsive to earnings announcements, long-term investments and R&D expenditures fall. These findings suggest that short-term performance pressures reduce investments in these assets that depreciate slowly or may take time to generate returns. However, because the 95th percentile of the ERC distribution is 0.031, these reductions in long-term investments and R&D are not large enough to overcome the baseline investment advantage of public firms. For short-term investments and total investments less R&D, a greater responsiveness to market pressures is related to public firms investing even more than their private counterparts.

4.2 Changes in Public Status

Table 6 reports estimates from equation 2. Panel A shows that following IPO, overall investment, investment in physical capital, and short-term investment as a share of lagged total physical capital, do not change in a statistically discernible way. Investments in long-term assets and in R&D, on the other hand, show a significant increase in the years after IPO. Firms increase their long-term investments by 51.6 percentage points, and much of the increase is attributable to R&D spending: going public is associated with a 34.5 percentage point increase in R&D investment as a share of lagged physical assets. As a share of total investment, R&D significantly increases by 16.9 percentage points after IPO (Panel B).

Figure 2, which plots the η_τ estimates of equation 3 for the share of total investment in R&D expenditures along with 90% confidence intervals, reveals a striking pattern. The years prior to IPO are not statistically different from the year immediately before an IPO. However, firms immediately invest more in R&D upon their IPO, and the elevated R&D investment share persists. R&D investment shares remain statistically significantly elevated 10 years later, although these estimates are less precise.

Exploiting within-firm variation in public status, we find that firms invest more in long-term assets upon going public – particularly in R&D. The ability to access equity capital boosts investment in intangible assets, but not the types of physical assets that could be used as collateral in bank- or other debt-financing. This association could be attributed to firms going public when they want to equity-finance risky R&D investments, rather than a causal impact of the availability of equity financing. Nevertheless, either story substantiates that the attributes of going public facilitate the undertaking of R&D investments, which thanks to spillovers can have impacts on the broader economy (Aghion and Howitt 1996).

A similar analysis can also be done with public firm delistings. We determine that a firm has gone private by identifying instances where the public indicator variable based on the tax data, as determined using our methodology outlined in Section 2, switches from one to zero. This definition requires that a firm files a tax return but is not deemed a public firm in the year of its delisting to ensure that the change in status was not due to a cease in operations or a merger.[24] This procedure yields 558 delistings between 2005 and 2015. Because firms do not continue to provide financial information in publicly available datasets after they go private, to our knowledge, delistings have not been used to examine changes in firm investment behavior under different ownership structures.

Figure 3 presents estimates of how the R&D expenditures share of total investment evolves after going private. The figure shows a fairly clear decline in R&D expenditures post-delisiting. And, indeed, in the simple comparison between the pre and post delisting year, firms invest less in R&D after delisting. However, this result is not significantly significant at conventional levels (the estimated coefficient is -0.014, with a standard error of 0.012).[25]

5 Robustness Tests

5.1 Robustness to Alternative Weighting Schemes

Interpreting our matched sample results as evidence of the differences in investment choices between public and private firms turns crucially on our ability to construct a compelling comparison group of private firms. The DFL-weighting scheme we use is well-known and

[24]It is possible that a firm has filed for bankruptcy, but we are unable to detect bankruptcy using a tax return.

[25]Regressions akin to those presented in Table 6 yield largely statistically insignificant estimates. The only exception is that the estimates reveal a statistically significant 5.3 percentage point reduction in investments excluding R&D relative to physical assets following delisting.

used extensively in the labor economics literature and other fields.[26] Alternative weighting schemes, however, could be employed. We examine the robustness of our results to two alternative matching methods. As with our baseline specification, final weights are computed as the product of the alternative methodology weight and firm size.

The first alternative weighting scheme that we use is nearest-neighbor matching with replacement. Under this weighting scheme, each public firm is matched to a single private firm with the same five-digit NAICS code based upon tangible capital assets in a base year, here 2005. We maintain the same public-private firm match throughout our analysis. If the private firm leaves the sample (perhaps due to sampling or change in private firm status), the public firm is rematched to a new private firm. Analysis using nearest-neighbor matching uses a smaller sample because public firms, which comprise only a small share of the full SOI sample, are matched to exactly one private firm in each year, and multiple public firms may be matched to the same private firm. Nearest-neighbor matching is less efficient than DFL weighting because the latter retains all firms. This alternative weighting scheme is similar to that used in Asker, Farre-Mensa, and Ljungqvist (2015).

The second weighting scheme is entropy balancing weights. This methodology re-weights the data to match the covariate distributions of the target group based on a set of specified moment conditions. We balance the data based on the first moments of firm size, income, salaries paid, and age distributions within each tax year. Thus, rather than re-weighting private firms to match the within-industry size distribution of public firms, we re-weight private firms to match the within-year means of several attributes of public firms. This weighting scheme retains all of the observations used in our DFL-weighted estimates.

[26]For example, Yagan (2015), which examines the impact of the 2003 dividend tax cut on corporate investment and employment, uses the DFL weighting method to construct a comparison sample of S corporations that matches the size distribution of the C corporations that are the subject of the analysis.

Table 7 reports results using these alternative weighting schemes. Panels A and B present results for our dependent variables scaled by lagged physical capital, and panels C and D present results for dependent variables measured as a share of total investment. Across the board, point estimates are consistent with our baseline analysis. Public firms invest more than private firms in total, and both short- and long-term assets. R&D also drives much of the increased investment by public firms. Point estimates obtained using nearest-neighbor matching are somewhat smaller, and because they use a much smaller sample, we sometimes lose statistical power. Estimates obtained using entropy balancing weights are generally larger than those using either DFL or nearest-neighbor matching. These estimates suggest that public firms invest 16.2 percentage points more in short-lived assets, and more than twice as much in long-term investments relative to physical assets. Public firms also invest 11.2 percentage points more of their investment budgets in R&D. Regardless of which weights are used, we consistently find that public firms out-pace private firms in investments, and particularly in R&D expenditures.

5.2 Robustness to Treatment of Bonus Depreciation

As described in Section 2, we may mis-measure short-term and long-term investments in years with bonus deprecation because these allowances are not reported by asset life. In the baseline results we allocate these investments based on a firm's average distribution of general depreciation allowances between 2005 and 2007, years in which bonus depreciation had temporarily expired. For example, if a firm invests 40% of its total investment in short term assets between 2005 and 2007, we allocate 40% of its bonus depreciation line to short term assets in all other years. We test the sensitivity of our results to this assumption in two ways: (1) by running our analysis on 2005-2007 only, and (2) by adjusting our definition of short term to include all asset lives up to 20 years–the maximum allowed by the bonus depreciation rules–and long term to be all investment in longer-lived assets. In this latter scenario, all bonus depreciation is allocated to the short-term investment category.

In Panels A and C of Table 8, we estimate Equation (1) using data from 2005 through 2007 only — the tax years in our sample period when there was no bonus depreciation. All of these results are quite similar to the baseline results in economic and statistical significance; none of the estimates are statistically different from our baseline results. In Panels B and D, we redefine short-term assets to include all assets with lives up to 20 years – the maximum asset life allowed under bonus depreciation rules. This definition effectively treats all assets that could qualify for bonus depreciation as short-term assets. To the extent that public firms utilize bonus depreciation allowances on assets with lives between 10 to 20 years, this specification biases us against detecting a higher rate of long-term investment among public firms. The estimates under this alternative treatment of bonus depreciation allowances are even more similar to the baseline estimates.

5.3 Robustness to Sample Selection

We examine the robustness of our results to several sample selection criterion. First, not all firms claim the R&D tax credit. Firms report R&D expenditures on Form 6765 (Credit for Increasing Research Activities), which calculates a firm's R&D tax credit as a percentage of eligible research expenditures above some base amount. Firms are most likely to report their research spending in years when they qualify for the R&D tax credit. Qualifying firms may also fail to report their eligible expenditures because they either are unaware that they qualify for the R&D tax credit, or because the costs of learning the tax and accounting rules related to the credit are too high. This type of selection may affect smaller firms more, which would upward bias our estimates of the public firm effect on R&D. We restrict our sample to firms that report some R&D expenditures in at least one year, dropping the vast number of firms that never report R&D. This sample of firms restricts attention to firms with the requisite expertise to fill out Form 6765. Results for the "ever R&D" sample are presented in Panels A and B of Table 9. We find estimates that are largely in line with our baseline results. As a share of total investment, the estimated public effect of R&D expenditures is nearly identical to those found in our main sample.

Second, we examine the robustness of our matched sample results using the full sample of firms unrestricted by assets or revenue. Panels C and D of Table 9 show that even in the full sample, where the DFL-weighted size distributions of public and private firms are less similar, our results are largely consistent with the baseline.[27] Interestingly, the differences in total investment less R&D are much smaller and statistically insignificant. The differences in long-term investment and R&D expenditures between public and private firms remain substantially and statistically significant. Moreover, the estimates in Panel D suggest that public firms lean even more heavily toward R&D when allocating their investments across asset classes.

Lastly, we examine the robustness of our IPO results to using the same size restrictions that we impose in our matched sample analysis in Table 10. The rationale for using a narrow revenue and asset range for our matched sample analysis was to aid in constructing comparable groups of public and private firms. For our IPO analyses, we do not impose such restrictions because we exploit within-firm variation in public status. Not surprisingly, the sample size is much smaller, cut roughly in half, and comprise the set of firms that remain within the specified income range over the sample period. As a share of physical assets, we

[27]We still exclude financial firms, and drop observations with negative physical capital assets. We re-calculate DFL weights using this full sample of firms.

find that these firms show an even stronger increase in investment following an IPO. Total investment increases by 80.7 percentage points and this effect is statistically significant. This increase is driven by both long-term physical capital and R&D. These increases do not translate into a reallocation of investment budgets, however.

6 Conclusions

In recent years, the concern that shareholders' focus on short-term performance induces public firms to forego profitable investment opportunities has become more prevalent. To this debate, we bring new evidence using administrative tax return data. Because our sample is representative of the universe of U.S. corporations, and because these firms detail their investments based on identical reporting requirements, we are able to make broad comparisons of investment behaviors by public and private corporations. In contrast to the myopia hypothesis, we find robust evidence that public firms invest significantly *more* than private firms, and that this overall investment advantage stems largely from commitments to R&D investment. Our results are broadly consistent using our two identification strategies: (1) comparing the investment choices of public firms and a re-weighted sample of private firms that match the industry-specific size distribution of public firms; and (2), comparing the investment choices using within-firm variation in ownership structure around an IPO.

The returns to R&D investment are highly uncertain. In addition, because the majority of this spending goes to the wages and salaries of research employees, these investments are largely unsecured by collateral, raising the cost of capital. That public firms invest more in R&D than private firms suggests that diversified public ownership somehow facilitates these risky, uncollateralized investments. Public status may not cause firms to undertake more research; instead, when a firm is poised to expand its R&D program, it could opt to IPO in order to access more cost effective financing for these projects. The strong association between public status and R&D investment repeatedly evidenced by our estimates is consistent with either interpretation, but is inconsistent with the notion that earnings pressure renders public firms so short-sighted that they on net forgo long-term investment.

Given the role that R&D plays in long-term growth and the potential for spillovers to other firms (Aghion and Howitt 1996), encouraging R&D spending has long been a priority for policymakers. In recent years, legislative changes have strengthened the federal Research and Experimentation credit, first by making it permanent and then indirectly through the corporate rate reductions in the Tax Cuts and Jobs Act of 2017.[28] Our results suggest that measures by policymakers or industry leaders that make it more difficult for firms to access capital through public markets would counter these legislative efforts and may reduce the R&D spending of U.S. firms.

Our findings shed light on the the trade-offs between the costs and benefits of public ownership, which is central to a number of current policy debates. In particular, they can inform recently proposed policy changes aimed at curbing short-termism that have appeared on both sides of the Atlantic. In France, rules grant long-term investors additional voting rights with the European Commission considering following suit. In the United States, the Delaware Supreme Court – which has an out-sized role in U.S. corporate law – has endorsed the idea that a firm's owners are those who have held shares for long durations rather than those who happen to own shares at a point in time. Meanwhile, Jamie Dimon of J.P. Morgan Chase and Warren Buffett of Berkshire Hathaway have led efforts among asset managers and

[28]Because firms cannot both claim the research tax credit and expense R&D expenditures, firms that claim the credit must forgo the tax deductibility of their R&D spending. By lowering the corporate tax rate, the 2017 tax bill increases the net subsidy for R&D granted by the credit.

corporate leaders to develop a set of principles to guide the governance of public companies with the aim of promoting long-term focus and investment. Our findings show that to the degree these concerns are merited, they are not so acute as to render public firms less able to invest than private firms. In fact, our results suggest that if the U.S. wants more investment and especially innovation investment, it wants more more public firms – even if short-termist pressures somewhat mute the large investment advantages of public ownership.

There is certainly more to be understood regarding the role of public ownership in investment decisions. 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. Using policy variation that enables or prevents firms from going public may allow future researchers to provide new evidence on this key question.

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Table 1: Summary Statistics

Panel A: Select Cross-Sections

	2005		2010		2015	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Total Assets ($1000s)	1,588	94,593	1,461	95,437	1,614	118,700
Business Receipts ($1000s)	1,893	64,081	1,554	60,134	1,593	61,097
Total Income ($1000s)	901	32,694	853	34,647	978	39,731
Total Deductions ($1000s)	801	27,381	778	30,139	876	34,584
Net Income ($1000s)	71	7,359	36	5,867	57	8,413
Profit Margin	0.18	0.26	0.17	0.26	0.17	0.24
Firm Age	11.98	11.75	13.42	12.42	14.60	13.06
Fraction S Corp	0.68	0.47	0.72	0.45	0.75	0.43
Interest Paid	31	2,062	31	2,399	30	2,496
Fraction Multinational	0.00	0.06	0.00	0.06	0.00	0.07
Physical Capital ($1000s)	537	45,287	480	53,572	460	52,069
N		71,398		62,900		66,406
Weighted N		4,152,990		4,367,530		4,698,055

Panel B: All Firm Years

	All Firms		Public		Private	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Total Assets ($1000s)	1,530	102,552	1,364,333	3,332,946	424	1,404
Gross Receipts ($1000s)	1,665	61,758	884,647	1,979,052	949	2,301
Total Income ($1000s)	909	36,227	511,117	1,164,111	495	1,507
Total Deductions ($1000s)	819	31,014	450,038	991,558	454	919
Net Income ($1000s)	49	7,119	48,857	227,397	9	2,612
Profit Margin	0.18	0.25	-0.18	0.77	0.18	0.25
Firm Age	13.33	12.43	24.89	22.48	13.32	12.41
Fraction S Corp	0.72	0.45	0.00	0.00	0.72	0.45
Interest Paid	31	2,322	29,738	75,946	7	21
Fraction Multinational	0.00	0.06	0.63	0.48	0.00	0.06
Physical Capital ($1000s)	480	49,892	302,904	1,614,341	235	17,379
N		71,398		62,900		66,406
Weighted N		48,624,009		39,429		48,584,579

Note: The upper panel of the table reports cross-sectional SOI-weighted means and standard deviations of key financial measures for all firms in 2005, 2010 and 2015. The lower panel reports the same means and standard deviations for the pooled sample and for public and private firms separately. Financial measures converted to thousands of 2004 dollars based on CPI. Source: U.S. Internal Revenue Service, Office of Tax Analysis, Statistics of Income (SOI) Corporate tax return files.

Table 2: Summary Statistics: SOI and DFL weights

	DFL Weighted				SOI Weighted	
	Public Firms		Private Firms		Private Firms	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Investment level						
Total investment ($1000s)	16,013	15,226	2,549	1,813	329	1,813
Total investment less R&D	12,314	13,191	2,406	1,710	303	1,710
Short-term investment	5,961	7,227	1,174	1,004	134	1,004
Long-term investment	371	397	2,236	3,845	42	397
R&D expenditures	3,699	7,306	144	322	25	322
Bonus depreciation allowances	4,112	7,059	837	980	88	980
Section 179 allowances	5	40	23	82	39	82
Physical Capital	49,320	63,133	30,444	45,275	1,686	45,275
Investment, as a share of lagged physical capital						
Total investment	1.07	2.51	0.72	1.65	0.91	1.65
Total investment less R&D	0.55	0.88	0.56	1.15	0.76	1.15
Short-term investment	0.45	0.75	0.46	0.97	0.62	0.97
Long-term investment	0.59	1.94	0.20	0.59	0.19	0.59
R&D	0.55	2.47	0.20	2.27	0.20	2.27
Investment, as a share of total investment						
Long-term investment	0.34	0.30	0.25	0.27	0.17	0.27
R&D	0.18	0.30	0.07	0.20	0.03	0.20
Control variables						
Firm Age	27.30	22.53	29.95	22.64	26.24	22.64
Fraction S Corp	0.00	0.00	0.41	0.49	0.59	0.49
Profit Margin	0.03	0.43	0.03	1.75	0.06	1.75
Interest Paid	6,618	9,357	1,012	714	142	714
Fraction Multinational	0.66	0.47	0.32	0.47	0.04	0.47

Note: The table contains means and standard deviations for DFL-size-weighted public and private firms and SOI-weighted private firms in our estimation sample for tax years 2004–2015. We separately report special depreciation allowances in this table. These are included in our total investment measures, but we have not allocated these allowances into short-term and long-term investments for purposes of reporting means and standard deviations. These amounts are allocated in our shares measures. 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. 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. Note that the share variables do not sum to one because roughly 10% of firms do not have measurable investment in any given year.
Source: U.S. Internal Revenue Service, Office of Tax Analysis, Statistics of Income (SOI) Corporate tax return files.

Table 3: Sample Statistics for the IPO Analysis Sample

	All Years		Pre-IPO		Post-IPO	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Investment level						
Total investment ($1000s)	114,127	168,923	149	80	148,543	179,016
Total investment less R\&D	92,212	146,009	149	80	120,010	156,288
Short-term investment	23,269	43,739	91	65	30,267	47,747
Long-term investment	20,186	41,195	37	22	26,271	45,277
R&D expenditures	21,915	52,598	0	0	28,533	58,425
Bonus depreciation allowances	48,755	94,216	20	22	63,471	103,075
Section 179 allowances	1.1	17.6	0.3	4.6	1.3	19.9
Physical Capital	767,633	1,845,194	506,929	1,143,089	846,354	2,003,058
Investment, as a share of lagged physical capital						
Total investment	1.25	3.50	0.96	4.64	1.33	3.06
Total investment less R&D	0.64	1.92	0.59	3.53	0.66	1.01
Short-term investment	0.52	1.71	0.50	3.22	0.52	0.82
Long-term investment	0.66	2.15	0.28	0.83	0.78	2.40
R&D	0.66	4.15	0.49	5.94	0.70	3.44
Investment, as a share of total investment						
Long-term investment	0.41	0.32	0.31	0.28	0.44	0.32
R&D	0.18	0.29	0.10	0.24	0.20	0.30
Control variables						
Firm Age	17.94	22.70	11.14	15.76	19.99	24.04
Fraction S Corp	0.00	0.03	0.00	0.06	0.00	0.00
Profit Margin	-0.05	12.63	-0.03	2.90	-0.06	14.32
Interest Paid	65,340	101,384	115	31	85,036	108,217
Fraction Multinational	0.80	0.40	0.85	0.35	0.78	0.41
Number of observations	4,043	4,043	1,368	1,368	2,675	2,675

Note: The table contains size-weighted means and standard deviations for firms that under-go an IPO for 2004–2015, where size is lagged gross receipts. The first two columns present summary statistics for all firm-years; the next four columns present summary statistics in pre-IPO years and post-IPO years, respectively. We separately report special depreciation allowances in this table. These are included in our total investment measures, but we have not allocated these allowances into short-term and long-term investments for purposes of reporting means and standard deviations. These amounts are allocated in our shares measures. Financial measures are converted to thousands of 2004 dollars based on CPI.

Source: U.S. Internal Revenue Service, Office of Tax Analysis, Statistics of Income (SOI) Corporate tax return files and Center for Research in Security Prices.

Table 4: The Effect of Public Status on Investment

	(1) Total Investment	(2) Investments less R&D	(3) Short-term Investments	(4) Long-term Investments	(5) R&D only
Panel A: Investment/Lagged Physical Assets					
PUBLIC	0.484***	0.076***	0.065***	0.461***	0.392***
	(0.048)	(0.019)	(0.018)	(0.036)	(0.046)
Observations	314,449	314,449	314,449	314,449	314,449
R-squared	0.128	0.117	0.123	0.096	0.033
Panel B: Long-Term Investment/Total Investment					
PUBLIC				0.088***	0.111***
				(0.009)	(0.009)
Observations				314,449	314,449
R-squared				0.111	0.180

Note: In panel A, the dependent variable is equal to investment divided by lagged tangible assets. In panel B, the dependent variable is long-term investment divided by total investment. Total investment is equal to the sum of total property investments and R& D expenditures, short-term investment is equal to investment in assets with less than 10-year lives, and long-term investment is equal to the sum of investments in assets with 10, 20 or 25-year lives, investments in residential and non-residential properties, and R&D expenditures. 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 and 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.
*** $p<0.01$, ** $p<0.05$,* $p<0.1$.
Source: U.S. Internal Revenue Service, Office of Tax Analysis, Statistics of Income (SOI) Corporate tax return files.

Table 5: The Effect of Public Status on Investment, by Short-Termist Pressures

	(1) Total Investment	(2) Investments less R&D	(3) Short-term Investments	(4) Long-term Investments	(5) R&D only
Panel A: Investment/Lagged Physical Assets					
PUBLIC	0.489***	0.075***	0.064***	0.468***	0.399***
	(0.048)	(0.020)	(0.018)	(0.037)	(0.047)
ERC	-0.222	-0.132	-0.110	0.014	-0.304
	(0.178)	(0.101)	(0.087)	(0.066)	(0.240)
PUBLIC × *ERC*	-0.250	0.289***	0.306***	-0.777***	-0.464**
	(0.229)	(0.126)	(0.129)	(0.126)	(0.248)
Observations	312,685	312,685	312,685	312,685	312,685
R-squared	0.128	0.117	0.123	0.096	0.033
Panel B: Long-Term Investment/Total Investment					
PUBLIC				0.090***	0.112***
				(0.009)	(0.009)
ERC				0.061**	0.023
				(0.034)	(0.022)
PUBLIC × *ERC*				-0.321***	-0.172***
				(0.046)	(0.029)
Observations				312,685	312,685
R-squared				0.111	0.180

Note: In panel A, the dependent variable is equal to investment divided by lagged tangible assets. In panel B, the dependent variable is long-term investment divided by total investment. Total investment is equal to the sum of total property investments and R& D expenditures, short-term investment is equal to investment in assets with less than 10-year lives, and long-term investment is equal to the sum of investments in assets with 10, 20 or 25-year lives, investments in residential and non-residential properties, and R&D expenditures. 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 and 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.
*** 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 and Thomson Reuters.

Table 6: Investments After Changing Public Status

	(1) Total Investment	(2) Investments less R&D	(3) Short-term Investments	(4) Long-term Investments	(5) R&D only
Panel A: Investment/Total Physical Assets					
quad $POST - IPO$	0.137	-0.171	-0.186	0.503***	0.315*
	(0.321)	(0.262)	(0.235)	(0.118)	(0.166)
Observations	4,043	4,043	4,043	4,043	4,043
R-squared	0.691	0.513	0.526	0.718	0.620
Panel B: Long-Term Investment/Total Investment					
$POST - IPO$				0.014	0.169***
				(0.019)	(0.031)
Observations				4,043	4,043
R-squared				0.877	0.826

Note: In Panels A and C, the dependent variable is investment divided by lagged tangible capital assets. In Panels B and D, the dependent variable is long-term investment divided by total investment. Total investment is equal to the sum of total property investments and R& D expenditures, short-term investment is equal to investment in assets with less than 10-year lives, and long-term investment is equal to the sum of investments in assets with 10, 20 or 25-year lives, investments in residential and non-residential properties, and R&D expenditures. The coefficients in both panels are estimated using a broader sample that includes firms with less than one million or more than one billion dollars in assets, or less than 0.5 million or 1.5 billion dollars in revenues, which are excluded in the prior analysis. All specifications also included an unreported constant and are weighted by Size-DFL weights where size is equal to the average of gross receipts over the previous two lagged years. All specifications control for profit margin, interest paid, tangible asset deciles, a multinational dummy, and S Corp dummy. All models include year and two-digit NAICS code fixed effects, and an unreported constant. Standard errors clustered by EIN.
*** 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 and Center for Research in Security Prices.

Table 7: Robustness to Alternative Weights

	(1) Total Investment	(2) Investments less R&D	(3) Short-term Investments	(4) Long-term Investments	(5) R&D only
Panel A: Nearest-Neighbor Matching, Investment/Physical Assets					
PUBLIC	0.237***	0.055**	0.046**	0.300***	0.154*
	(0.083)	(0.023)	(0.020)	(0.046)	(0.083)
Observations	28,367	28,367	28,367	28,367	28,367
R-squared	0.241	0.238	0.250	0.168	0.130
Panel B: Entropy Balancing Weights, Investment/Physical Assets					
PUBLIC	1.032***	0.190***	0.153***	0.893***	0.784***
	(0.062)	(0.018)	(0.016)	(0.052)	(0.070)
Observations	314,449	314,449	314,449	314,449	314,449
R-squared	0.195	0.143	0.149	0.165	0.106
Panel C: Nearest-Neighbor Matching, LT Investment/Total Investment					
PUBLIC				0.040***	0.061***
				(0.014)	(0.013)
Observations				28,367	28,367
R-squared				0.132	0.228
Panel D: Entropy Balancing Weights, LT Investment/Total Investment					
PUBLIC				0.095***	0.114***
				(0.007)	(0.007)
Observations				314,449	314,449
R-squared				0.186	0.277

Note: The dependent variable in Panels A and B is investment divided by lagged tangible assets. The dependent variable in Panels C and D is long term investment divided by total investment. Total investment is equal to the sum of total property investments and R& D expenditures, short-term investment is equal to investment in assets with less than 10-year lives, and long-term investment is equal to the sum of investments in assets with 10, 20 or 25-year lives, investments in residential and non-residential properties, and R&D expenditures. In Panels A and C, private firms are weighted according to the nearest-neighbor matching method while in Panels B and D, private firms are weighted using entropy balancing weights which are weighted on the first moments of firm size, total income, lagged total business receipts, salaries and firm age. All specifications are also weighted by size, defined as average of gross receipts over the previous two lagged years. 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 two-digit NAICS code fixed effects, and an unreported constant. Standard errors clustered by EIN.
*** $p<0.01$, ** $p<0.05$,* $p<0.1$.
Source: U.S. Internal Revenue Service, Office of Tax Analysis, Statistics of Income (SOI) Corporate tax return files.

Table 8: Robustness to Treatment of Bonus Depreciation

	(1) Total Investment	(2) Investments less R&D	(3) Short-term Investments	(4) Long-term Investments	(5) R&D only
Panel A: Investment/Total Physical Assets, 2005–2007 Only					
PUBLIC	0.403***	0.043*	0.039*	0.392***	0.387***
	(0.046)	(0.023)	(0.020)	(0.034)	(0.043)
Observations	85,154	85,154	85,154	85,154	85,154
R-squared	0.125	0.122	0.126	0.087	0.047
Panel B: Investment/Total Physical Assets, Alternative ST/LT Definitions					
PUBLIC			0.069***	0.489***	
			(0.018)	(0.035)	
Observations			314,449	314,449	
R-squared			0.125	0.095	
Panel C: Long-Term Investment/Total Investment, 2005–2007 Only					
PUBLIC				0.093***	0.116***
				(0.011)	(0.009)
Observations				85,154	85,154
R-squared				0.127	0.190
Panel D: Long-Term Investment/Total Investment, Alternative ST/LT Definitions					
PUBLIC				0.096***	
				(0.009)	
Observations				314,449	
R-squared				0.114	

Note: In Panels A and B, the dependent variable is investment divided by lagged tangible capital assets. In Panels C and D, the dependent variable is long-term investment divided by total investment. Total investment is equal to the sum of total property investments and R& D expenditures, short-term investment is equal to investment in assets with less than 10-year lives, and long-term investment is equal to the sum of investments in assets with 10, 20 or 25-year lives, investments in residential and non-residential properties, and R&D expenditures. Panels A and B only use data from 2005 through 2007 when no bonus depreciation was allowed. Panels C and D classify all bonus depreciation as short-term investment. All specifications are weighted by Size-DFL weights, where size is average of gross receipts over the previous two lagged years. 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 two-digit NAICS code fixed effects, and an unreported constant. Standard errors clustered by EIN.

*** $p<0.01$, ** $p<0.05$,* $p<0.1$.

Source: U.S. Internal Revenue Service, Office of Tax Analysis, Statistics of Income (SOI) Corporate tax return files.

Table 9: Robustness to Sample Restrictions

	(1) Total Investment	(2) Investments less R&D	(3) Short-term Investments	(4) Long-term Investments	(5) R&D only
Panel A: Investment/Total Physical Assets, Ever R&D Sample					
PUBLIC	0.486***	0.055**	0.039*	0.621***	0.324***
	(0.074)	(0.025)	(0.022)	(0.058)	(0.083)
Observations	66,180	66,180	66,180	66,180	66,180
R-squared	0.315	0.230	0.239	0.239	0.208
Panel B: Long-Term Investment/Total Investment, Ever R&D Sample					
PUBLIC				0.097***	0.120***
				(0.013)	(0.014)
Observations				66,180	66,180
R-squared				0.100	0.147
Panel C: Investment/Total Physical Assets, Full Sample					
PUBLIC	0.223***	0.028	0.035	0.205***	0.201***
	(0.048)	(0.031)	(0.027)	(0.029)	(0.042)
Observations	548,619	548,619	548,619	548,619	548,619
R-squared	0.098	0.094	0.097	0.064	0.007
Panel D: Long-Term Investment/Total Investment, Full Sample					
PUBLIC				0.035**	0.193***
				(0.017)	(0.016)
Observations				548,619	548,619
R-squared				0.344	0.498

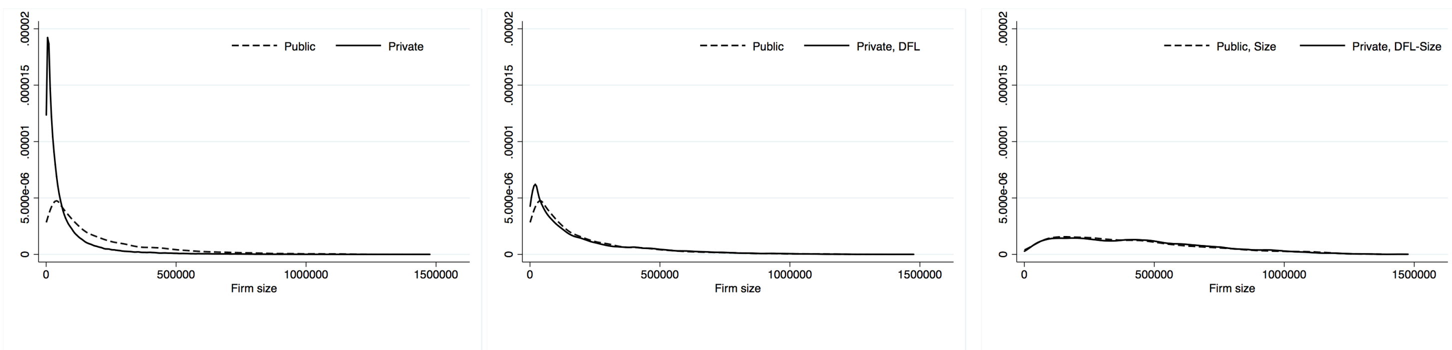
Note: In panel A, the dependent variable is equal to investment divided by lagged tangible assets. In panel B, the dependent variable is long-term investment divided by total investment. Total investment is equal to the sum of total property investments and R& D expenditures, short-term investment is equal to investment in assets with less than 10-year lives, and long-term investment is equal to the sum of investments in assets with 10, 20 or 25-year lives, investments in residential and non-residential properties, and R&D expenditures. 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 and 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.
*** 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.

Table 10: Robustness of IPO Results to Restricted Sample

	(1) Total Investment	(2) Investments less R&D	(3) Short-term Investments	(4) Long-term Investments	(5) R&D only
Panel A: Investment/Total Physical Assets					
$POST-IPO$	0.807***	0.062	0.041	1.102***	0.627**
	(0.292)	(0.159)	(0.130)	(0.241)	(0.272)
Observations	2,223	2,223	2,223	2,223	2,223
R-squared	0.748	0.641	0.658	0.724	0.741
Panel B: Long-Term Investment/Total Investment					
$POST-IPO$				0.003	0.024
				(0.022)	(0.018)
Observations				2,223	2,223
R-squared				0.803	0.872

Note: In Panels A and C, the dependent variable is investment divided by lagged tangible capital assets. In Panels B and D, the dependent variable is long-term investment divided by total investment. Total investment is equal to the sum of total property investments and R& D expenditures, short-term investment is equal to investment in assets with less than 10-year lives, and long-term investment is equal to the sum of investments in assets with 10, 20 or 25-year lives, investments in residential and non-residential properties, and R&D expenditures. The coefficients in both panels are estimated using a broader sample that includes firms with less than one million or more than one billion dollars in assets, or less than 0.5 million or 1.5 billion dollars in revenues, which are excluded in the prior analysis. All specifications also included an unreported constant and are weighted by Size-DFL weights where size is equal to the average of gross receipts over the previous two lagged years. All specifications control for profit margin, interest paid, tangible asset deciles, a multinational dummy, and S Corp dummy. All models include year and two-digit NAICS code fixed effects, and an unreported constant. Standard errors clustered by EIN.
*** 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 and Center for Research in Security Prices.

Figure 1: Distribution of Public and Private Firms by Size



(a) Unweighted (b) Public: Unweighted; Private: DFL-Wgt. (c) Public: Size Wgt.; Private: DFLxSize Wgt.

Source: SOI Corporate Sample

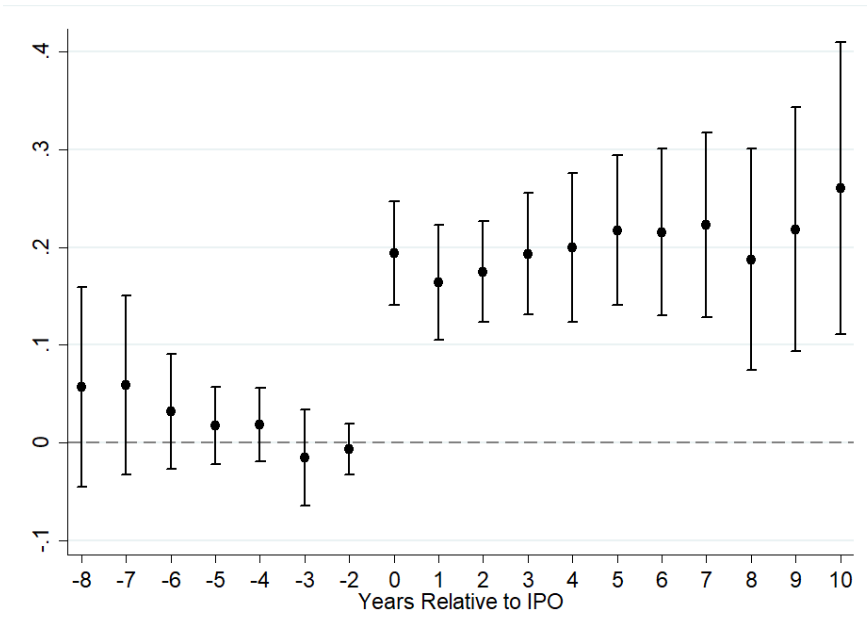


Figure 2: R&D Share of Total Investments, by Years Since IPO

Notes: This figure plots coefficients from an event-study analysis of R&D expenditures in years surrounding an IPO. The omitted year is the one immediately prior to the IPO year. The specifications controls 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, firm, and two-digit NAICS code fixed effects, and an unreported constant. Standard errors are clustered at the firm level.
Source: U.S. Internal Revenue Service, Office of Tax Analysis, Statistics of Income (SOI) Corporate tax return files and Center for Research in Security Prices.

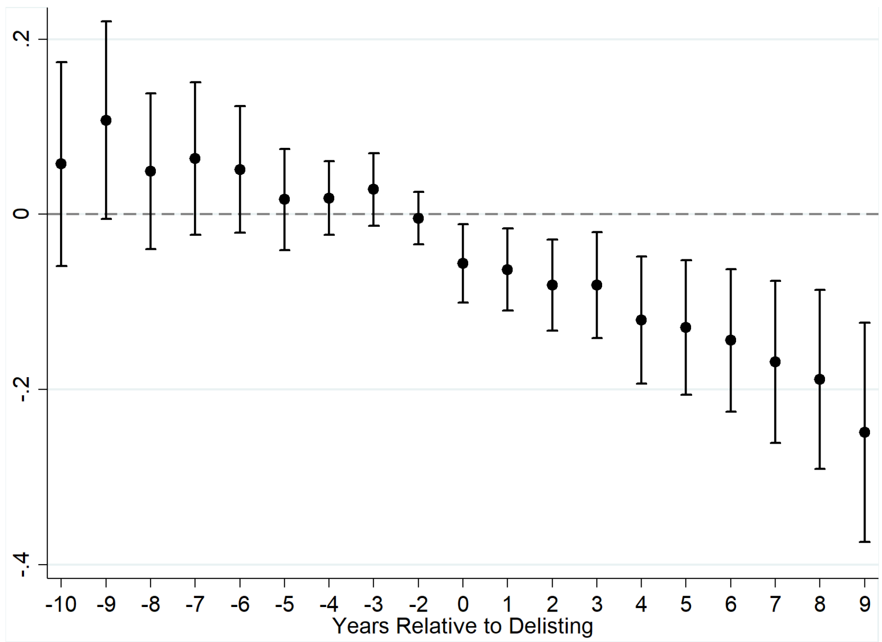


Figure 3: R&D Share of Total Investments, by Years Since Delisting

Notes: This figure plots coefficients from an event-study analysis of R&D expenditures in years surrounding a delisting. The omitted year is the one immediately prior to the delist year. The specifications controls 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, firm, and two-digit NAICS code fixed effects, and an unreported constant. Standard errors are clustered at the firm level.
Source: U.S. Internal Revenue Service, Office of Tax Analysis, Statistics of Income (SOI) Corporate tax return files and Center for Research in Security Prices.

Data Appendix: Description of SOI Corporate Sample Tax Variables

Variable	Description
Firm age (Date incorporated)	From 1120, Box C or Form 1120S, Box E
Gross receipts	Form 1120 or 1120S, Line 1a
Operating Profit	
For C-corporations	Form 1120 or 1120S, Line 1c+ Line 12 + Line 18 + Line 19 + Line 20 + Line 25 - Line 2 - Line 27
For S-corporations	Form 1120 or 1120S, Line 1c + Line 7 + Line 13 + Line 14 - Line 2 - Line 20
Total revenue	Form 1120 or 1120S, Line 1c
Operating Profit	Gross Receipts + Executive Compensation + Interest Paid + Charitable Contributions + Depreciation + DPAD - Cost of Goods Sold - Total Deductions
Profit margin	Form 1120 or 1120S, Operating Profit/Gross Receipts
Total tangible capital assets	Schedule L, Line 10a - Line 10b
Total balance sheet assets	Schedule L, Line 15
Total income	Form 1120 or 1120S, Line 11
Total deductions	Form 1120 or 1120S, Line 27
Net income	Form 1120 or 1120S, Line 28
Taxes paid	Form 1120 or 1120S, Line 31
Salaries paid	Form 1120 or 1120S, Line 12 + Line 13
Interest deductions	Form 1120 or 1120S, Line 18
R&D = maximum of:	
Qualified research expenses under regular credit method	Form 6765, Line 9
Qualified research expenses under ASC method	Form 6765, Line 53
Qualified research expenses under AIC method	Form 6765, Line 28
Short-term investments = sum of:	
Property basis amount, 3 years	Form 4562, Line 19a
Property basis amount, 5 years	Form 4562, Line 19b
Property basis amount, 7 years	Form 4562, Line 19c
Long-term investments, less R&D = sum of:	
Property basis amount, 10 years	Form 4562, Line 19d
Property basis amount, 15 years	Form 4562,Line 19e
Property basis amount, 20 years	Form 4562, Line 19f
Property basis amount, 25 years	Form 4562, Line 19g
Residential rental property basis amount	Form 4562, Line 19h
Nonresidential rental property basis amount	Form 4562, Line 19i
Basis for the Alternative Depreciation System (ADS)	Form 4562, Line 20a + 20b + 20c
Investments under bonus depreciation rules = sum of:	
Special depreciation allowance for qualified property	Form 4562, Line 14
Property subject to section 168(f)(1) election	Form 4562, Line 15
Other depreciation (including ACRS)	Form 4562, Line 16