R&D Accounting and the Tradeoff between Exclusivity and Uncertainty †

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ABSTRACT: Research and development (R&D) expenditures are an important part of many firms' investment portfolios, with R&D as a percent of assets exceeding capital expenditures on average across publicly traded firms in recent years. U.S. GAAP requires immediate expensing of these investments, which involves several conceptual and practical tradeoffs. We re-examine the continued applicability of this accounting treatment in light of changes in the properties of R&D expenditures and other reporting events in recent years. Using data since 2000, we find that there are benefits to R&D expenditures and these benefits are no more uncertain than those associated with capital expenditures. We find evidence, however, that peer firms' R&D investments correlate with a firm's own future benefits, providing evidence of non-exclusive benefits to R&D expenditures, which is distinct from capital expenditures. Thus, although firms benefit from their R&D investments, they may not hold exclusive rights to the R&D-related economic resources. Our results provide recent evidence to the FASB as they deliberate the treatment of intangible assets, including R&D.

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1. Introduction

We reconsider the accounting treatment of research and development (R&D) expenditures in the 21st century by examining how the properties of R&D align with the definition of an asset.[1] Statement of Financial Accounting Standards No. 2 (SFAS 2) governs the accounting treatment of research and development (R&D) activities under U.S. GAAP and requires immediate expensing of all related costs (FASB 1974). Because R&D investments are made with the intention of providing future economic benefits, immediate expensing may not offer the best depiction of the underlying economics of the firm. Consistent with this view, the expensing of R&D has been shown to produce biased rates of return and to lower the usefulness of earnings as a predictor of future earnings and earnings growth (Beaver and Ryan 2005; Penman and Zhang 2002), and has often been identified as a contributor to the decline in the relevance of financial statements as R&D spending has increased over time(Lev and Zarowin 1999; Lev and Gu 2016, Figure 8.2, p. 89). Moreover, because immediate expensing limits management's ability to incorporate their private information about the prospects of R&D activities into the financial statements, mandatory expensing of all R&D expenditures restricts the information content of reported R&D for financial statement users.[2]

There are several reasons why it is important and timely to examine the accounting treatment of R&D. First, R&D spending has grown substantially over time and, since the turn of the century, approximates capital spending for the average firm (see Figure 1). Second, the

[1] For an item to be recognized as an asset in the financial statements, it must meet both the definition of an asset as well as the recognition criteria. Because we focus on the definition criteria, our analysis is insufficient to draw a normative conclusion about the appropriate accounting treatment of R&D. Rather, our results provide evidence to contribute to this debate.

[2] External users do not have the capacity to assess which R&D expenditures are likely to generate future benefits; this is knowledge imparted by management through their capitalization decision. In other words, this accounting treatment reflects unconditional conservatism, which is not necessarily a desirable characteristic and precludes subsequent conditional conservatism that would otherwise convey new information to stakeholders if the R&D-related economic resources lost value (Penman and Zhang 2002; Beaver and Ryan 2005; Basu 2005).

expensing of internal R&D results in several concerns about the comparability of financial statements, which is an important characteristic for enhancing the usefulness of financial information (FASB 2010). For instance, international standards allow for development costs to be capitalized once technical and commercial feasibility of the asset for sale or use is established (IASB 2004) and since 2008, firms that acquire in-process R&D as part of a business combination have been required to capitalize the fair value of the R&D acquired as an intangible asset (FASB 2007). Finally, although uncertainty about the existence of benefits to R&D, and concerns about the volatility of any such benefits, were important justifications for requiring expensing of R&D in 1974, these concerns appear less relevant in recent years. Specifically, there is a substantial body of literature that establishes the existence of benefits to R&D (e.g., Lev and Sougiannis 1996; Pandit et al. 2011; Curtis et al. 2017) and both the Financial Accounting Standards Board (FASB) and International Accounting Standards Board (IASB) have proposed changes to the definition of an asset with the intention of reducing the impact that economic uncertainty has on whether an item meets the definition of an asset.[3]

For an item to be considered an asset, it must first be established that it represents an economic resource. Economic resources are items that are scarce and capable of producing economic benefits to a firm (FASB and IASB 2007). Therefore, we first examine whether R&D expenditures made from 2000-2012 generate future economic benefits using both operating cash flows and net income as proxies for economic benefits. Consistent with prior research, we find that R&D expenditures are positively associated with future firm performance on average. These benefits, however, appear to take around five years to materialize, consistent with these investments being more long-term in nature than investments in capital expenditures, which

[3] See http://www.fasb.org/project/cf_phase-b.shtml#decisions for the status of the FASB's efforts to update the conceptual framework. Although the Boards halted their efforts toward establishing a joint Conceptual Framework in 2010, the IASB has since resumed this project, issuing an exposure draft in 2015 (IASB 2015).

typically provide benefits within three years. These results illustrate that, *on average*, R&D activities create an economic resource.

As stated above, traditional arguments against capitalizing R&D included concerns that the benefits were highly uncertain. Consistent with this argument, Kothari et al. (2002) develop a methodology to assess the uncertainty of benefits to R&D and find that R&D expenditures made between 1972-1992 are significantly more uncertain than the benefits associated with capital expenditures. However, recent research demonstrates that the average profitability of R&D has declined significantly over the past three decades (Curtis et al. 2017). If the average payoffs from these investments is lower, it is possible that the riskiness, or uncertainty, of these benefits has also declined. Consistent with this idea, we find little evidence that the benefits associated with R&D expenditures from 2000-2012 are significantly more uncertain than those related to capital expenditures on average (Kothari et al. 2002).[4] This finding suggests that the traditional argument against the capitalization of R&D based on the uncertainty of benefits to these expenditures is less compelling in more recent years.

We next consider how R&D expenditures align with standard setter's proposed definition of an asset. Specifically, an important change in the proposed definition is that the entity must have privileged rights or access to the economic resource under consideration (i.e., the exclusivity of the resource). Although patented technologies, which are often the product of R&D activities, provide legally enforceable rights, whether firms are able to restrict other firms' access to R&D-related economic resources at earlier stages or to other non-patented innovations is unclear. To examine the exclusivity of R&D-related economic resources, we correlate R&D

[4] Note that because the sample period in Kothari et al. (2002) ends prior to the beginning of our sample, our results are not inconsistent with the evidence in their study but rather represent a change in the estimates of the uncertainty of future benefits over time. Untabulated results confirm inferences from prior research; supporting our position that this represents a change in the properties of R&D.

spending by peer firms with a firm's own future benefits. We find evidence of a positive association between peer firm R&D spending and a firm's future performance. The existence of non-exclusive benefits to R&D expenditures represents an important distinction from other investments. For instance, we find no evidence that peer firms' capital expenditures, an investment for which access is generally controllable, or purchased intangibles provide benefits to the firm. We interpret this evidence as documenting the difficulty of restricting access to the benefits that accrue from R&D-related economic resources.

Our results provide evidence that should be of interest to standard setters, as the treatment of intangibles, including R&D has recently been added to their research agenda (www.fasb.org). We do not make any normative conclusions about whether R&D expenditures should be capitalized. Although we contribute evidence that the uncertainty of future benefits to R&D is not significantly different from those related to capital expenditures in a more recent time period, there are questions about whether R&D expenditures meet other aspects of the definition of an asset; namely, exclusivity or the existence of privileged rights to the economic resource. This latter result appears to be a distinct feature of R&D expenditures relative to other investments that are typically capitalized (e.g., capital expenditures).

There are several caveats to the inferences from our paper. First, we acknowledge that there are other important considerations that standard setters must make in their deliberations about the accounting treatment of R&D. For instance, as with most material rule changes (e.g., expensing employee stock option grants, capitalizing operating leases), allowing management to capitalize some or all R&D expenditures could change their behavior or result in opportunistic accounting treatments (e.g., Seybert 2010). It could also, however, curb the current ability to unduly affect earnings by cutting R&D (Penman and Zhang 2002). Second, although we must include both research and development in our measure, any capitalized portion would contain only the development component after reaching technological feasibility. Therefore, if management could use their discretion to capitalize amounts that reflect their private information about the feasibility of each project, we would likely see the coefficients on R&D with respect to future benefits increase in our empirical analysis.

2. Background and motivation

Under U.S. GAAP, expenditures on internal R&D activities are immediately expensed when incurred (FASB 1974). There are certain important conceptual tradeoffs with this accounting treatment. On the one hand, full expensing of R&D expenditures prevents management from imparting their knowledge of which investments are expected to generate future benefits. Allowing management to capitalize certain costs associated with R&D activities (e.g., development costs) provides them with the ability to add value beyond simply reporting total spending on R&D. Specifically, the value of R&D expenditures can vary widely and "standard accounting measures do not easily communicate its performance" (Merkley 2014). Thus, users of the financial statements are required to form their own expectations, coupled with any narrative disclosures provided by management, to adjust net income and book values for R&D expensing (e.g., through a capitalization procedure such as that outlined in Lev and Sougiannis (1996)).[5]

On the other hand, managers could use their discretion in capitalization decisions opportunistically. For instance, managers might overstate the expected benefits to avoid current

[5] If managers are permitted to account for projects differently, users are still able to adjust the financial statements in a manner that would reflect full expensing of R&D. Thus, by prohibiting capitalization of certain costs, users are provided with strictly less information.

period expenses or overinvest in R&D (Seybert 2010). This conceptual tradeoff is similar to that associated with accrual accounting more generally.

There are also practical consequences of the current expensing treatment of R&D. First, international standards allow for development costs to be capitalized once technical and commercial feasibility of the asset for sale or use is established (IASB 2004). Second, since 2008, firms that acquire in-process R&D as part of a business combination have been required to capitalize the fair value of the R&D acquired as an intangible asset (FASB and IASB 2007).[6] These apparent inconsistencies for internal versus purchased R&D are important given that comparability is an important characteristic for enhancing the usefulness of financial information (FASB 2010).[7] Third, numerous studies have documented that R&D leads to earnings and book values that are too low, distorting rates of return and the usefulness of accounting (Beaver and Ryan 2005; Penman and Zhang 2002; Lev and Zarowin 1999; Lev and Gu 2016).

Prior literature exploits the differential accounting treatment of R&D expenditures internationally to provide some insights into the implications of the different approaches (i.e., expensing versus capitalizing). For instance, consistent with the notion that the ability to capitalize certain development costs allows management to convey more useful information to investors, Oswald and Zarowin (2007) provide evidence that firms that capitalize R&D costs have more informative stock prices. Specifically, using a sample of firms in the U.K., the authors find that capitalizers have significantly higher forward earnings response coefficients. There is

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[6] This rule (SFAS 141(R)) also applies to firms emerging from Chapter 11 bankruptcy. Thus, the implications of capitalizing in-process R&D extend beyond firms acquiring innovation. Similar to internal R&D expenditures, Deng and Lev (2006) provide evidence of future benefits to in-process R&D.

[7] Although managers have the option to capitalize certain internally-developed intangibles (e.g., software), many managers opt to continue to expense these costs after reaching technological feasibility. This variation in treatment also creates comparability issues.

also evidence that expensing R&D can lead to underinvestment in these activities (e.g., Baber et al. 1991; Graham et al. 2005; Oswald et al. 2016).

Traditional arguments against capitalization of R&D expenditures were based on a lack of evidence of a relation between R&D expenditures and future benefits as well as a high degree of uncertainty in any potential future benefits from R&D activities (FASB 1974). However, there are several reasons to re-examine the properties of R&D activities and how they fit within the reporting framework in more recent years. First, since SFAS 2 was adopted in 1974, a number of studies have documented evidence of a significant positive association between R&D expenditures and future benefits (e.g., Lev and Sougiannis 1996; Pandit et al. 2011; Curtis et al. 2017).[8]

Second, R&D expenditures have become a more economically significant proportion of firms' investment portfolios. For instance, in Figure 1 we plot the average ratio of R&D and capital expenditures to total assets for all firms on Compustat over time. Since the late 1990s, average spending on R&D has closely approximated that of capital expenditures and even reached higher levels around 2009. There is also evidence that the profitability implications of R&D have changed over time as spending has increased (Curtis et al. 2017), which could suggest a shift in the properties of R&D investments.

Finally, the Financial Accounting Standards Board (FASB) and International Accounting Standards Board (IASB) have proposed changes to the definition of an asset. Specifically, as part of ongoing convergence efforts, the FASB and the IASB identified several shortcomings of the definition of an asset.[9] One of these limitations is the subsequent emphasis that users placed on

[8] Moreover, the Bureau of Economic Analysis (BEA) has included R&D expenditures in annual GDP calculations since 2014, consistent with the perception that R&D expenditures produce economy-wide benefits.

[9] The current Conceptual Framework for U.S. GAAP defines an asset as "…probable future economic benefits obtained or controlled by a particular entity as a result of past transactions or events." (FASB1985, ¶25).

the likelihood of economic benefits, where items with a low likelihood of benefits (i.e., greater uncertainty) are often excluded from consideration as an asset. Before halting their efforts for the development of a unified Conceptual Framework, the Boards tentatively proposed the following definition: "[a]n *asset* of an entity is a present economic resource to which the entity has a right or other access that others do not have" (FASB and IASB 2007, ¶9). An important motivation for this change is to reduce the impact that economic uncertainty has on whether an item meets the definition of an asset. As stated above, given that one of the primary arguments against capitalizing R&D costs has been that the benefits to be obtained from these investments are highly uncertain (FASB 1974), this change in the proposed definition is particularly relevant in considering the accounting treatment of R&D in more recent years.

The first step in examining the relevant accounting treatment of a transaction is to examine the definition of the item. Therefore, we structure our analyses around how R&D expenditures align with both the existing and proposed definitions of an asset. Although we do not consider the recognition and measurement criteria of the reporting framework, our analyses should be informative to standard setters, particularly as they add the treatment of intangibles including R&D to their technical agenda (Barlas 2016).

3. Sample and descriptive statistics

3.1. Sample

We obtain financial data for U.S. firms listed on the NYSE, AMEX, and NASDAQ for the period 2000-2015 from Compustat. We begin our sample period in 2000 to coincide with the apparent stabilization of R&D profitability in the early 2000s (Curtis et al. 2017). Our last year of R&D expenditures analyzed is 2012 because we use at least three years of future data to form our dependent variables. We exclude observations with missing or negative assets in year $t – 1$ or year t or sales in year t. Finally, we remove firm-years with missing industry codes, sales, operating cash flows, operating income, net income, leverage, book-to-market, or market value of equity. This provides us with a final sample of 47,461 firm-years, 43.2% of which disclose non-zero R&D expenditures.[10] Table 1 outlines our sample selection.

In Panel A of Table 2, we summarize our sample across the Fama-French 12 industry classification. The proportion of firms disclosing R&D varies substantially across industries. However, of the 12 Fama-French industry groups, all but Utilities have a non-zero proportion of firms that disclose R&D expenditures. R&D is most commonly disclosed in the Business Equipment (87.6%) and Healthcare, Medical Equipment, and Drugs industries (84.3%). Amongst the 11 industry groups with a non-zero proportion of R&D disclosers, the average R&D intensity ranges from 0.3% to 129.8% of contemporaneous sales, with an average ratio of 20.8% across our entire sample.

In Panel B, we present the distribution of R&D to sales amongst the subsample of firms that disclose non-zero R&D. Amongst those firms spending on R&D, the average firm spends over 10% of contemporaneous sales on R&D in six of the twelve industry groups. For instance, in the Healthcare, Medical Equipment, and Drugs industries, average R&D spending is over 150% of contemporaneous sales (1.541). This high ratio is not simply due to a few extreme outliers, as illustrated by the fact that the 75th percentile of R&D intensity in this industry is also 1.465. Overall, this information illustrates the importance of R&D expenditures for many firms and also indicates the economic significance of potentially unrecognized assets on many firms' financial statements.

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[10] Because we examine outcomes over several future periods, actual sample sizes used throughout our analyses differ. We adjust for any potential survivorship bias as a robustness check.

3.2. Descriptive statistics and correlations

We present descriptive statistics and pairwise correlations for the primary variables used throughout our analyses in Tables 3 and 4, respectively. We define all variables in Appendix A. The average firm in our sample spends 5.4% of beginning of the year total assets on R&D and 5.3% on capital expenditures. We also find that the average change in intangible assets, adjusted for amortization expense, is positive and 3.7% of beginning of period total assets. This highlights the growth in recognized intangible assets on firms' balance sheets as firms acquire intangible assets. Firms in our sample have positive operating cash flow (excluding R&D and advertising expenditures) on average. Similarly, firms are profitable on average, with net income before R&D, advertising and depreciation (hereafter "net income") of 10.2% of beginning of period total assets. Most firms in our sample have a book-to-market ratio less than one, with an average (median) ratio of 0.637 (0.504). Average market leverage of our sample firms is 0.231. Finally, the five-year volatility of cash flows is slightly lower than the volatility of net income in our sample; in untabulated analyses we confirm this is due to special items as generally earnings is expected to be less volatile than cash from operations as a result of accrual accounting within GAAP.

The correlations in Table 4 reveal a positive association between investment classes (R&D, capital expenditures, and acquired intangibles). Investment expenditures in year *t* are generally positively correlated with firm performance in the same fiscal year, except R&D, which is slightly negatively correlated with contemporaneous net income. Firms with higher book-to-market (i.e., lower growth opportunities) have lower investment intensity across the various investment types. We also find that firm size is negatively correlated with R&D spending but positively correlated with all other investments. Larger firms also have higher firm performance and lower book-to-market ratios.

4. Empirical analysis

4.1. Do R&D expenditures result in an economic resource?

To be defined as an asset, R&D activities must first create an economic resource. An economic resource represents an item that is useful for carrying out economic activities and therefore is capable of producing cash inflows or reducing cash outflows for an entity. In their efforts to reduce the perceived probabilistic emphasis in the prior definition, standard setters also elaborate that "…as long as there is some likelihood of cash flows or a reduction in cash outflows, there is an economic resource" (FASB and IASB 2007, ¶14). The Boards also explain that although the existence of a market price is strong evidence for the existence of an economic resource, the lack of a market does not preclude an item from being an economic resource. To this point, examples of intangible investments are provided as examples of economic resources, including patents and goodwill.[11] Therefore, we first examine whether R&D expenditures are associated with future benefits on average.[12]

We model these benefits as a function of expenditures on both tangible and intangible investments, including R&D (*R&D*), capital expenditures (*Capex*), and acquired intangible assets (Δ*Intangibles*).[13] Specifically, we use OLS to estimate the following regression model:

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[11] As another example in their discussion of this proposed definition, standard setters specifically note that an internally-developed list of past customers would meet the definition of an asset (FASB and IASB 2007, ¶35).

[12] Note that we assume that if an R&D-generated economic resource is deemed to exist, it exists at the date of the financial statements given the expenditures have been incurred. That is, we do not provide an empirical analysis of the "present" component of the definition of an asset because by construction, these expenditures have been incurred at the date of the financial statements.

[13] We do not include advertising in our formal analyses given it is reported as zero in Compustat for the majority of firms (59.8 percent), and even amongst the firms disclosing advertising expense, the median firm reports advertising

$$Benefits_{it+1,t+n} = \beta_0 + \beta_1 R\&D_{it} + \beta_2 Capex_{it} + \beta_3 \Delta Intangibles_{it} + \beta_4 Benefits_{it} + \beta_5 BM_{it} + \beta_6 LnMVE_{it} + \beta_7 Leverage_{it} + e_{it} \quad (1)$$

We use two measures of future benefits over various horizons in estimating Equation (1) ($Benefits_{it+1,t+n}$; where n = 3, 5, and 8). First, because standard setters define an asset with respect to cash flows, we examine whether R&D spending is positively associated with the future operating cash flows of a firm (*OCF*). We add back R&D and advertising expense to operating cash flows so as not to induce a mechanical negative association between R&D and any related advertising and future cash flows. An additional benefit of cash flows as a measure of benefits is that it is less affected by accounting distortions. Second, to aid in comparability with prior research we also calculate future benefits using net income after adding back R&D, advertising, and depreciation expense (*NI*) (Lev and Sougiannis 1996; Kothari et al. 2002; Curtis et al. 2017).[14] We set missing values of *R&D*, *Capex*, and Δ*Intangibles* to zero and scale each variable by total assets at the beginning of year *t*. We include the level of benefits (either operating cash flows or net income) in year *t,* scaled by beginning of year total assets to control for the persistence of firm performance. Finally, we control for various fundamental firm characteristics at the end of year *t* such as growth opportunities (*BM*), firm size, *(LnMve*), and leverage (*Leverage*). We winsorize all variables at the 1% and 99% levels and cluster standard errors by firm and year (Gow et al. 2010).

We present the results of estimating Equation (1) in Table 5. Columns 1 – 3 (4 – 6) present results using cash flows (net income) as the dependent variable. We find positive associations between all investment types and future operating cash flows. For instance, in column 2, we find

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expense of less than 1% of total assets. Our inferences regarding R&D, however, are not affected by their inclusion (not tabulated).

[14] We add back depreciation expense to avoid a mechanical negative association between capital expenditures and net income. Because depreciation is already excluded from operating cash flows, this adjustment is not necessary for our first measure.

that spending $1 of R&D expenditures in year *t* is associated with $0.82 of operating cash flows over the subsequent five years, controlling for other investments, current profitability, and other firm characteristics.[15] The coefficients on the control variables are as expected. For instance, operating cash flows are persistent, as illustrated by a positive coefficient on OCF_t. Firms with higher growth opportunities and lower leverage also have greater future cash flows, all else equal. Although firm size is negatively associated with future cash flows, this is because we control for contemporaneous operating cash flows in the analysis. We find similar evidence when we measure the benefits to R&D in terms of future net income values.[16]

Overall, consistent with prior research, our results illustrate that R&D expenditures are capable of producing future economic benefits on average, particularly over longer horizons. This suggests that R&D activities plausibly create an economic resource. It is important to note, however, that accounting standards are unlikely to allow all R&D to be capitalized. For instance, international standards require research-related expenditures to be expensed, while development costs that have reached technological feasibility, as per management's assessment, are capitalized. Thus, if managers use their discretion in an unbiased manner under a capitalization regime, it is likely that the benefits to actual capitalized R&D would exceed the coefficients reported herein.

4.2. Uncertainty of the benefits to R&D expenditures

The traditional argument against capitalizing R&D is based on the notion that the benefits of R&D expenditures are significantly more uncertain than the benefits of capital expenditures

[15] Because we control for other, potentially complementary investments and current profitability, this does not represent the total return to R&D expenditures. Moreover, R&D returns can often be long-term in nature.

[16] One difference between Panels A and B is that acquired intangibles are negatively associated with future net income. In untabulated analyses we confirm that this negative association is induced by future amortization expense being included in net income but not operating cash flows and will be updating this in the next draft to avoid this issue.

(Kothari et al. 2002). However, given empirical evidence that the average profitability of R&D has declined over time (Curtis et al. 2017), it is feasible that the uncertainty, or risk, associated with these investments has also fallen. Therefore, we examine the uncertainty of the benefits to R&D expenditures relative to capital expenditures in a more recent time period. Specifically, we adapt the model of Kothari et al. (2002) and examine the standard deviation of future benefits using the following regression model:

$$\sigma(Benefits_{it+1,t+n}) = \beta_0 + \beta_1 R\&D_{it} + \beta_2 Capex_{it} + \beta_3 \Delta Intangibles_{it} + \beta_4 BM_{it} + \beta_5 LnMVE_{it} + \beta_6 Leverage_{it} + e_{it} \quad (2)$$

where $\sigma(Benefits_{it+1,t+n})$ is the standard deviation of operating cash flows or net income over t + 1 through t + n, where n = 3, 5, and 8. All future values of cash flows and net income are scaled by total assets at the beginning of year t and winsorized at the 1st and 99th percentiles before calculating the standard deviation. We estimate Equation (2) using OLS and cluster standard errors by firm and year.

We present results of estimating Equation (2) using the standard deviation of future operating cash flows (net income) as the dependent variable in columns 1 – 3 (4 – 6) of Table 6. We find a significant positive association between investment expenditures and future performance volatility, consistent with uncertainty in the benefits to firms' investment decisions. Following Kothari et al. (2002), we compare the coefficients on *R&D* and *Capex* as a benchmark for evaluating the uncertainty of the benefits to R&D expenditures. Although we find that the cash flow volatility associated with R&D is significantly higher than the association with capital expenditures in the subsequent three years, over longer horizons, these coefficients are statistically indistinguishable. Furthermore, the uncertainty of R&D benefits measured using future net income are not significantly different from the uncertainty of capital expenditures over any of the horizons we examine.

Overall, these results contrast with earlier estimates of the relative uncertainty of the benefits to tangible and intangible investments (Kothari et al. 2002). Nonetheless, there is evidence that the profitability of R&D has declined over time (Curtis et al. 2017), which could be correlated with a decline in the uncertainty of these benefits (e.g., due to a change in the type of R&D activities being undertaken). More recent evidence in Lev et al. (2016) suggests that sales and cost of goods sold volatility are lower in more recent periods. In untabulated analysis, we confirm that our method produces results similar to Kothari et al. (2002) in their sample period.

4.3. Can firms restrict access to R&D-related economic resources?

Our evidence thus far suggests that traditional arguments against capitalizing R&D are less relevant in the 21st century. However, standard setters are also proposing changes to the definition of an asset, in which the entity must have "rights or other access" to the economic resource under consideration.[17] This condition can be satisfied through ownership or legally enforceable rights over the economic resource. However, standard setters explain that if an entity can restrict others' access to an economic resource (i.e., it has privileged access), this also creates an asset.[18] Thus, the existence of a patent or trademark is not required to establish that an entity has the rights to an R&D-generated economic resource. This is an important distinction given that firms often decide not to patent technology they develop (e.g., Tesla).

To empirically examine the extent to which firms can restrict other entities access to various economic resources (i.e., the exclusivity), we investigate whether firms benefit from the expenditures of peer firms in terms of future cash flows and/or net income. That is, we

[17] Theory predicts that R&D expenditures might be more difficult to control relative to other investments. For example, Romer (1990), Jones (1995), and Jones and Williams (1998) argue that knowledge assets can be easily replicated, limiting a firm's ability to restrict access to the benefits of R&D activities.
[18] The example used is "an entity might have no legally enforceable rights to secret know-how, or an unpatented invention, but can use or sell the knowledge or invention (to generate cash inflows) and restrict, or otherwise prevent or limit, others' access. Therefore, the ability to restrict others' access also creates an asset of an entity in that it creates an advantage beyond the common advantages of others (that is, privileged access)" (FASB and IASB 2007).

supplement the model in Equation (1) with additional terms that capture aggregate spending by industry peers to estimate the exclusivity of economic resources that arise from various firm expenditures:

$$Benefits_{it+1,t+n} = \beta_0 + \beta_1 R\&D_{it} + \beta_2 Peer\ R\&D_{it} + \beta_3 Capex_{it} + \beta_4 Peer\ Capex_{it} + \beta_5 \Delta Intangibles_{it} + \beta_6 Peer\ \Delta Intangibles_{it} + \beta_7 Benefits_{it} + \beta_8 BM_{it} + \beta_9 LnMVE_{it} + \beta_7 Leverage_{it} + e_{it} \quad (3)$$

We define peer firms as those in the same three-digit SIC industry group. To calculate peer R&D spending we calculate aggregate R&D spending in the industry, excluding the firm's own expenditures, and scale by the sum of total assets of industry peers at the beginning of the year.[19] We define peer spending in capital expenditures and acquired intangibles using the same methodology. If use of the economic resource created by each type of expenditure can be restricted, we expect to see a non-positive coefficient on the related peer firm investment. Consistent with our prior analysis, we use two measures of future benefits (*OCF* and *NI*) and estimate Equation (3) using OLS and cluster standard errors by firm and year.

We present the results of estimating Equation (3) using operating cash flows as the dependent variable in columns 1 – 3 of Table 7. We continue to find evidence of positive associations between firm-level investments in R&D and capital expenditures and future operating cash flows once we include peer investments in the model. We also, however, we find a significantly positive association between peer R&D spending and firm-level future operating cash flows, implying that firms benefit from the R&D activities of industry peers, on average. In contrast, we find no evidence that peer firms' investments in tangible assets (i.e., capital expenditures) are associated with firm-level benefits.[20]

[19] We acknowledge that there is noise in defining peer firms as those in the same three-digit industry group. This should bias against finding an association between peer investment expenditures and firm-level benefits.
[20] If correlations in firms' growth opportunities were driving the positive association between peer firm R&D spending and a firm's future profits, we should also see similar evidence for capital expenditures. In untabulated

In columns 4 – 6 of Table 7 we present results using future values of net income as our measure of future benefits. Our main inferences with respect to the exclusivity of R&D and capital expenditures are unchanged using this alternative measure of future benefits. The peer firm effects of acquired intangibles are stronger in this analysis. This latter result suggests that acquisitions of intangible assets are generally for resources with greater exclusivity (e.g., patents).

Collectively, we interpret these results to illustrate that although expenditures in fixed assets typically do not provide benefits to peer firms, use of the economic resources that internal R&D activities generate is more difficult to control. Given the stated importance of the ability to restrict use of an economic resource to define an item as an asset, this result suggests that although R&D expenditures are capable of producing economic benefits to a firm, the lack of privileged access to this resource potentially provides a justification against capitalizing these expenditures under the proposed definition of an asset.

5. Further analysis

5.1. Industry-specific analysis

Our main results illustrate that there are benefits to R&D and these benefits are no more uncertain than capital expenditures. However, we also find that the R&D producing firms do not appear to have exclusive rights to their R&D. Given differences across industries in both the competitive structure, the nature and the intent of R&D activities, we next conduct an exploratory analysis in which we examine variation in these main results across the two Fama-

analyses we find a negative association between peer firm spending on advertising and the future cash flows of the firm. This result is consistent with advertising campaigns having positive business stealing effects on cash flows.

French industries with the most R&D spending (Business Equipment, Computers, Software and Electronic Equipment and Healthcare, Medical Equipment, and Drugs).

We present summary results for these two industries in Table 8. In Panel A we present the coefficient on R&D from Equation (1) when the dependent variable captures future benefits over a 5-year and 8-year horizon. When considering operating cash flows as the measure of future economic benefits, we find strong evidence of benefits to firm-specific R&D expenditures in Business Equipment, Computers, Software and Electronic Equipment (1.665 for the five-year horizon). In the Healthcare, Medical Equipment, and Drugs industry, however, we find no significant association between R&D spending and future economic benefits (–0.362 for the five-year horizon). Inferences are unchanged when using net income to proxy for future economic benefits.

In Panel B we present the results of estimating Equation (2), using the volatility of economic benefits over the subsequent five and eight years. Specifically, we present the coefficient on R&D and Capex, as well as the F-statistic comparing the magnitude of these coefficients. In both industries, we find no evidence that the association between R&D and the volatility of future operating cash flows or net income is significantly higher than the similar association for Capex. In the Business Equipment, Computers, Software and Electronic Equipment industry we find some evidence that over longer horizons, the association between R&D and the volatility of net income over the subsequent eight years is lower than that for capital expenditures. These results suggest that R&D is not a significantly more uncertain investment than capital expenditures in both the major industries in our sample.

Finally, in Panel C we present the results of estimating Equation (3), which provides evidence of how a firm's future profits are associated with peer firm spending (i.e., the exclusivity of R&D). Consistent with the results in Panel A, we continue to find that R&D expenditures are only positively correlated with future benefits in the Business Equipment, Computers, Software and Electronic Equipment industry. However, we find a negative (positive) coefficient on peer firm's R&D spending in the Business Equipment, Computers, Software and Electronic Equipment (Healthcare, Medical Equipment, and Drugs) industry. These differences indicate greater concerns about "privileged rights or access" to R&D-related economic resources in the Healthcare, Medical Equipment, and Drugs industry.

Overall, the results in Table 8 suggest that the properties of R&D expenditures vary significantly across industries, which should be informative to standard setters when considering accounting standards that apply broadly across industries. Moreover, by demonstrating substantial differences in the properties of R&D across major industries, these results reinforce the notion that allowing management to capitalize certain development costs based on their private information could potentially enhance the usefulness of reported R&D to investors and other stakeholders.

5.2. Robustness to missing future values

In our main analyses, we estimate the returns to R&D over the medium to long term (three to eight years) because investment expenditures typically provide a payoff with some lag. In these regressions, we only include firm-years with non-missing values of future net income for the entire future aggregation period under consideration. Excluding observations with missing future outcome variables could be problematic because we do not expect missing observations to be exogenously determined. Instead, all else equal, failing firms will be more likely to drop from our sample, and prior literature documents a positive association between R&D and contemporaneous operational distress (Resutek 2015). Therefore, our results could overstate the benefits to R&D and bias our estimates of the uncertainty of these benefits. To examine the impact of this potential survivorship bias, we set missing values of future benefits to zero, provided the future period is prior to 2016 and re-estimate the results in Tables 4 and 6.[21] Our inferences are unchanged once we correct for this potential survivorship bias (results untabulated).

6. Conclusion and Discussion

Under U.S. GAAP, R&D expenditures are immediately expensed when incurred (FASB 1974). The standard outlines that a lack of consistent evidence on the existence of, as well as uncertainty about, future benefits associated with these expenditures were important factors that influenced the decision to require expensing. However, there have been several changes since this time that raise questions about the continued relevance of these arguments and the accounting treatment of internal R&D activities. For instance, the increased significance of R&D spending as well the capitalization of acquired in-process R&D demonstrate the importance of R&D activities in a firm's production function. Moreover, Curtis et al. (2017) provide evidence that the properties of R&D have changed over time, with the benefits to R&D falling over the 1980s and 1990s, and stabilizing in the 2000s. This decline in profitability suggests the risk may have also fallen. Finally, the FASB and IASB have made efforts to amend the definition of an asset, which is intended to reduce the emphasis that is placed on uncertainty in determining the existence of an asset. Consequently, we investigate how the properties of R&D expenditures align with the current and proposed definitions of an asset.

[21] Because we only have data until 2015, some attrition in our sample is mechanical in that future years have not yet occurred (i.e., in 2012, we only have three years of available future data).

Consistent with prior literature, we find that R&D expenditures are positively correlated with future benefits to a firm, implying the existence of an economic resource. In contrast to prior evidence, we find that in more recent years the uncertainty of benefits of R&D is not significantly different from the uncertainty of benefits associated with capital expenditures. Finally, we provide evidence on the exclusivity of R&D investments. Our results reveal that unlike tangible economic resources (i.e., fixed assets), peer firms' R&D investments correlate with a firm's own future benefits, providing evidence of non-exclusive benefits to R&D expenditures. This suggests that firms do not experience the same privileged rights to these resources.

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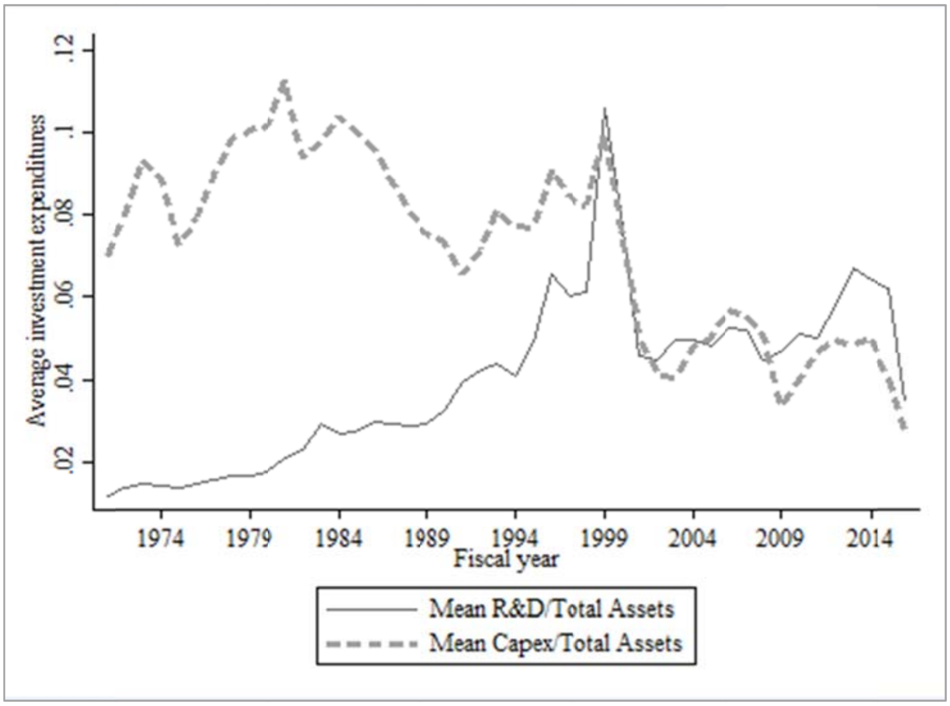
Appendix A

Variable Name	Definition
BM_t	Book-to-market ratio (Compustat items CEQ / (PRCC_F × CSHO))
$Capex_t$	Capital expenditures in year *t* scaled by total assets in year *t* – 1 (Compustat items CAPX / AT)
$\Delta Intangibles_t$	Change in intangible assets from year *t* – 1 to year *t* plus amortization expense in year *t* scaled by total assets in year *t* – 1 (Compustat items ($INTAN_t$ – $INTAN_{t-1}$ + AM) / AT)
$Leverage_t$	Leverage, measured as the book value of debt divided by the sum of book value of debt and market value of equity (Compustat items (DLC + DLTT) / (DLC + DLTT + (CHSO × PRCC_F))
$LnMve_t$	Log of market value of equity (Compustat items PRCC_F × CSHO)
NI_t	Net income before R&D, advertising and depreciation in year *t* scaled by total assets in year *t* – 1 (Compustat items (NI + XRD + XAD + DPC) / AT)
$NI_{t+1,t+n}$	NI aggregated from fiscal year *t* + 1 through fiscal year *t* + n
OCF_t	Operating cash flow before R&D and advertising in year *t* scaled by total assets in year *t* – 1 (Compustat items (OANCF + XRD + XAD) / AT)
$OCF_{t+1,t+n}$	OCF aggregated from fiscal year *t* + 1 through fiscal year *t* + n
$Peer\ INV_t$	Aggregate investment in a three-digit SIC code defined industry, excluding the firm's own expenditures, scaled by aggregate lagged total assets in the industry, excluding the firm's asset base, where investment (*INV*) equals *R&D, Capex, Advertising,* or Δ*Intangibles*
$R\&D_t$	R&D expenditures in year *t* scaled by total assets in year *t* - 1 (Compustat item XRD / AT)
$\sigma(NI_{t+1,t+n})$	Standard deviation of future adjusted net income (*NI*) from *t* + 1 through *t* + n, where future values are scaled by total assets at the end of year *t*. Scaled future variables are winsorized at the 1st and 99th percentiles
$\sigma(OCF_{t+1,t+n})$	Standard deviation of future adjusted operating cash flows (*OCF*) from *t* + 1 through *t* + n, where future values are scaled by total assets at the end of year *t*. Scaled future variables are winsorized at the 1st and 99th percentiles

Figure 1



This figure plots the average R&D/total assets and capital expenditures/total assets for all public companies on Compustat.

Table 1
Sample selection

	Number of observations
U.S. firms listed on NYSE, AMEX, or NASDAQ from 2000-2012 (with non-missing firm identifiers – CIK and GVKEY)	67,772
Less: Firm-years with non-positive or missing total assets in year *t* – 1 or year *t* or non-positive sales in year *t*	(13,392)
Less: Firm-years with missing BM, market value of equity, operating cash flow, net income, operating income, or leverage in year *t*	(6,491)
Less: Firm-years with missing SIC code	(428)
Final sample with year t data	**47,461**

Notes: This table presents a summary of our sample selection process.

Table 2
Descriptive statistics by industry

Panel A: Industry summary (all firm-years)

Fama-French 12 Industry	N	Proportion of R&D firms	Mean R&D/Sales
Consumer Non-Durables	2,287	0.273	0.007
Consumer Durables	1,052	0.781	0.059
Manufacturing	4,780	0.720	0.042
Oil, Gas, and Coal Extraction and Products	1,830	0.077	0.003
Chemicals and Allied Products	1,153	0.785	0.109
Business Equipment, Computers, Software and Electronic Equipment	9,743	0.876	0.207
Telephone and Television Transmission	1,384	0.162	0.030
Utilities	1,397	0.000	0.000
Wholesale, Retail, and Some Services	4,720	0.067	0.005
Healthcare, Medical Equipment, and Drugs	5,296	0.843	1.298
Finance	8,198	0.034	0.006
Other	5,621	0.133	0.083
Total	47,461	0.432	0.208

Panel B: Industry R&D descriptive statistics for R&D disclosers

		R&D/Sales			
Fama-French 12 Industry	N	Mean	25th %	50th %	75th %
Consumer Non-Durables	625	0.027	0.006	0.013	0.024
Consumer Durables	822	0.075	0.012	0.026	0.048
Manufacturing	3,441	0.058	0.008	0.017	0.039
Oil, Gas, and Coal Extraction and Products	141	0.037	0.002	0.005	0.019
Chemicals and Allied Products	905	0.139	0.012	0.020	0.032
Business Equipment, Computers, Software and Electronic Equipment	8,536	0.237	0.069	0.138	0.219
Telephone and Television Transmission	224	0.184	0.007	0.028	0.077
Utilities	0	-	-	-	-
Wholesale, Retail, and Some Services	318	0.077	0.002	0.006	0.062
Healthcare, Medical Equipment, and Drugs	4,464	1.541	0.069	0.207	1.465
Finance	275	0.166	0.036	0.092	0.196
Other	748	0.626	0.009	0.031	0.163
Total	20,499	0.482	0.022	0.083	0.204

This table presents summary descriptive statistics of our sample by Fama-French 12 industry classification. In Panel A, we present the proportion of R&D disclosers and average R&D/Sales of the industry for all firm-years. In Panel B, we present descriptive statistics of R&D/Sales for the subsample of firms that disclose non-zero R&D expense. Industry-groupings in Panel B are based on the Fama-French 12 industry classification.

Table 3
Descriptive statistics

Variables	N	Mean	25th %	50th %	75th %
$R\&D_t$	47,461	0.054	0.000	0.000	0.052
$Capex_t$	47,461	0.053	0.010	0.028	0.062
$\Delta Intangibles_t$	47,461	0.037	0.000	0.000	0.014
OCF_t	47,461	0.125	0.031	0.106	0.195
NI_t	47,461	0.102	0.019	0.097	0.183
BM_t	47,461	0.637	0.281	0.504	0.827
$LnMVE_t$	47,461	6.005	4.575	5.988	7.348
$Leverage_t$	47,461	0.231	0.010	0.154	0.380
$OCF_{t+1,t+5}$	31,355	1.016	0.264	0.666	1.302
$NI_{t+1,t+5}$	31,429	0.839	0.170	0.597	1.215
$\sigma(OCF_{t+1,t+5})$	31,429	0.117	0.026	0.059	0.131
$\sigma(NI_{t+1,t+5})$	31,355	0.108	0.027	0.055	0.114

Notes: This table presents descriptive statistics for the firms in our sample.

Table 4
Correlation matrix

	$R\&D_t$	$Capex_t$	$\Delta Intangibles_t$	NI_t	OCF_t	BM_t	$LnMVE_t$
$Capex_t$	*0.0479*						
$\Delta Intangibles_t$	*0.1444*	*0.1101*					
NI_t	*-0.0247*	*0.1022*	*0.0767*				
OCF_t	*0.1819*	*0.1784*	*0.1112*	*0.7248*			
BM_t	*-0.1691*	*-0.0964*	*-0.0389*	*-0.1366*	*-0.1806*		
$LnMVE_t$	*-0.1029*	*0.0796*	*0.065*	*0.2329*	*0.2142*	*-0.2984*	
$Leverage_t$	*-0.2931*	*-0.0712*	*-0.0707*	*-0.2279*	*-0.2784*	*0.2781*	*-0.1035*

This table presents pairwise correlations between the independent variables used throughout our analyses. Correlations are italicized if they are significantly different from zero at the 10% level. See Appendix A for variable descriptions.

Table 5
Benefits of R&D

	Cash-flow benefits			*Net income benefits*		
	(1)	(2)	(3)	(4)	(5)	(6)
	$OCF_{t+1,t+3}$	$OCF_{t+1,t+5}$	$OCF_{t+1,t+8}$	$NI_{t+1,t+3}$	$NI_{t+1,t+5}$	$NI_{t+1,t+8}$
$R\&D_t$	0.204	0.824***	2.581***	-0.042	0.573**	2.427***
	(1.26)	(3.33)	(4.47)	(-0.30)	(2.29)	(5.17)
$Capex_t$	1.031***	2.780***	6.786***	0.645***	1.920***	4.281***
	(10.46)	(12.42)	(8.61)	(4.13)	(9.89)	(7.71)
$\Delta Intangibles_t$	0.239**	0.536**	0.904	-0.180	-0.126	0.036
	(2.37)	(2.41)	(1.30)	(-1.39)	(-0.81)	(0.08)
OCF_t	2.448***	4.214***	7.430***			
	(20.33)	(17.27)	(11.66)			
NI_t				2.204***	3.659***	6.288***
				(14.37)	(12.59)	(10.20)
BM_t	-0.067***	-0.162***	-0.507***	-0.090***	-0.145***	-0.387***
	(-4.34)	(-3.96)	(-4.96)	(-4.35)	(-3.79)	(-4.30)
$LnMVE_t$	-0.008**	-0.042***	-0.167***	-0.012**	-0.029**	-0.093***
	(-2.07)	(-3.37)	(-5.42)	(-2.10)	(-2.27)	(-3.80)
$Leverage_t$	-0.228***	-0.526***	-1.206***	-0.177***	-0.393***	-0.940***
	(-6.81)	(-7.75)	(-6.74)	(-5.69)	(-6.43)	(-7.22)
Intercept	0.279***	0.752***	2.192***	0.342***	0.685***	1.644***
	(5.17)	(5.90)	(7.72)	(4.99)	(5.16)	(6.81)
Observations	40,473	31,355	19,745	40,533	31,429	19,820
R-squared	0.461	0.378	0.293	0.378	0.313	0.256

This table presents regression estimates of Equation (1). See Appendix A for variable definitions. We cluster standard errors by firm and year and present *t*-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 6
Uncertainty of R&D benefits

	Cash-flow benefits			*Net income benefits*		
	(1)	(2)	(3)	(4)	(5)	(6)
	$\sigma(OCF_{t+1,t+3})$	$\sigma(OCF_{t+1,t+5})$	$\sigma(OCF_{t+1,t+8})$	$\sigma(NI_{t+1,t+3})$	$\sigma(NI_{t+1,t+5})$	$\sigma(NI_{t+1,t+8})$
$R\&D_t$	0.280***	0.393***	0.567***	0.302***	0.434***	0.607***
	(9.21)	(10.33)	(13.20)	(11.12)	(11.83)	(10.00)
$Capex_t$	0.235***	0.372***	0.618***	0.309***	0.419***	0.647***
	(9.25)	(10.15)	(12.03)	(10.08)	(11.13)	(11.84)
$\Delta Intangibles_t$	0.043***	0.062**	0.090*	0.117***	0.140***	0.148***
	(2.73)	(2.20)	(1.68)	(8.79)	(5.22)	(2.96)
BM_t	-0.017***	-0.026***	-0.051***	-0.022***	-0.033***	-0.056***
	(-4.46)	(-4.18)	(-4.59)	(-5.52)	(-4.87)	(-5.53)
$LnMVE_t$	-0.011***	-0.017***	-0.028***	-0.012***	-0.018***	-0.029***
	(-13.84)	(-9.72)	(-9.03)	(-18.05)	(-12.77)	(-11.49)
$Leverage_t$	-0.054***	-0.084***	-0.132***	-0.038***	-0.068***	-0.117***
	(-8.76)	(-10.23)	(-9.62)	(-7.07)	(-9.09)	(-8.56)
Intercept	0.136***	0.203***	0.325***	0.146***	0.214***	0.334***
	(15.85)	(11.84)	(11.97)	(18.72)	(14.35)	(14.67)
F-statistic	3.392	0.339	0.553	0.040	0.122	0.294
(p-value)	(0.066)	(0.560)	(0.457)	(0.841)	(0.727)	(0.588)
Observations	40,473	31,355	19,745	40,533	31,429	19,820
R-squared	0.222	0.248	0.234	0.235	0.281	0.274

This table presents regression estimates of Equation (2). We also present the F-statistic and corresponding p-value from a test of the equality of the coefficients on *R&D* and *Capex*. See Appendix A for variable definitions. We cluster standard errors by firm and year and present *t*-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 7
Benefits to peer firm R&D spending

	Cash-flow benefits			*Net income benefits*		
	(1)	(2)	(3)	(4)	(5)	(6)
	$OCF_{t+1,t+3}$	$OCF_{t+1,t+5}$	$OCF_{t+1,t+8}$	$NI_{t+1,t+3}$	$NI_{t+1,t+5}$	$NI_{t+1,t+8}$
$R\&D_t$	0.096	0.606**	2.148***	-0.140	0.421*	2.178***
	(0.53)	(2.29)	(3.41)	(-1.12)	(1.65)	(4.69)
$Peer\ R\&D_t$	0.712***	1.409***	2.851*	0.771***	1.150*	1.911
	(2.60)	(2.72)	(1.75)	(2.94)	(1.80)	(1.42)
$Capex_t$	1.089***	2.862***	7.064***	0.774***	2.020***	4.528***
	(12.29)	(12.41)	(8.18)	(5.32)	(9.55)	(9.06)
$Peer\ Capex_t$	-0.072	-0.028	-0.426	-0.289**	-0.121	-0.490
	(-0.60)	(-0.07)	(-0.40)	(-2.15)	(-0.33)	(-0.53)
$\Delta Intangibles_t$	0.238**	0.540**	0.926	-0.172	-0.111	0.070
	(2.41)	(2.44)	(1.33)	(-1.36)	(-0.73)	(0.15)
$Peer\ \Delta Intangibles_t$	-0.010	-0.078	-0.667	-0.398***	-0.517**	-1.214**
	(-0.10)	(-0.29)	(-1.39)	(-3.19)	(-1.98)	(-2.39)
OCF_t	2.447***	4.213***	7.435***			
	(20.41)	(17.45)	(11.80)			
NI_t				2.203***	3.657***	6.292***
				(14.55)	(12.64)	(10.30)
BM_t	-0.067***	-0.161***	-0.508***	-0.091***	-0.147***	-0.390***
	(-4.29)	(-3.92)	(-4.97)	(-4.47)	(-3.83)	(-4.31)
$LnMVE_t$	-0.007*	-0.040***	-0.163***	-0.011*	-0.027**	-0.090***
	(-1.83)	(-3.17)	(-5.18)	(-1.90)	(-2.09)	(-3.55)
$Leverage_t$	-0.204***	-0.480***	-1.126***	-0.162***	-0.370***	-0.912***
	(-6.79)	(-6.91)	(-6.34)	(-4.22)	(-4.76)	(-5.85)
Intercept	0.254***	0.702***	2.121***	0.338***	0.666***	1.637***
	(5.11)	(5.38)	(7.50)	(4.42)	(4.52)	(5.98)
Observations	40,365	31,275	19,705	40,424	31,348	19,779
R-squared	0.461	0.378	0.293	0.380	0.314	0.257

This table presents regression estimates of Equation (3). See Appendix A for variable definitions. We cluster standard errors by firm and year and present *t*-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 8
Industry analysis

Panel A: Benefits to R&D

	Business Equipment, Computers, Software and Electronic Equipment				Healthcare, Medical Equipment and Drugs			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$OCF_{t+1,t+5}$	$OCF_{t+1,t+8}$	$NI_{t+1,t+5}$	$NI_{t+1,t+8}$	$OCF_{t+1,t+5}$	$OCF_{t+1,t+8}$	$NI_{t+1,t+5}$	$NI_{t+1,t+8}$
$R\&D_t$	1.665***	3.417***	1.740***	4.431***	-0.362	0.566	-0.525	0.234
	(3.75)	(3.05)	(4.00)	(4.28)	(-1.35)	(0.82)	(-1.60)	(0.35)
Observations	6,030	3,793	6,057	3,813	3,269	1,967	3,272	1,969
R-squared	0.381	0.277	0.285	0.233	0.191	0.109	0.286	0.171

Panel B: Uncertainty of R&D benefits

	Business Equipment, Computers, Software and Electronic Equipment				Healthcare, Medical Equipment and Drugs			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\sigma(OCF_{t+1,t+5})$	$\sigma(OCF_{t+1,t+8})$	$\sigma(NI_{t+1,t+5})$	$\sigma(NI_{t+1,t+8})$	$\sigma(OCF_{t+1,t+5})$	$\sigma(OCF_{t+1,t+8})$	$\sigma(NI_{t+1,t+5})$	$\sigma(NI_{t+1,t+8})$
$R\&D_t$	0.341***	0.504***	0.359***	0.484***	0.385***	0.544***	0.401***	0.556***
	(6.31)	(7.07)	(8.09)	(6.94)	(10.88)	(9.71)	(11.05)	(9.55)
$Capex_t$	0.443***	0.869***	0.508***	0.906***	0.311***	0.534***	0.349***	0.520**
	(4.60)	(3.35)	(5.71)	(4.16)	(2.92)	(2.95)	(3.14)	(2.53)
F-statistic	1.14	1.59	2.52	3.09	0.48	0.00	0.19	0.02
(p-value)	(0.29)	(0.21)	(0.11)	(0.08)	(0.49)	(0.96)	(0.67)	(0.88)
Observations	6,030	3,793	6,057	3,813	3,269	1,967	3,272	1,969
R-squared	0.236	0.210	0.270	0.248	0.229	0.200	0.250	0.242

Table 8, continued.

Industry analysis

Panel C: Benefits to peer firm R&D spending

	Business Equipment, Computers, Software and Electronic Equipment				Healthcare, Medical Equipment and Drugs			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$OCF_{t+1,t+5}$	$OCF_{t+1,t+8}$	$NI_{t+1,t+5}$	$NI_{t+1,t+8}$	$OCF_{t+1,t+5}$	$OCF_{t+1,t+8}$	$NI_{t+1,t+5}$	$NI_{t+1,t+8}$
$R\&D_t$	1.748***	3.607***	1.822***	4.596***	-0.589**	0.103	-0.707**	-0.061
	(3.80)	(3.14)	(4.13)	(4.35)	(-2.25)	(0.17)	(-2.12)	(-0.09)
$Peer\ R\&D_t$	-2.854*	-9.707**	-2.680	-4.941	4.073***	6.326**	3.012**	3.216
	(-1.95)	(-2.19)	(-1.59)	(-1.13)	(3.23)	(2.05)	(2.45)	(1.10)
Observations	6,030	3,793	6,057	3,813	3,269	1,967	3,272	1,969
R-squared	0.385	0.285	0.291	0.241	0.201	0.114	0.290	0.171

This table presents regression estimates of Equations 1-3 in Panels A-C respectively for two major industries in our sample. We also present the F-statistic and corresponding p-value from a test of the equality of the coefficients on *R&D* and *Capex* in Panel B. See Appendix A for variable definitions. We cluster standard errors by firm and year and present *t*-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.10.