The Consequences of Limiting the Tax Deductibility of R&D

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Abstract

We study the real effects of limiting the tax deductibility of research and development ("R&D") expenditures. Beginning in 2022, U.S. companies are required to capitalize and amortize R&D rather than immediately deduct these expenditures. We use variation in U.S. firms' fiscal year ends to examine the extent of – and heterogeneity in – firms' responses to the R&D tax change in a difference-in-differences framework. We first document that affected U.S. firms' cash effective tax rates increase by 9.6 to 10.9 percentage points (47.5% to 56.8%). Second, we find that R&D investment declines in response to the change, and the effects are largest for research-intensive, domestic-only, and constrained firms. In aggregate, we estimate a reduction in R&D of $18.0 billion in the first year among the most research-intensive firms. Finally, we observe decreased capital expenditures and share repurchases among affected companies, consistent with the policy change impacting firms' other investing and financing decisions. This paper provides policy-relevant evidence regarding the significant real effects of limiting the R&D tax deduction, which is an important but understudied innovation tax incentive.

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1 Introduction

This paper provides initial evidence on the consequences of an important U.S. tax law change limiting the tax deductibility of research and development (R&D) expenditures. R&D, and innovation more generally, is a key determinant of long-term economic growth (e.g., Solow 1957; Romer 1990). Consequently, most countries offer tax incentives, such as immediate expensing, to stimulate innovative activities (e.g., EY 2023). Beginning in 2022, the U.S. requires firms to capitalize and amortize R&D expenditures, rather than immediately deducting them, as was the case for decades. U.S. companies have expressed concerns about the potential effects of this tax law change on U.S. competitiveness. For example, in a November 2022 letter to the U.S. Congress, Chief Financial Officers of 178 large U.S. companies, including Ford Motor Co., Raytheon Technologies Corp, Lockheed Martin Corp, and Boeing Co., warned, "Unfortunately, the current playing field is tilted against the U.S., and every day this policy continues to be in place makes it harder for the U.S. to remain a global leader in innovation" (WSJ 2022). We identify \$59 billion of impacted tax benefits among U.S. public companies, and we examine (i) the extent to which U.S. companies decreased R&D investments in response to this tax law change, (ii) which companies were most impacted, and (iii) spillover effects of the tax law change beyond firms' R&D decisions.

Studying the U.S. R&D capitalization and amortization requirement (hereafter "R&D capitalization" or "R&D tax change") is important for two main reasons. First, this tax law change has potential implications for the effectiveness of U.S. innovation tax policy in incentivizing U.S. R&D investment. Such policies aim to address underinvestment that occurs because investing firms do not capture all the financial benefits of their R&D investments. Rather, a significant portion of these benefits spill over to other firms, consumers, and society (Lucking et al. 2019). To incentivize R&D investment, the U.S. provides two main innovation tax incentives: the R&D credit and the R&D deduction. Although prior literature focuses predominantly on the U.S. R&D credit (e.g., Berger 1993; Hall 1993; Klassen et al. 2004;

Finley et al. 2015; Rao 2016), we estimate that prior to this tax law change, the aggregate annual tax savings from the R&D deduction were *twice* as large as those from the R&D credit. Thus, the R&D tax deduction is a key U.S. innovation tax incentive. However, the R&D deduction's role in stimulating U.S. R&D activity is underexplored, and the change to R&D capitalization and amortization is at odds with U.S. policy goals of increasing U.S. R&D investments.

Second, this tax law provision is novel because there were strong expectations it would be repealed before it became effective. The R&D capitalization requirement was included in the 2017 Tax Cuts and Jobs Act (TCJA) primarily to raise revenue to offset the costs of other TCJA provisions, but the effective date was delayed until 2022. For example, the Bloomberg Editorial Board explained: "If this [R&D capitalization] sounds foolish, that's because it was never intended to actually happen. Lawmakers scheduled the end of full expensing for R&D as one of many maneuvers to make budget numbers add up in outlying years... The law's designers expected policymakers to revisit the matter before any harm was done. Congress never got around to it" (Bloomberg 2023). However, even with bipartisan agreement that R&D capitalization should be repealed, the U.S. Congress was unable to enact legislation to do so (e.g., WSJ 2023c; WSJ 2023d). Thus, our study sheds light on the real economic costs of this unique tax law provision and how those costs differ across firms.

Under the new R&D capitalization requirement, instead of immediately deducting 100% of R&D costs, U.S. companies must capitalize and amortize domestic R&D investment over a five-year period. While the total *nominal* amount of deductions is the same over time (i.e., 100% of the investment cost will eventually be deducted), the *real* present value of the tax benefits is lower because the deductions are spread over time. This reduced present value of R&D tax benefits increases the after-tax cost of R&D.

Economic theory predicts that increases in tax burdens decrease capital investment spending (Hall and Jorgenson 1967; Rao 2016). Prior research examining changes in the timing of other tax deductions (i.e., depreciation on capital investments) documents sizeable effects on corporate investment (e.g., Zwick and Mahon 2017; Ohrn 2019; Garrett et al. 2020; Curtis et al. 2022). In addition, anecdotal evidence indicates companies may cut R&D in response to this tax law change. For example, Moderna Inc.'s CFO Jamey Mock cautioned, "The recent change in research and development capitalization rules will require a greater use of short-term cash and could place some pressure on the amount that innovative, research-based companies can invest over time" (WSJ 2023a).

Although theoretical predictions and prior empirical evidence demonstrate the importance of tax deduction timing to capital investment decisions, several factors may limit the impact of R&D capitalization on U.S. companies' R&D investments. Mostly notably, some policymakers and business leaders were confident the R&D capitalization requirement would be repealed before taking effect (e.g., Bloomberg 2023; WSJ 2023c; WSJ 2023d). For example, Doyle Edwards, director of government programs for Brewer Science, admitted, "Our understanding was that Congress was going to find a way to fix it, so we really didn't plan for it" (WSJ 2023c). To the extent companies expected R&D capitalization to be repealed before their taxes were due for the 2022 year, they may not have incorporated the tax law change into their R&D investment decisions. Second, due to high R&D adjustment costs, firms' responses to the increased after-tax cost of R&D may be muted in the short run (e.g., Hall and Lerner 2010). Third, given the critical role of innovation in long-term growth and competitiveness, firms may have prioritized R&D and instead adjusted other financial decisions, such as capital expenditures or shareholder payouts. Thus, while we expect firms to reduce R&D investment in response to this change, the magnitude and pervasiveness of this response are empirical questions.

To quantify the effect of R&D capitalization on U.S. firms' R&D investments, we employ a difference-in-differences research design that exploits variation in U.S. firms' fiscal year ends. Specifically, we compare U.S. December fiscal-year-end firms (whose fiscal years ending in

December 2022 were the first impacted by R&D capitalization) to U.S. firms with fiscal years ending in September, October, or November 2022 (who were not yet affected by the change). To address concerns about differences between treatment and control firms, we (i) require all firms to engage in R&D activity in at least one pre-period year, (ii) entropy balance treatment and control firms based on observable firm characteristics, and (iii) include firm- and event-year fixed effects that absorb other unobservable differences across the two groups. Event-study plots confirm that treatment and control firms exhibit similar pre-period patterns in tax payments and R&D investment.

Before examining the impact of R&D capitalization on R&D investment, we document the impact on U.S. companies' tax payments. First, we identify 570 December year-end firms with financial statement deferred tax asset (DTA) disclosures specifically related to the R&D tax change. In 2022, these firms capitalized $496 million of R&D, on average, which is equivalent to 14.2% of total assets. Second, coefficient estimates from regression analyses show that treatment firms report a 9.6 percentage point increase in cash effective tax rates ("ETRs") on average. This effect is equivalent to a 47.5% increase given treatment firms' average cash ETR of 20.2 percent.

Next, we examine our research questions regarding the impact of the R&D capitalization requirement on U.S. companies' R&D investments. We observe a significant on-average decrease in R&D investment among treatment firms relative to control firms after the R&D tax change of approximately 0.6% of assets, which represents a decline of 4.5% relative to the sample mean R&D scaled by assets. Additionally, we observe decreased R&D investment among three groups of firms that are most acutely affected by the R&D capitalization requirement: (1) research-intensive firms, (2) domestic-only companies, and (3) financially constrained firms for whom the sudden increase in cash taxes likely further hindered their ability to fund R&D investments. Observing that the effects vary predictably across these subsamples is consistent with the effects being attributable to the 2022 R&D tax change and not to other policy or regulatory events. For the most research-intensive firms whose average R&D is 31.8% of assets, the decline relative to control firms is 3.7% of assets ($63.5 million per firm). This is equivalent to 11.6% of these firms' average R&D (scaled by assets), which is similar to estimates in Zwick and Mahon (2017) of firms' responses to bonus depreciation.[1] In aggregate, for the most research-intensive firms, this represents a decrease in R&D of $18.0 billion in the policy's first year alone. The aggregate impact across all firms in the economy is likely greater when taking into account private firms for which data are not publicly available to estimate the response.

While constrained firms cut R&D investment, unconstrained firms appear to largely sustain their innovation activity. This suggests that unconstrained firms adjust along other margins to compensate for the increased tax payments triggered by R&D capitalization. Thus, we test the effect of the R&D tax change on other financial decisions and find that unconstrained firms reduce share repurchases and capital investment.

In additional analysis, we investigate the effect of R&D capitalization on innovation quality. We separate firms based on several proxies of innovation quality (measured over the sample pre-period), including patent grants and patent citations, patent value (Kogan et al. 2017), innovative efficiency (Hirshleifer et al. 2013), and R&D output elasticity (Cooper et al. 2022). We do not observe a difference in the R&D investment effects across these subsamples. Thus, we fail to find evidence that firms that were more innovative prior to the R&D tax change reduced R&D to a greater extent than other firms. We caveat that the firm-level innovation quality proxies used in the literature do not permit an analysis of within-firm changes made across a portfolio of projects (such as cutting incremental R&D projects). Consequently, it is difficult to evaluate the extent to which the foregone investments would have been value-increasing for firm stakeholders or society.

This paper contributes some of the first evidence regarding the R&D deduction to the

[1] Bonus depreciation accelerates tax deductions for specified capital expenditures. Zwick and Mahon (2017) find a 10.4% (16.9%) investment response to bonus depreciation between 2001 and 2004 (2008 and 2010).

academic literature on innovation tax policy. While prior research has generally focused on the R&D tax credit (Hall 2022), it has largely overlooked the R&D tax deduction, despite the tax benefits from the U.S. R&D tax deduction significantly exceeding those of the R&D tax credit. Glaeser and Lang (2024) conclude "how tax incentives affect innovation, and in particular the degree to which they affect real innovation production over shorter horizons, are open empirical questions" (pg. 21). We contribute to the literature by providing evidence on the extent to which limiting the tax deductibility of R&D impacts U.S. firms' short-run R&D investments and on which types of firms are most impacted. In so doing, we shed light on a common, yet understudied, policy for incentivizing R&D and answer the calls in Jacob (2022) and Lester and Olbert (2024) for research on the effects of tax base elements on investment behavior.

Importantly, this paper provides timely, policy-relevant evidence of the impact of the R&D capitalization requirement on U.S. firms. This issue is of great concern to policymakers, the media, and U.S. firms. While countries worldwide have been increasing tax incentives for innovation (EY 2023), the U.S. R&D capitalization requirement decreased the tax benefits available for U.S. innovative activities. R&D capitalization was included in the TCJA to reduce the estimated cost of the legislation. We document the real economic costs of such legislative accounting maneuvers and of lawmakers' inability to take timely actions with respect to this policy despite bipartisan agreement it should be repealed. Even if immediate R&D expensing is eventually restored, R&D capitalization has had immediate consequences for U.S. firms that cannot be fully unwound (WSJ 2024).

2 Background and Research Questions

2.1 Innovation Tax Incentives Background

Economic theory demonstrates that changes in taxation influence investment decisions by changing the after-tax user cost of capital (Hall and Jorgenson 1967; Rao 2016). Specifically, Hall and Jorgenson (1967) model two specific channels through which tax changes increase capital investment: (i) increased deductibility of investment expenditures and (ii) reduced tax rates on income derived from such investments. Rao (2016) extends this model to R&D, showing that these two channels also impact innovation-related investment.

Governments provide innovation tax incentives because companies would otherwise underinvest in R&D relative to the socially optimal level (Solow 1957; Romer, 1990). This underinvestment arises because the returns to R&D extend beyond the investing firm, generating information spillovers and positive externalities that benefit the broader economy (Lucking et al. 2019). Additionally, R&D projects are high-risk, making them difficult and costly to finance. Innovation tax incentives typically take one of two forms: *output*-based tax incentives (e.g., lower tax rates on profits derived from innovation activities, such as patent box regimes) and *input*-based tax incentives (e.g., deductions and tax credits for R&D expenditures). Empirical research on output-based incentives generally finds that lower tax rates are associated with increased innovation (e.g., Akcigit et al. 2022; Atanassov and Liu 2020).

Our study examines the effects of a change in a U.S. *input*-based innovation incentive. Broadly, input-based innovation incentives fall into two categories.[2] The first, R&D tax credits, have been extensively examined in prior research. Prior literature generally finds that the U.S. R&D tax credit is associated with greater R&D investment (e.g., Berger 1993; Hall 1993; Bloom et al. 2002; Klassen et al. 2004; Gupta et al. 2011; Finley et al. 2015).

[2] Appendix A provides a detailed explanation of the input-based innovation incentives available in the U.S.

However, additional studies conclude that R&D tax credits primarily affect the location of R&D activity (Wilson 2009) and the type of R&D investments (Rao 2016), rather than generating incremental R&D spending. Further, the complexity of the U.S. R&D credit creates uncertainty about the expected value of the tax benefits (Towery 2017), which can discourage firms from claiming the credit and consequently reduces the effectiveness of the credit in stimulating additional R&D investment (Cowx 2024).

The second category of input-based innovation tax incentives is the tax deduction for R&D expenditures. The R&D deduction allows firms to deduct R&D expenditures that may not qualify for the R&D tax credit. In the U.S., for example, all experimental or laboratory costs related to the development or improvement of a product or process are eligible for the tax deduction (I.R.C. 174; Deloitte 2023). Prior to 2022, we estimate that the U.S. tax deduction for R&D provided more than *twice* the tax benefits of the U.S. R&D tax credit.[3] Globally, most countries also allow for immediate R&D expensing, and some jurisdictions such as Brazil and China offer "super-deductions" that exceed 100% of incurred R&D expenditures (EY 2023).[4]

The ability to immediately deduct R&D expenditures reduces the after-tax present value cost of R&D investments and, consistent with the theory discussed above, should incentivize greater investment in innovation. This tax benefit is analogous to bonus depreciation, which allows firms to immediately deduct a significant portion (e.g., 30% to 100%) of the cost of qualifying tangible assets. Empirical research on bonus depreciation finds that immediate expensing increases firms' capital investments. For example, Zwick and Mahon (2017) docu-

[3]In 2021, the total amount of R&D deducted on corporate tax returns exceeded $327 billion. At a 21% statutory corporate tax rate, this translates to tax savings of approximately $69 billion. By comparison, the total value of R&D tax credits claimed was $22.4 billion. These amounts are based on IRS Statistics of Income estimates from Schedule M-3, Part III, line 35 column (d) of research and development costs deducted per the tax return for Form 1120 filers, as well as estimates from Form 3800, Part III, line 1c for the credit for increasing research activities (Internal Revenue Service 2024).

[4]For example, China and Brazil allow companies to deduct up to 200% of their qualifying R&D expenditures. Thus, a company that spends $1 million on R&D in these countries receives a $2 million tax deduction in the year of the investment. In contrast, under the current U.S. R&D capitalization rules, $1 million of R&D spending results in a deduction of only $100,000 in the year of investment, with the deduction for the remaining $900,000 spread over the following five years.

ment a 10.4% (16.9%) investment response to the U.S. bonus depreciation available between 2001 and 2004 (2008 and 2010).

2.2 U.S. R&D Capitalization and Amortization Requirement

A 2022 change in U.S. tax law requires firms to capitalize and amortize domestic R&D expenditures over a five-year period. Under this provision, firms can no longer immediately deduct 100% of R&D costs in the year they are incurred. Instead, deductions are spread over six years, with 10% deductible in the first year, 20% in each of the next four years, and the remaining 10% in the sixth year.[5] This change in tax treatment significantly reduces the present value of the tax benefits associated with R&D deductions.

Appendix B provides an illustrative example quantifying this reduction. Assuming R&D spending of $304 million in year 1, which is the average amount for firms in our sample, and applying the U.S. corporate tax rate of 21%, the tax benefit under the pre-2022 law, which allowed for full expensing, would have been $63.8 million ($304 million × 21%). In contrast, under the new law, only 10% of the R&D expenditures ($30.4 million) can be deducted in the first year, with the remaining amount spread over the following five years. This change reduces the tax benefit in the year of the R&D spending to only $6.4 million ($30.4 million × 21%), and reduces the present value of the total tax benefit to $53.0 million.

Figure 1(a) depicts the differences in the current period present value of R&D tax benefits over a 10-year period, where year 1 is the first year of R&D capitalization. While the difference in the single year present value is greatest in year 1, differences persist through year 6, which is the point at which the nominal annual tax deductions under the old and new rules equalize, assuming constant R&D spending. Appendix B shows that, when incurring $304 million of R&D costs annually for ten years, firms receive total tax benefits of $638 million under the prior immediate expensing rules ($304 million × 21% × 10 years). In contrast,

[5] The five-year amortization period occurs over six years due to the half-year convention, which only allows 50% of the deduction (20% × 50%) in the first year.

under the new amortization rules, the present value of the tax benefits is approximately only *two-thirds* of this amount at $407 million. Figure 1(b) depicts this cumulative difference in the present value of R&D tax benefits over time.

Because the R&D capitalization requirement decreases the present value of the tax benefits from deducting R&D costs, it increases the after-tax cost of R&D investments. As a result, consistent with economic theory and prior empirical research on the effects of deduction timing on capital investment, we expect U.S. firms to reduce R&D investment in response to this tax law change. This expectation aligns with concerns expressed by companies regarding the impact of R&D capitalization. For example, Yelp's Chief Financial Officer David Schwarzbach stated the requirement to capitalize and amortize R&D "really creates an inhibitor for increasing investment" (WSJ, 2023b).

This significant change in the tax treatment of U.S. companies' R&D expenditures presents a rare opportunity to study the effect of the R&D tax deduction on innovation. Specifically, this setting offers two key advantages. First, given the magnitude and salience of the tax law change, firms are likely to adjust their R&D investment decisions in response. Second, the change was relatively isolated from other tax policy changes, which enhances our ability to identify casual effects. This was the first substantial change in the U.S. R&D tax deduction since its inception in 1954. Although the R&D capitalization requirement was included in the TCJA of 2017, its implementation was delayed until 2022. Thus, the policy took effect after the initial years of the TCJA, as well as after the height of the COVID-19 pandemic. Given the absence of confounding earlier events specific to this policy, we can more confidently attribute observed changes in R&D investment to this specific tax policy change.

While economic theory and prior empirical research support the prediction that U.S. firms will reduce their R&D investment in response to this tax law change, the extent of the effects of R&D capitalization on U.S. firms' R&D investments is an open empirical question. We focus on quantifying the magnitude of the effect because the initial impact on U.S. firms' R&D investments may be limited for several reasons. First, many businesses and policymakers expected Congress to repeal the requirement before it took effect. For example, during Tyler Technologies, Inc.'s fourth-quarter 2022 earnings conference call, CEO H. Lynn Moore explained, "Since the enactment of the TCJA, businesses, including us, have been monitoring congressional actions around this rule, and there was a strong expectation that Section 174 would be repealed or delayed. However, Congress has not yet taken action." Appendix C provides additional examples of conference call discussions in which executives expressed similar expectations. Because some companies expected Congress to repeal the R&D capitalization requirement, they may not have incorporated the reduced present value of R&D tax benefits into their investment decisions. Second, the relatively high adjustment costs associated with R&D may impede firms from immediately reducing R&D expenditures in response to its increased after-tax cost.[6] Third, innovation is important to firms' future growth and competitiveness. In the short-run, firms may prioritize maintaining R&D investment by adjusting along other margins, such as capital investment or shareholder payouts, rather than immediately scaling back innovation-related activities in response to the increased after-tax cost of R&D.

In light of the importance of the R&D deduction as a U.S. innovation tax incentive, the broader importance of innovation for U.S. long-term growth and competitiveness, and the unique legislative history of this tax law provision, our research questions examine (i) the magnitude of firms' R&D investment responses to R&D capitalization, (ii) heterogeneity in these responses across firms, and (iii) spillover effects of the tax law change on firms' capital investment and shareholder payout decisions.

[6] Research finds 50% or more of R&D spending relates to the wages and salaries of scientists and engineers. As a result, cutting R&D investment likely requires reducing R&D personnel. This is costly to firms because R&D expenditures generate a knowledge base embedded in the firm's human capital, which is lost if these employees are laid off (Hall and Lerner 2010).

3 Research Design and Data

3.1 Quantification of Tax Impact

Before examining our research questions, we first quantify the extent to which the R&D tax change affects U.S. companies' tax liabilities, measured with effective tax rates. Our identification strategy exploits variation in the timing of the effective date of the R&D capitalization requirement by comparing treated U.S. December year-end firms to not-yet-treated U.S. firms with fiscal years ending in September, October, or November, following prior work (Gipper 2021). Specifically, U.S. December year-end firms were required to capitalize and amortize R&D for their 2022 fiscal year, but U.S. firms with fiscal years ending in September, October, or November 2022 were not yet required to capitalize and amortize R&D for their 2022 fiscal year. Limiting the sample to U.S. firms with fiscal years ending close together in time ensures our treatment and control firms are subject to similar macroeconomic conditions. We estimate the following specification:

$$ETR_{it} = \beta_0 \ + \beta_1 \ Dec\ FYE\ Firm_i \times Post_t + ETR\ Controls_{it-1} + \alpha_i + y_t + \epsilon_{it} \qquad (1)$$

where *ETR* is the cash ETR (cash taxes paid divided by pre-tax income) or current ETR (current tax expense divided by pre-tax income). Both measures require positive pre-tax income. We trim observations with extreme ETR values that are less than zero or greater than one. The resultant measures, *Cash ETR* and *Current ETR*, are increasing in cash taxes paid and current tax expense, respectively.[7] Other variables are defined below and in Appendix E. The treatment timeline and event years are depicted in Appendix F. We include firm fixed effects (α) to address cross-sectional variation in effective tax rates not otherwise

[7]Because the R&D tax law change is not a permanent book/tax difference with respect to the total nominal deductions claimed, we expect less of an effect on the GAAP ETR and thus do not use this alternative measure. Appendix D provides an example of how this change affects a representative sample firm's Cash ETR, GAAP ETR, and the amount of R&D credit claimed.

captured by the control variables. We also include event-year fixed effects (y) to capture the effects of macroeconomic events occurring during the sample period. All continuous variables are winsorized at the 1st and 99th percentiles. Standard errors are clustered at the firm level.

Dec FYE Firm is an indicator variable set equal to one if the firm has a December fiscal year end. *Post* is an indicator variable set equal to one for fiscal years ending in 2022. The firm and event-year fixed effects subsume the main effects of *Dec FYE Firm* and *Post*, respectively. The variable of interest is the interaction term *Dec FYE Firm* $\times$ *Post*. A positive and significant β_1 coefficient indicates that treated U.S. firms paid higher cash taxes or incurred increased current tax expense in fiscal year 2022, relative to control U.S. firms not yet subject to the R&D capitalization requirement (i.e., firms with fiscal years ending in September, October, or November).

ETR Controls is a vector of control variables shown to be associated with tax avoidance in prior literature (e.g., Hoopes et al. 2012; Dyreng et al. 2017), including firm size (*Log(Assets)*), firm age (*Log(Age)*), leverage (*Leverage*), loss firm status (*Loss Firm*), performance (*ROA*), sales growth (*Sales Growth*), market-to-book ratio (*MTB*), cash holdings (*Cash*), R&D (*R&D Investment*), capital expenditures (*Capex*), property, plant, and equipment (*PPE*), domestic-only operations (*Domestic*), foreign income percentage (*Foreign Income %*), and the presence of net operating loss carryovers (*NOL Indicator*). We measure all control variables in year t-1 to ensure that they are not impacted by the R&D tax change (Whited et al. 2022).

Controlling for observable characteristics and including firm fixed effects helps address endogeneity concerns related to differences in treatment and control firms. We further ensure treatment and control samples are comparable across observable dimensions by employing entropy balancing, where treatment and control observations are balanced across all control variables using the first two moments of the distribution (Hainmueller 2012; Hainmueller and Xu 2013).[8]

3.2 R&D Investment Responses

To examine the extent to which R&D investment declines in response to the U.S. R&D capitalization requirement, we estimate the following model:

$$R\&D\ Investment_{it} = \beta_0 + \beta_1\ Dec\ FYE\ Firm_i \times Post_t + R\&D\ Controls_{it-1} + \alpha_i + y_t + \epsilon_{it} \quad (2)$$

where *R&D Investment* is research and development expenditures as reported in a firm's financial statements, scaled by beginning-of-year total assets. We scale R&D by assets to account for cross-sectional differences in R&D spending due to firm size (e.g., Brown et al. 2009; Ljungqvist et al. 2017; Kim and Valentine 2021; Williams and Williams 2021). *R&D Controls* is a vector of control variables intended to capture cross-sectional variation in firm characteristics associated with R&D investment decisions. Following prior literature (e.g., Ljungqvist et al. 2017; Armstrong et al. 2019; Guo et al. 2019; Kim and Valentine 2021; Williams and Williams 2021), we include firm size (*Log(Assets)*), age (*Log(Age)*), leverage (*Leverage*), performance (*ROA*), sales growth (*Sales Growth*), market-to-book ratio (*MTB*), cash holdings (*Cash*), capital expenditures (*Capex*), tangibility (*PPE*), an indicator for tax losses (*NOL Indicator*), an estimate of industry concentration (*Industry Concentration*), and institutional ownership (*Institutional Ownership*). The other variables are defined previously, and we retain firm and event-year fixed effects. A negative and significant β_1 coefficient indicates that U.S. R&D investment declines for treatment firms relative to control firms in response to the R&D tax change.

[8] Due to the larger number of treatment observations than control observations in our sample, we assign weights to the treatment sample rather than the control sample as recommended by McMullin and Schonberger (2020).

3.3 Data

Table 1 reports our sample selection procedure. We begin with all U.S. incorporated firms in Compustat North America with fiscal years ending January 1, 2019 through December 31, 2022. Starting the sample in 2019 ensures that the sample is not affected by the immediate impacts of the TCJA. We end in 2022 because our control firms become treated after this date. We exclude observations with missing industry codes, observations in the financial and utilities industries (SIC 6000 to 6999 and SIC 4900 to 4999, respectively), and observations with missing data necessary to construct control variables. As our research questions focus on the effect of a U.S. tax policy change, we exclude firms with missing or non-U.S. headquarters. We also exclude firms with fiscal years ending in January through August because of our identification strategy. We require non-missing R&D expense to calculate the dependent variable in Eq. 2. We further require firms to report positive R&D year in at least one pre-period year. Finally, we require that each firm have requisite data for our tests in the year prior to and the year of the tax law change (event years t-1 and $t = 0$, where the latter is the first year the U.S. R&D capitalization requirement is effective for December year-end firms). This sample selection procedure results in 3,710 observations (1,011 firms) for the event window [-3,0].

We also hand-collect deferred tax asset disclosures relating to the R&D tax change. Specifically, we search firms' Forms 10-K for R&D keywords, and then research assistants review each disclosure to determine if the firm was, in fact, impacted by this tax law change.[9] Appendix G provides examples of these disclosures. We use these disclosures to construct a "restricted" sample of treatment firms that excludes December fiscal year end companies for whom we do not identify a capitalized R&D disclosure. Thus, this restricted sample

[9]The keywords include capitalized development costs; capitalization of research and development, capitalized research and development, capitalized R&D, R&D capitalization, Section 174, and Sec. 174. Among the small number of firms that were previously electing to capitalize and amortize R&D in the pre-period (as evidenced by R&D-related deferred tax assets prior to the tax law change), we use the *increase* in the deferred tax asset from 2021 to 2022 to estimate the impact of the R&D change.

employs relatively strict requirements to construct the sample of "treatment" firms, for which we also estimate Eq. 1 and 2 to assess a range of economic magnitudes. This sample selection procedure results in 2,432 observations (663 firms).

3.4 Descriptive Statistics

Table 2 reports descriptive statistics for the variables used in our main analyses. Average R&D as a percent of assets (*R&D Investment*) is 12.6%. This value is higher than that reported in other R&D studies such as Ljungqvist et al. (2017) (5.3%) and Williams and Williams (2021) (2.7%), primarily because those studies include firms with zero values of R&D (including firms with missing R&D, which is reset to zero), whereas we require positive R&D in at least one pre-period year. For the 570 December year-end treatment firms for whom we identify a capitalized R&D disclosure, the average increase in the deferred tax asset related to the R&D tax change is $104.2 million (*R&D DTA*), which is equal to 3.0% of total assets (*R&D DTA / Assets*). In total, this represents $59 billion of deferred tax benefits for these firms; Figure 2 provides the amounts by industry. We also estimate the gross pre-tax amount of R&D expenditures impacted by dividing *R&D DTA* by the U.S. statutory tax rate of 21%; average *Capitalized R&D* is $496 million, or 14.2% of total assets (*Capitalized R&D/Assets*). *Capitalized R&D* exhibits substantial skewness, as the mean of *Capitalized R&D* is much greater than the median. Average values of *Cash ETR* and *Current ETR* are 21.9% and 22.0%, respectively.

Table 3 reports descriptive statistics after partitioning the sample on the treatment indicator (*Dec FYE Firm*). Panel A reports tests of differences in means for the control variables, measured across the full sample period. These tests indicate that treatment December year-end firms and control non-December year-end firms differ along several observable dimensions. After entropy balancing, the differences across treatment and control observations for all control variables are not statistically different from zero. Panel B reports tests of differences in means for dependent variables and cross-sectional variables, measured over the sample pre-period. Although treatment December year-end firms have higher levels of R&D (*R&D Investment*) and capital expenditures (*Capex Investment*) than control non-December year-end firms, the two groups exhibit statistically similar R&D and capital expenditure growth in the pre-period (*R&D Investment Growth* and *Capex Investment Growth*, respectively). This provides some comfort that, while the level of investment differed, the preceding trends were similar; we explicitly test this in Section 4. In addition, both sets of firms have statistically similar cash and current effective tax rates in the pre-period.

4 Results

4.1 Effective Tax Rates

Table 4 reports results from estimating Eq. 1 to quantify the impact of R&D capitalization on U.S. firms' tax burdens. Panel A reports results of the cash ETR analysis; Panel B reports results of the current ETR analysis. In both panels, we report results using a series of specifications: without controls or fixed effects (Column 1), with controls (Column 2), with controls and fixed effects (Column 3), with entropy balancing (Column 4), and using the restricted sample of treatment firms with R&D capitalization disclosures (Column 5). Across all specifications in both panels, the coefficient on *Dec FYE Firm* $\times$ *Post* is positive and significant, consistent with increases in cash tax payments and current tax expense following the R&D tax change. With respect to cash ETRs (Panel A), the coefficients in the most stringent specifications (Columns 4 and 5) translate to increased cash effective tax rates of between 9.6 and 10.9 percentage points, respectively, for December fiscal year-end firms relative to control firms. These magnitudes represent sizeable increases in *Cash ETR* ranging from 47.5% (0.096/0.202) to 56.8% (0.109/0.192) relative to the sample means of treated December fiscal year-end firms (reported at the bottom of the table).[10]

We take three steps to further assess the reasonableness of these large estimated effects. First, we confirm that the effects are not driven by observable pre-period differences in the treatment and control firms. Figures 3(a) and 3(b) present the event study plots for *Cash ETR* and *Current ETR*, respectively, that correspond to Table 4. In both panels, the effects are plotted relative to base year t-1. The figures confirm that treatment and control firms exhibit similar pre-event trends in the outcomes of interest without and with entropy balancing on observables. The figures also depict the statistically significant increase in ETRs for treated firms in 2022 (t=0).

Second, we review firm disclosures to further place the magnitudes in context. Consistent with the effects in Table 4, the examples in Appendix G show large increases in deferred tax assets specifically related to this tax law change. These examples validate that our estimated effects are in line with the underlying impact.[11]

Third, we prepare example ETR calculations based on the average firm in our sample. Appendix D shows that this tax law change reduces the average firm's cash ETR by approximately 8.9 to 10.0 percentage points, depending on R&D growth, which is in line with our estimates.

4.2 R&D Investment Responses

Table 5 reports the results of examining U.S. firms' on average R&D investment response to the R&D capitalization requirement. Similar to Table 4, we present a series of increasingly stringent specifications. In Column (1), we observe a negative and statistically significant coefficient on the interaction of *Dec FYE Firm* × *Post*, providing initial evidence of a decline

[10] In untabulated tests, we obtain similar inferences when winsorizing ETRs at 0 and 1 rather than trimming: cash ETRs increase by 12.9 to 15.1 percentage points.

[11] Appendix G shows DTAs for capitalized R&D reported by Bristol-Myers Squibb Company ($1.5 billion) and PepsiCo Inc. ($150 million); these companies reported increases in their cash ETRs following the tax law change of 26.8 and 6.2 percentage points, respectively, reflecting the large impact across firms.

in R&D investment among treated firms relative to control firms, on average. This effect persists when including controls (Column 2), fixed effects (Column 3), and entropy balancing (Column 4) in the model. Figure 4(a) presents the event study plots corresponding to Columns (3) and (4), and confirms parallel pre-period trends in R&D expenditures among treatment and control observations.

In Column (4), the coefficient estimate (-0.006) indicates an R&D investment decrease in response to the R&D tax change of approximately 0.6% of assets. This represents a decline of 4.5% relative to the sample mean of *R&D Investment* (0.006/0.132). Based on these firms' average assets of $7,546 million (untabulated), we estimate a decrease in U.S. R&D investment of $45.3 million per firm in the first year. There are 918 December fiscal year end firms in our main sample, which results in an estimated aggregate decline in R&D investment among our sample of $41.6 billion.

Column (5) reports results restricting the treatment sample to December fiscal year end firms that make R&D capitalization disclosures. The coefficient on the interaction of *Dec FYE Firm* × *Post* (0.006) is equivalent to that estimated using the full sample (Column 4), but is not statistically significant (two-tailed p-value of 0.110), likely due to lower statistical power attributable to the smaller sample size.

4.3 Differential R&D Investment Responses Across Firms

We next examine heterogeneity in the R&D response across groups of firms that should be most impacted by the R&D tax change: firms that are more R&D-intensive, firms operating entirely in the U.S., and financially constrained firms. Observing that the results vary predictably across these subsamples would further confirm that the driving force behind the documented effects is the R&D tax change.

For each cross-sectional test, we re-estimate Eq. 2 after including a triple interaction with a cross-sectional indicator variable. In each test, the coefficient on *Dec FYE Firm* ×

Post represents the difference-in-differences (DiD) estimate for the benchmark group (e.g., the change in R&D investment for multinational treatment firms, relative to multinational control firms). The sum of the coefficients on *Dec FYE Firm* × *Post* and the triple interaction term (reported at the bottom of each panel) represents the DiD estimate for the focal group (e.g., the change in R&D for domestic treatment firms, relative to domestic control firms). The coefficient on the triple interaction reflects the difference in these two DiD estimates.

4.3.1 R&D Intensity

First, we investigate whether the effect differs based on firm or industry research intensity. We re-estimate Eq. 2 after including a triple interaction with the indicator *High R&D Firm* or *High R&D Industry*. *High R&D Firm* equals one for firms with *R&D Investment* in the top tercile in event year t-1, and zero otherwise.[12] *High R&D Industry* equals one for firms in high R&D industries. We identify high R&D industries using the top tercile of industry-aggregate R&D spending scaled by industry-aggregate assets across the universe of Compustat North America firms measured in the year before the R&D tax change. High R&D industries include Business Services (SIC2 = 73), Miscellaneous Retail (SIC2 = 59), Electronic and Other Electric Equipment (SIC2 = 36), and Chemical and Allied Products (SIC2 = 28).

Table 6, Panel A, Columns (1) and (2) report the results of the high R&D tests. In Column (1), we observe a negative and significant coefficient on the triple interaction term, indicating the R&D capitalization requirement resulted in a greater decrease in R&D investment among treated research-intensive firms, as compared to low R&D treated firms, relative to their respective control groups. In terms of economic magnitude, the sum of the coefficients on *Dec FYE Firm* × *Post* × *High R&D Firm* and *Dec FYE Firm* × *Post* in Column (1) (as reported at the bottom of the table) translates to a decrease in R&D investment

[12] When forming terciles to construct indicator variables, we use all available firm-year observations in Compustat North America with necessary data.

of 3.7% of assets for treated research-intensive firms, relative to research-intensive control firms. This represents an 11.6% decline relative to these firms' average *R&D Investment* (0.318). Using these firms' average assets of $1,715.2 million (untabulated), we estimate a decrease in R&D investment of $63.5 million per firm in the first year. There are 283 treated high R&D firms in our sample, which results in an estimated aggregate decline in R&D investment among the most research-intensive firms in our sample of $18.0 billion. Figure 4(b) presents the event study plot for high R&D firms and confirms the absence of differential pre-period trends in R&D investment. The graphs also illustrate a decline in R&D among the research-intensive subsample. The results in Column (2) further support a decline in R&D spending among treated firms in the most research-intensive industries, relative to treated firms in other industries, following the tax law change. In an untabulated figure, we confirm similar trends in pre-period R&D investment among treatment and control firms in high R&D industries.

4.3.2 Domestic Firms

We next examine domestic-only firms relative to multinationals. While domestic firms are smaller than the average firm in our sample, we examine this subsample because all of their R&D investment is affected by the R&D tax change. Multinational companies may conduct R&D activities outside of the U.S., and the tax treatment of R&D in the country where the R&D takes place is unaffected by the U.S. tax law change.[13] Thus, we expect the R&D tax change to have a stronger impact on R&D investment for domestic-only firms. We re-estimate Eq. 2 after including a triple interaction with the indicator *Domestic*, which equals one for firms that report zero pre-tax foreign income and zero foreign tax expense in event year t-1, and zero otherwise. The main effect of *Domestic* is subsumed by firm fixed effects.

[13] Although the U.S. tax law includes a provision requiring a fifteen-year amortization period for foreign R&D investments, this provision is only applicable in calculations that involve foreign income for U.S. tax purposes (for example, the GILTI tax rules) and can have an unfavorable or favorable impact. See WSJ (2023a) for an example of a favorable impact.

As shown in Table 6, Panel A, Column (3), we observe a negative and significant coefficient on the triple interaction term (*Dec FYE Firm* × *Post* × *Domestic*), providing evidence of a greater decrease in R&D investment among treated domestic-only firms than treated multinational firms, relative to their respective control groups. The sum of the coefficients on *Dec FYE Firm* × *Post* × *Domestic* and *Dec FYE Firm* × *Post* indicates a decrease in R&D of approximately 2.5% of assets for treated domestic-only firms, relative to domestic-only control firms. This represents a decline of 11.4%, relative to the average *R&D Investment* in this subsample of 0.220 (0.025/0.220). Based on these firms' average assets of $387 million (untabulated), we estimate a decrease in U.S. R&D investment of $9.7 million per firm in the first year. There are 271 treated domestic-only firms in our sample, which results in an estimated aggregate decline in R&D investment among our sample of domestic-only firms of $2.6 billion. Figure 4(c) reports the event study plot for domestic-only firms and indicates similar pre-period trends in R&D investment.

4.3.3 Financial Constraints

Our final cross-sectional analysis examines whether the effect of the R&D tax change on R&D investment is greater among constrained firms. While the R&D tax change applies to all U.S. firms investing in R&D, the large increases in cash tax payments should particularly impact financially constrained firms. Brown et al. (2009) provide evidence that internal cash flows and external equity are important sources of R&D financing. Prior work shows that the effect of tax changes on investment vary based on constraints (e.g., Zwick and Mahon 2017). Further consistent with this evidence, Atanassov and Liu (2020) find the positive effect of corporate tax rate cuts on innovation is stronger for financially constrained firms.

We re-estimate Eq. 2 after including a triple interaction with *High Constraints*, an indicator variable equal to one for constrained firms, and zero otherwise. Due to the limitations of financial constraints proxies (see, for example, Farre-Mensa and Ljungqvist 2016), we use several proxies, including the Hadlock and Pierce (2010) size-age index and the Kaplan and Zingales (1997) KZ index.[14] For each index, we construct an indicator variable (*High HP Index* and *High KZ Index*, respectively) equal to one if the firm is in the top tercile of the financial constraint index in event year *t*-1, and zero otherwise. We also proxy for constraints using two firm-level characteristics: the indicator variables *Small* and *Young* are equal to one if the firm is in the bottom tercile of *Assets* or *Age* in event year *t*-1, and zero otherwise. Finally, *Negative OCF* is an indicator variable equal to one if the firm has negative cash flow from operations in event year *t*-1, and zero otherwise. A negative and significant coefficient on the triple interaction term implies a larger decrease in R&D investment for constrained treatment firms than for unconstrained treatment firms.

Table 6, Panel B reports the results. In three of the five specifications, we observe negative and significant coefficients on the triple interaction term *Dec FYE Firm* × *Post* × *High Constraints*. This indicates that the R&D capitalization requirement has a stronger impact on constrained firms than on unconstrained firms, relative to their respective control groups. Further, the sum of the coefficients on *Dec FYE Firm* × *Post* and *Dec FYE Firm* × *Post* × *High Constraints* is negative and statistically significant when using *High HP Index, Small, Young*, and *Negative OCF* constraint proxies. These coefficients suggest declines in R&D ranging from 2.8% to 6.5% of assets for constrained U.S. December year-end firms relative to their respective constrained control firms.[15] These coefficients translate to a decline of 14.0% (26.1%) for *Negative OCF* (*High HP Index*) firms relative to their mean *R&D Investment* of 0.221 (0.249). Based on the average total assets within each subsample of constrained firms, these effects translate to per firm R&D reductions ranging from $5 million among the *High*

[14] We do not use the Altman (1968) Z Score in these tests due to a lack of variation in this measure among control firms. Specifically, only 12 control observations are classified as constrained as defined by the top tercile of the Z Score distribution.

[15] One potential concern is that the constraint proxies capture firms in tax loss positions that are relatively insensitive to the R&D policy change. While we control for tax loss carryforwards, we also re-estimate our tests using subsamples of firms that we estimate have positive federal taxable income (untabulated). We identify these firms in the following three ways (each measured in event year *t*-1): (1) firms with positive pre-R&D pre-tax income, (2) firms with positive cash taxes paid, and (3) firms with positive current federal tax expense. We continue to find reduced R&D among constrained firms in these tests.

HP Index subsample to $21 million among the *Negative OCF* sample.

Figure 4(d) reports the event study plot for the *High HP Index* constraint proxy. This plot confirms the absence of differential pre-period trends in constrained firms' R&D investment, and supports a decline in R&D investment among treated constrained firms following the R&D tax change. In untabulated figures, we confirm the existence of parallel pre-period trends for the other constraint measures, with the exception of *Small* for which we observe a slight difference in pre-period trends.

4.4 Effects on Shareholder Payout and Capital Investment

While Table 6, Panel B shows a decline in R&D investment among constrained December year-end firms, unconstrained firms appear to sustain their R&D investment despite the increased tax payments triggered by R&D capitalization. Therefore, we study whether these unconstrained firms adjust along other margins in response to the increase in their U.S. tax liability triggered by the R&D tax change. Specifically, we estimate the following specification:

$$Outcome_{it} = \beta_0 + \beta_1 \; Dec\; FYE\; Firm_i \times Post_t + Outcome\; Controls_{it-1} + \alpha_i + y_t + \epsilon_{it} \quad (3)$$

Where *Outcome* is *Repurchases* or *Capital Investment* and *Outcome Controls* represents a vector of control variables, described below and in Appendix E. We include firm and event-year fixed effects and cluster standard errors by firm.

We first examine whether treated firms reduce share repurchases in response to the R&D capitalization requirement. We examine *Repurchases* because they are a more flexible shareholder payout vehicle than dividends, and prior work shows that firms alter repurchases after tax changes (e.g., Blouin and Krull 2009). Following Nessa (2017), we measure *Repurchases* based on a firm's purchases of common and preferred stock, less any annual decrease in redemption value of preferred stock, scaled by beginning of year assets. Control variables include *Domestic ROA, Foreign ROA, Log(Assets), Sales Growth, MTB, Capex, Log(Age), Retained Earnings, Cash, Domestic ROA Volatility, Foreign ROA Volatility,* and *Returns*.

Table 7, Panel A reports the results, with effects for the full sample with requisite data in Column (1). Columns (2) through (6) present results for subsamples of *unconstrained* firms for which we do not observe an on-average decline in R&D (i.e., financially unconstrained firms, larger firms, older firms, and firms with positive prior year operating cash flows) in Table 6, Panel B.[16] Event study plots in Figure 5, Panel A confirm parallel trends in the full sample (i.e., Column 1).

The DiD coefficient of -0.011 in Column (1) indicates a reduction in share repurchases of 1.1% of assets, on average, by December fiscal-year end firms relative to control firms. This translates to a 34.4% reduction in repurchases based on average *Repurchases* for December fiscal year end firms (0.032). In Columns (2) through (7), we further observe this decrease among the unconstrained firms, with effect sizes ranging from -1.0 to -1.2% of assets.[17]

Panel B reports the results for capital investment. The dependent variable *Capital Investment* is equal to capital expenditures divided by beginning of year property, plant, and equipment. Control variables follow those in prior work (e.g., Lester 2019) and include *Log(Assets), ROA, MTB, Leverage,* and *Cash Flow*. In Column (1) of Panel B, the statistically significant DiD coefficient of -0.052 indicates a decrease in capital expenditures of 5.2% of prior year property, plant, and equipment, relative to control firms. This decline represents 18.5% of the mean *Capex Investment* of treated firms (0.281). We observe similar effects ranging from -0.051 to -0.078 in Columns (2) through (6), specifically when measuring constraints using *High HP Index* or *High KZ Index*, confirming decreased capital

[16]Because the control variables in these specifications are distinct from the controls used in the R&D tests, and because the samples are smaller due to requisite data restrictions, we entropy balance within each sample to ensure covariate balance across the treatment and control firms.

[17]Untabulated tests fail to find evidence of a change in the extensive margin (i.e., the likelihood of repurchasing shares). Thus, the evidence is consistent with firms, on the margin, not changing *whether* they repurchase shares but rather changing the *amount* of repurchases. The observed declines in repurchases is not driven by the 1% excise tax on repurchases passed in the Inflation Reduction Act of 2022. This tax applies to repurchases made after December 31, 2022, which is after our sample period ends.

expenditures among unconstrained firms.[18]

4.5 Summary

We provide evidence treated firms decreased R&D investments in response to R&D capitalization relative to control firms. The decrease in R&D is statistically and economically significant. The effects of R&D capitalization are heterogeneous, with stronger effects on research-intensive, domestic-only, and constrained firms. Among the most research-intensive firms in our sample, we estimate an aggregate decline in R&D investment of $18.0 billion. We also find evidence consistent with spillover effects of the R&D tax change to firm's share repurchase and capital expenditures.

5 Additional Analyses

5.1 Innovation Quality

Given the evidence of declines in R&D, we explore implications of the R&D change for innovation quality. Specifically, we examine whether the response to the R&D change differs based on a firms' pre-period innovation quality. We estimate the following model:

$$\begin{aligned} R\&D\ Investment_{it} = \beta_0 &+ \beta_1\ Dec\ FYE\ Firm_i \times Post_t \\ &+ \beta_2\ Dec\ FYE\ Firm_i \times Post_t \times Quality_i \\ &+ \beta_3\ Quality_i \times Post_t + Controls_{it-1} + \alpha_i + y_t + \epsilon_{it} \quad (4) \end{aligned}$$

[18] In additional untabulated tests, we examine whether firms decrease dividends or increase borrowing in response to R&D capitalization. In both the full sample and unconstrained subsamples, we fail to find evidence of statistically significant effects on dividends or borrowing. One possible explanation for why we do not observe increased borrowing is that it introduces additional costs that the firm can otherwise avoid by adjusting along the other margins. Observing no change in dividend payout is consistent with dividends being a less flexible form of payout, and that firms are less likely to cut dividends given the information content of such a decision.

where *Quality* represents one of five firm-level measures of innovation quality: *High Patent Grants, High Forward Citations, High Patent Value, High Innovative Efficiency,* and *High Research Quotient*, described below. We measure innovation quality using indicator variables representing the top tercile of innovation quality, computed across all Compustat North America firms with available data. For each measure, a negative (positive) coefficient on the three-way interaction term indicates treated firms with higher innovation quality decrease R&D more (less) than treated firms with lower innovation quality, relative to their respective control groups.

Our measures of innovation quality include: (1) pre-period patent grants (*High Patent Grants*), (2) pre-period forward citations (*High Forward Citations*), (3) pre-period patent value (*High Patent Value*), (4) innovative efficiency in event year t-1 (*High Innovative Efficiency*), and (5) R&D output elasticity in event year t-1 (*High Research Quotient*) (Cooper et al. 2022). We measure patent value using stock market reactions (Kogan et al. 2017). Innovative efficiency is computed as the number of patent grants in event year t-1 scaled by R&D capital (Hirshleifer et al. (2013)). For this purpose, R&D capital is computed as the five-year cumulative R&D spend (measured two years before the patent grants), assuming an annual depreciation rate of 20%.

Table 8 presents the results. Across all columns, the coefficient on the triple interaction term *Dec FYE Firm* × *Post* × *Quality* is statistically insignificant. Thus, we fail to find evidence that the R&D tax change differentially affected firms conducting higher-quality innovation relative to other firms. However, we acknowledge that, while we use firm-level measures of innovation quality following prior work, these measures do not capture possible adjustments firms make *within* their R&D project portfolios, for example by continuing radical innovations and cutting incremental projects.

5.2 Anticipatory Effects

The delay between the R&D capitalization requirement's enactment and implementation creates the potential for anticipatory effects. Specifically, firms have an incentive to shift R&D expenditures into the fiscal year before the requirement becomes effective to maximize the present value of the tax benefits from the R&D expenditures. Such anticipatory effects should be limited among our December fiscal year end treatment firms because many expected Congress to repeal the law during calendar year 2022 (see Appendix C). However, control firms with fiscal years ending in 2022 may have responded to the looming R&D capitalization requirement for their 2023 fiscal year by accelerating R&D expenditures into their 2022 fiscal year to ensure full deductibility. If control firms accelerated their R&D spending into fiscal year 2022, the documented difference-in-differences effects of R&D declines among treated firms in response to the R&D tax change may instead reflect *increases* in R&D by control firms. While anticipatory effects are interesting and important to understand, observing such effects would change the inferences that we draw from our empirical analyses (i.e., control firms shifting the timing of R&D expenditures in anticipation of the R&D tax change versus treatment firms decreasing their R&D investment in response to the increased after-tax cost of R&D).

We assess this potential concern in two ways. First, we compare quarterly R&D spending of December fiscal year end firms to that of September, October, and November fiscal year end firms. Specifically, we re-estimate Eq. 2 using quarterly data and replace the *Post* indicator with indicators for each quarter of the sample period.[19] The fourth quarter of 2021 serves as the base period. If control firms accelerated R&D expenditures into the post period before they became subject to R&D capitalization, we would observe positive and significant

[19] For this purpose, we measure all control variables with available data by quarter and any variables that lack quarterly data (i.e., *NOL Indicator and Institutional Ownership*) annually. We also measure *Industry Concentration* annually to account for potential seasonality in sales. To avoid the control variables being affected by the R&D tax change, we measure all control variables at a one year lag. We also note the tests using quarterly data have 35% fewer firms than the main tests using annual data.

coefficients on *2022 Q1, 2022 Q2, 2022 Q3,* and *2022 Q4* indicators.

Table 9 reports the results of this analysis. The coefficients on each of the 11 pre-period interaction terms is statistically insignificant, supporting that treatment and control firms exhibit similar pre-period R&D investment trends. We observe negative and significant coefficients on the interaction terms starting in 2022, consistent with our main tests. Most importantly, the coefficients on the standalone year-quarter indicators *2022 Q1, 2022 Q2, 2022 Q3,* and *2022 Q4* are insignificant, which fails to provide evidence control firms increased R&D expenditures in 2022 in anticipation of becoming subject to R&D capitalization.

Figure 6 plots the coefficient point estimates from these regressions without and with entropy balancing (Panels A and B, respectively). In each figure, the dashed trend lines represent expected R&D investment based on the pre-period coefficient estimates (2019 through 2021). If control firms engage in anticipatory behavior, we expect increases in R&D investment in 2022, followed by declines in R&D investment in 2023. In contrast, we observe that September, October, and November year-end firms' R&D spending is in line with expectations. In addition, we observe a decline in R&D spending by December fiscal year end firms starting in Q1 2022, consistent with our main tests.

Second, we compare R&D investment dynamics of our control firms (i.e., firms with fiscal years ending in September, October, and November) to firms with fiscal years ending in June, July, and August. Like our control firms, firms with fiscal year-ends in June, July, and August will be impacted by the change in their 2023 fiscal years. Thus, like the September, October, and November fiscal-year-end control firms, they potentially have incentive to accelerate R&D expenditures into fiscal year 2022. However, given widespread beliefs that the R&D capitalization requirement would be repealed during calendar year 2022, we expect any such shifting will be more prevalent among firms with later fiscal year ends (i.e., September, October, and November year ends) as it became clearer that the law would not be repealed as the end of calendar year 2022 approached. Thus, comparing these two groups helps to identity any potential anticipatory effect among our control firms. If our control firms accelerated R&D expenditures into fiscal year 2022, we expect to observe increased (decreased) R&D expenditures for September, October, and November fiscal year end firms in fiscal year 2022 (2023) relative to June, July, and August fiscal year end firms.

Table 10 reports the results of this analysis. We find statistically similar trends in R&D among our control firms and firms with fiscal years ending in June, July, and August, as evidenced by the insignificant coefficients on the interactions of *Sept/Oct/Nov FYE* and the yearly indicator variables. In Column (2), we observe a positive and significant coefficient on the *Year 2022* indicator, which could be consistent with both groups of firms accelerating R&D spending in 2022. However, we do not observe a negative and significant coefficient on the *Year 2023* indicator, which is inconsistent with the shifting story.

Figure 7 depicts coefficient estimates for these regressions without and with entropy balancing (Panels A and B, respectively). The dashed lines in these figures represent the expected trend in R&D spending based on the coefficient estimates for 2019 through 2021. To the extent that September, October, and November fiscal year end firms engaged in anticipatory behavior, we would expect to see the 2022 point estimate for these firms to exceed the dashed expectation line, followed by a decrease in 2023. However, the 2022 plots are in-line with expectations, further mitigating the concern that intertemporal R&D shifting by control firms drives our main difference-in-differences results. In untabulated analyses, we compare September, October, and November fiscal year end firms to January, February, and March fiscal year end firms. Again, we observe similar trends in R&D investment among these two groups of firms, inconsistent with anticipatory behavior among our control sample.

Overall, these analyses do not support anticipatory effects among our control firms.

5.3 Other Tax Policy Changes

We are unaware of other policy or regulatory events that would induce similar heterogeneity in the response. However, in untabulated analyses, we examine whether 2022 changes in the tax deductibility of interest expense under I.R.C Sec 163(j) affect our inferences. We re-estimate the R&D investment tests excluding (1) firms newly affected by I.R.C Sec 163(j) in 2022 (whose interest would have been fully deductible under the pre-2022 interest rules) or (2) excluding all firms affected by §163(j) in 2022. Using both of these alternative samples, we continue to observe a negative and significant effect of the tax law change on R&D investment. In addition, inferences regarding our repurchases and capital expenditures tests are unchanged when omitting firms newly affected by I.R.C Sec 163(j) or all firms affected by I.R.C Sec 163(j).

6 Conclusion

We study the consequences for U.S. public firms of limiting the R&D tax deduction. We find R&D investment declined for treated U.S. firms relative to control firms by approximately 0.6% of assets, which represents 4.5% of these firms' average R&D investment. The effects on R&D investment are strongest among the most research-intensive firms, domestic-only firms, and constrained firms. In aggregate, we estimate a decrease in R&D investment of $18.0 billion among the most-research intensive firms in our sample. In addition to reducing their R&D investments in response to the increased after-tax cost of R&D, we also find evidence consistent with firms reducing share repurchases and capital investment to compensate for their increased tax burden.

We contribute some of the first evidence regarding investment effects of the R&D deduction to the academic literature. While prior research on R&D tax incentives focuses largely on the R&D tax credit, we provide empirical evidence of economically significant real effects of the change from R&D immediate expensing to R&D capitalization in the policy's first year, its differential effects across firms, and spillover effects on firms' other investing and payout decisions.

Importantly, this paper also provides timely, policy-relevant evidence regarding the impact of the R&D capitalization requirement on U.S. firms. Removing the immediate R&D deduction is incongruent with other U.S. efforts to ensure the U.S. remains a leader in innovation and is inconsistent with increases in innovation tax incentives in countries across the globe. The U.S. R&D capitalization requirement was included in the TCJA to lower the bill's overall cost. We document the real economic repercussions of such legislative maneuvering and the costs of subsequent congressional inaction, despite bipartisan recognition of the need for repeal. Our paper informs the broader discussions about the effects of U.S. innovation tax policies and the effects of the TCJA.

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Appendix A: Tax Technical Details

Historically, the U.S. has offered two key innovation tax incentives: the R&D tax credit (I.R.C. Sec. 41) and the R&D tax deduction (I.R.C. Sec. 174). This appendix describes the technical details of these tax incentives.

The R&D tax credit, officially called the Credit for Increasing Research Activities, was enacted in 1981. The R&D credit had a long history of temporary lapses and retroactive extensions, but was made permanent in 2015 (Hoopes 2018). The R&D tax credit is available for qualifying R&D spending in excess of a base amount, where the base amount is intended to approximate what the firm would spend on R&D in the absence of the credit. Qualifying R&D for purposes of the tax credit consists of activities that pass a four-part test as defined by I.R.C. Sec. 41(d). This test requires R&D projects (1) to eliminate uncertainty (as defined by I.R.C. Sec. 174), (2) to discover previously unknown technological information using the physical or natural sciences, engineering, or computer science, (3) for a new or improved business component (e.g., product, formula, or process), *and* (4) through a process of experimentation in which hypotheses are formulated, tested, and subsequently refined. The credit provides a tax benefit equal to the credit rate multiplied by qualifying research expenditures in excess of a benchmark amount. The credit rate and benchmark calculation differ depending on the method used to compute the credit (see Finley et al. 2015). For example, under the Alternative Simplified Method calculation, the credit rate is 14% and the benchmark amount is the sum of the prior three years R&D expenditures divided by six (see Appendix D). The tax law requires firms to either (1) include the credit amount in taxable income or (2) compute the credit using a reduced credit rate (known as the I.R.C. Sec. 280C election) that is equal to the credit rate multiplied by 1 minus the statutory tax rate (e.g., 14% $\times$ (1-21%)). When the tax credit exceeds the total tax liability, the tax law allows firms to carry the excess tax credit back one year and forward 20 years to offset tax liabilities in those periods.

The R&D tax deduction, enacted in 1954, historically allowed U.S. businesses to immediately deduct 100% of the cost of qualifying R&D investments. For this purpose, qualifying investments include expenditures incurred to eliminate uncertainty in the "experimental or laboratory sense" (i.e., part one of the R&D credit four-part test). Examples of qualifying expenses include researchers' wages and benefits, contract research expenditures, wages of researchers' direct supervisors, costs of supplies, overhead expenses, depreciation on equipment, costs related to a pilot model, and software development expenses (RSM 2023). Thus, more R&D expenditures qualify for the deduction than for the tax credit because the definition of qualifying R&D for purposes of the U.S. R&D deduction is broader than the definition under the R&D tax credit, and the deduction does not require the expenditures to exceed a base amount. The R&D tax deduction provided a tax benefit equal to the amount of the expenditure multiplied by the federal corporate statutory tax rate.

The R&D deduction was substantially altered by the Tax Cuts and Jobs Act (TCJA) of 2017, although the effective date of the change was delayed until taxable years beginning after December 31, 2021. This change was included in the TCJA as a means of raising tax revenue to offset other tax cuts included in the Act (e.g., WSJ 2024; Bloomberg 2023). This legislation required that R&D be capitalized and amortized rather than immediately deducted. Specifically, beginning in 2022, U.S. companies are only permitted to deduct 10% of their domestic R&D costs in the year the R&D investment is made. Twenty percent of the costs are deducted in each of years two through five, and the remaining 10% deducted in year six.[20]

The law also requires U.S. firms to capitalize and amortize foreign R&D investment over 15 years. This requirement applies to R&D expenditures incurred in foreign operations for purposes of any income computations or reporting on a U.S. tax basis. Examples of affected

[20] Prior to the 2022 tax law change, U.S. taxpayers had the option to elect to capitalize and amortize R&D expenditures rather than immediately deduct the costs in the year incurred. We are unaware of public data to determine how prevalent this election was among corporate taxpayers, but practitioner guidance suggests that it was relatively uncommon (Weinberg and Eller 2022).

calculations include computations of global intangible low-tax income (GILTI), Subpart F, and foreign tax credits (RSM 2023). The U.S. R&D tax change does not impact the R&D tax treatment for purposes of computing taxable income in the foreign country where the R&D is conducted.

Although the firm will eventually be able to deduct 100% of all R&D costs, this tax law change substantially reduces the present value of the tax benefit and has important cash flow consequences. Figure 1 and Appendix B illustrate the decrease in the present value of tax benefits under the R&D tax change relative to the previous immediate expensing regime. For the average firm in our sample investing $304 million in R&D per year, this changes decreases the net present value of the associated tax benefit from $63.8 million to $53.0 million (a decline of 17.0%), increasing the after-tax cost of R&D from $240 million to $251 million (an increase of 4.5%).

Appendix B: Present value (PV) calculation
(all amounts in millions)

Pre-period: R&D immediate expensing

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
R&D expenditure	304	304	304	304	304	304	304	304	304	304
PV tax savings from year 1 expenditure	64									
PV tax savings from year 2 expenditure		64								
PV tax savings from year 3 expenditure			64							
PV tax savings from year 4 expenditure				64						
PV tax savings from year 5 expenditure					64					
PV tax savings from year 6 expenditure						64				
PV tax savings from year 7 expenditure							64			
PV tax savings from year 8 expenditure								64		
PV tax savings from year 9 expenditure									64	
PV tax savings from year 10 expenditure										64
Total PV tax savings	64	64	64	64	64	64	64	64	64	64
PV of after-tax R&D costs	240	240	240	240	240	240	240	240	240	240
Cumulative PV tax savings	**64**	**128**	**192**	**255**	**319**	**383**	**447**	**511**	**575**	**638**
Cumulative PV of after-tax R&D costs	240	480	720	961	1,201	1,441	1,681	1,921	2,161	2,402

Post-period: R&D capitalization and five-year amortization

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
R&D expenditure	304	304	304	304	304	304	304	304	304	304
PV tax savings from year 1 expenditure	6	12	11	10	9	4				
PV tax savings from year 2 expenditure		6	12	11	10	9	4			
PV tax savings from year 3 expenditure			6	12	11	10	9	4		
PV tax savings from year 4 expenditure				6	12	11	10	9	4	
PV tax savings from year 5 expenditure					6	12	11	10	9	4
PV tax savings from year 6 expenditure						6	12	11	10	9
PV tax savings from year 7 expenditure							6	12	11	10
PV tax savings from year 8 expenditure								6	12	11
PV tax savings from year 9 expenditure									6	12
PV tax savings from year 10 expenditure										6
Total PV tax savings	6	18	29	39	49	53	53	53	53	53
PV of after-tax R&D costs	298	286	275	265	255	251	251	251	251	251
Cumulative PV tax savings	**6**	**25**	**54**	**93**	**142**	**195**	**248**	**301**	**354**	**407**
Cumulative PV of after-tax R&D costs	298	583	858	1,123	1,378	1,629	1,880	2,131	2,382	2,633
Difference in year's PV tax savings	(57)	(46)	(35)	(25)	(15)	(11)	(11)	(11)	(11)	(11)
Difference in cumulative PV tax savings - stable R&D	**(57)**	**(103)**	**(138)**	**(162)**	**(177)**	**(188)**	**(199)**	**(210)**	**(221)**	**(232)**
Difference in cumulative PV tax savings - 5% R&D growth	**(57)**	**(106)**	**(146)**	**(178)**	**(202)**	**(223)**	**(245)**	**(268)**	**(292)**	**(317)**
Difference in cumulative PV tax savings - 10% R&D growth	**(57)**	**(109)**	**(154)**	**(194)**	**(229)**	**(263)**	**(300)**	**(341)**	**(386)**	**(435)**

This appendix illustrates the timing and present value of tax savings from R&D deductions under the pre-2022 immediate expensing rules and the post-2022 capitalization and amortization rules. The calculations are estimated using the sample average annual R&D spending, an 8% discount rate, and a 21% marginal tax rate. The difference in each year's present value of tax savings is reported at the bottom of the table as well as the cumulative deferred tax savings in present value dollars under various R&D growth assumptions (stable, 5% growth, and 10% growth).

Appendix C: Conference Call Transcripts

Example 1: Raytheon Corp (Ticker: RTX) Q4 2022 Call – January 24, 2023

GREGORY J. HAYES (CEO): We obviously thought going into the end of 2022 that the tax legislation, the R&D amortization would get eliminated. Unfortunately, that didn't happen. That cost us $1.6 billion last year. As Neil said, it will be another $1.4 billion. And as we go into the 2025 time frame, that drag will still be about $1 billion, about $800 million of that is actual net R&D deferral and there's a couple of hundred million dollars of additional interest expense and financing our little loan to the government.

Example 2: CSG Systems International Inc (Ticker: CSGS) Q4 2022 Call – February 1, 2023

BRIAN A. SHEPHERD (CEO): Higher tax obligations, of which the primary negative impact was from Section 174 of the 2017 Tax Cuts and Jobs Act, which deals with the amortization of R&D spending beginning in 2022. As a result of this, we will not get the previously anticipated amount of the tax deduction benefit related to our R&D investment in 2022. We have previously expected this legislation to be repealed, but because the legislation was not repealed, we now anticipate higher cash taxes going forward.

Example 3: Trimble Inc. (Ticker: TRMB) Q4 2022 Call – February 8, 2023

ROBERT G. PAINTER (CEO): Our cash flow forecast for this year now assumes that amortization of R&D costs under Section 174 of the U.S. tax code will not be repealed within a time frame that will allow us to recover the accelerated tax payments that we made in 2022. While we believe that there is bipartisan support for this change, we are less confident than we were a quarter ago that this legislation will pass soon enough to help us this year. By way of reminder, this issue impacts the timing of tax payments and has an immaterial impact on our tax rate. If Section 174 is repealed within the next several months, our free cash flow would benefit by approximately $150 million.

Example 4: Leidos Holdings Inc. (Ticker: LDOS) Q4 2022 Call – February 14, 2023

CHRISTOPHER R. CAGE (CFO). This guidance reflects approximately $300 million of additional cash taxes compared to fiscal year 2022, primarily related to the Tax Cuts and Jobs Act of 2017 provision requiring the capitalization and amortization of research and development costs. As we're awaiting potential congressional action, we didn't make any Section 174 related tax payments last year. So we'll need to make payments this year to cover both '22 and '23. We paid the 2022 Section 174 taxes in January, and we expect to pay the '23 taxes in quarterly installments throughout the year.

Example 5: Tyler Technologies, Inc. (Ticker: TYL) Q4 2022 Call – February 16, 2023

H. LYNN MOORE (CEO): The Tax Cuts and Jobs Act required that starting in 2022, research and experimentation expenditures, known as Section 174 costs, are required to be capitalized and amortized over either 5 years for expenditures in the U.S. or 15 years for those incurred outside the U.S. for tax purposes. Since the enactment of the TCJA, businesses, including us, have been monitoring congressional actions around this rule, and there was a strong expectation that Section 174 would be repealed or delayed. However, Congress has not yet taken action.

Example 6: Itron Inc. (Ticker: ITRI) Q4 2022 Call – February 27, 2023

JOAN S. HOOPER (SVP and CFO): But the bigger issue is the legislative change that happened with the 2017 tax reform, which essentially forced you to capitalizing R&D. We were expecting those laws to get overturned as well as everybody else and they haven't yet. So the current tax law relative to the capitalization of R&D creates quite a bit larger cash tax payments. So as an example, just cash tax alone is going to be up something like $25 million year-over-year.

Appendix D: Example Effective Tax Rate Calculations

(all amounts in millions)	(1) Pre period: R&D immediate expensing	(2) Post period: R&D capitalization and amortization: Stable R&D	(3) Post period: R&D capitalization and amortization: 5% R&D Growth	(4) Post period: R&D capitalization and amortization: 10% R&D Growth	Calculation
Mean values per main sample:					
Pre-tax book income	642	642	627	612	(a)
R&D expenditure year t	304	304	319	334	(b)
R&D expenditure year t-1	278	278	278	278	(c)
R&D expenditure year t-2	261	261	261	261	(d)
R&D expenditure year t-3	260	260	260	260	(e)
Statutory rate	21%	21%	21%	21%	(f)
Qualifying Research Expenditures (QREs) (assuming 50% of R&D qualifies):					
Year t	152	152	160	167	(g) = (b) × 50%
Total QREs for the prior three tax years (assuming 50% of R&D qualifies):					
Year t-1	139	139	139	139	(h) = (c) × 50%
Year t-2	131	131	131	131	(i) = (d) × 50%
Year t-3	130	130	130	130	(j) = (e) × 50%
Total	400	400	400	400	(k) = (h) + (i) + (j)
Divide total by 6	67	67	67	67	(l) = (k) ÷ 6
Excess of current year QREs over baseline	85	85	93	101	(m) = (g) - (l)
Alternative Simplified Credit rate	14%	14%	14%	14%	(n)
Section 280C adjustment:					
Reduced credit rate (14% × (1-21%))	11.1%	11.1%	11.1%	11.1%	(o) = (1 - (f)) × (n)
Reduced credit amount	9	9	10	11	(p) = (m) × (o)
Summary of current-year tax savings:					
Tax savings on R&D tax credit	9	9	10	11	(p)
Tax savings on R&D amortization	n/a	6	7	7	(q) = 50% × [(b) ÷ 5] × (f)
Tax savings on R&D deduction	64	n/a	n/a	n/a	(r) = (b) × (f)
Total tax savings	**73**	**16**	**17**	**18**	(s) = (p) + (q) + (r)

Total GAAP tax expense	125	125	121	117	(t) = (a) × (f) - (p)
Total cash taxes paid	125	183	182	181	(u) = (a + b) × (f) - (s)
Total deferred tax asset	0	57	60	63	(v) = (u) - (t)
Effective tax rates:					
GAAP ETR	19.5%	19.5%	19.4%	19.2%	(w) = (t) ÷ (a)
Cash ETR	19.5%	28.5%	29.0%	29.5%	(x) = (u) ÷ (a)
Percentage point change in GAAP ETR relative to pre-period		0.0%	-0.2%	-0.3%	
Percentage point change in cash ETR relative to pre-period		8.9%	9.5%	10.0%	

This appendix depicts how the R&D capitalization change affects effective tax rates and deferred tax assets over time. For simplicity, the calculations use the Alternative Simplified Credit method of computing the R&D tax credit. The calculation uses the average pre-tax book income and average R&D expenditures for the firms in our main sample. Consistent with prior literature, we assume 50% of research spending qualifies for the R&D tax credit (see for example Gupta, Hwang, and Schmidt (2011) and Finley, Lusch, and Cook (2015)). Column (1) reports the calculation prior to the tax law change; the remaining columns report the calculation after the tax law change assuming stable R&D (Column 2), 5% R&D growth (Column 3), and 10% R&D growth (Column 4).

Appendix E: Variable Descriptions

Variable	Description
Treatment & Post Variables:	
Dec FYE Firm	An indicator variable set equal to one if the fiscal year end is December, and zero otherwise.
Post	An indicator variable set equal to one for fiscal years beginning on or after October 1, 2021, and zero otherwise.
Dependent Variables:	
Capex Investment	Total capital expenditures (CAPX) as a percent of beginning of year property, plant, and equipment (PPENT).
Cash ETR	Cash taxes paid (TXPD) scaled by pre-tax book income (PI). Set to missing if PI is less than zero and for ETRs less than zero and greater than one.
Current ETR	Current tax expense (TXC) scaled by pre-tax book income (PI). Set to missing if PI is less than zero and for ETRs less than zero and greater than one.
ETR	Effective tax rate measures, including *Current ETR* and *Cash ETR.*
Outcome	Other outcome measures, including *Repurchases* and *Capex Investment.*
Quarterly R&D Investment	Quarterly R&D (XRDQ) scaled by one-year lagged quarterly assets (ATQ).
R&D Investment	Research and development expense (XRD) scaled by beginning of year assets (AT).
Repurchases	Purchases of common and preferred stock (PRSTKC) less any annual decrease in redemption value of preferred stock (PSTKRV), scaled by beginning of year assets (AT).
Cross-Sectional Variables:	
Domestic	An indicator variable set equal to one for domestic-only corporations, and zero otherwise. We define multinational status as firms with non-zero pre-tax foreign income (PIFO) or non-zero foreign tax expense (TXFO).
High Constraints	Measures of high constraints, including *High HP Index* , *High KZ Index, Small, Young,* and *Negative OCF.*
High Forward Citations	An indicator variable set equal to one for observations with pre-period forward citations in the top tercile, and zero otherwise. Patent citation data is obtained from https://patentsview.org/.
High HP Index	An indicator variable set equal to one for observations in the highest tercile of the Hadlock and Pierce (2010) size-age index in event year *t-1* , and zero otherwise. We compute the size-age index as $(-0.737) \times Log(Assets) + (0.043 \times Log(Assets)^2) - (0.040 \times Age)$. For this purpose, we limit assets to a maximum of $4.5 billion and age to a maximum of 37.
High Innovative Efficiency	An indicator variable set equal to one if innovative efficiency (IE) measured in event-year *t*-1 is in the top tercile, and zero otherwise. We measure IE per Hirshleifer et al. (2013), computed as patent grants divided by (XRDt-2 + 0.8×XRDt-3 + 0.6×XRDt-4 + 0.4×XRDt-5 + 0.2×XRDt-6). For purposes of this calculation, missing values of XRD are set equal to zero.

High KZ Index	An indicator variable set equal to one for firms with KZ Index in the top tercile in event-year *t* -1, and zero otherwise. KZ Index is computed following Kaplan and Zingales (1997) as (-1.002)×((IB+DP)/$PPENT_{t-1}$) + 0.283×((AT+MVE-CEQ-TXDB)/AT) + 3.139×(DLTT+DLC)/(DLTT + DLC + SEQ) - 39.368×((DVC + DVP)/$PPENT_{t-1}$) - 1.315×(CHE/$PPENT_{t-1}$). Where DVC or DVP are missing, total dividends (DV) is used. MVE is computed as price (PRCC_F) multiplied by shares outstanding (CSHO) at the fiscal year end.
High Research Quotient	An indicator variable set equal to one for firms with research quotients (RQ) in the top tercile, and zero otherwise. RQ data is obtained from WRDS.
High Patent Grants	An indicator variable set equal to one for observations with pre-period patent grants in the top tercile, and zero otherwise. Patent grant data is obtained from Kogan et al. (2017).
High Patent Value	An indicator variable set equal to one for firms for whom the value of patents granted in the pre-period is in the top tercile, and zero otherwise. Data on patent values is obtained from https://github.com/KPSS2017/Technological-Innovation-Resource-Allocation-and-Growth-Extended-Data.
High R&D Firm	An indicator variable set equal to one for observations with *R&D Investment* in the top tercile in event year *t-1* , and zero otherwise.
High R&D Industry	An indicator variable set equal to one for observations in high R&D industries, and zero otherwise. We identify high R&D industries using aggregate R&D spending divided by aggregate total assets for all firms in each two-digit SIC. The high R&D industries include the following two-digit SIC groups: 28, 36, 41, 59, and 73.
Negative OCF	An indicator variable set equal to one for observations with negative operating cash flows (OANCF) in event year *t-1* , and zero otherwise.
Quality	One of five measures of innovation quality, including *High Patent Grants, High Forward Citations, High Patent Value, High Innovative Efficiency,* and *High Research Quotient.*
Small	An indicator variable set equal to one for observations in the lowest tercile of *Age* in event year *t-1* , and zero otherwise.
Young	An indicator variable set equal to one for observations in the lowest tercile of *Assets* in event year *t-1,* and zero otherwise.

Control Variable Vectors:

Capex Controls	A vector of control variables including *Log(Assets), ROA, MTB, Leverage,* and *Cash Flow.*
R&D Controls	A vector of control variables including *Log(Assets), Log(Age), Leverage, ROA, Sales Growth, MTB, Cash, Capex, PPE, NOL Indicator, Industry Concentration,* and *Institutional Ownership.*
ETR Controls	A vector of control variables including *Log(Assets), Log(Age), Leverage, Loss Firm, ROA, Sales Growth, MTB, Cash, R&D Investment, Capex, PPE, Domestic, Foreign Income %,* and *NOL Indicator.*
Outcome Controls	A of vector of control variables including *Payout Controls* and *Capex Controls.*
Payout Controls	A vector of control variables, including *Domestic ROA, Foreign ROA, Log(Assets), Sales Growth, MTB, Capex, Log(Age), Retained Earnings, Cash, Domestic ROA Volatility, Foreign ROA Volatility,* and *Returns.*

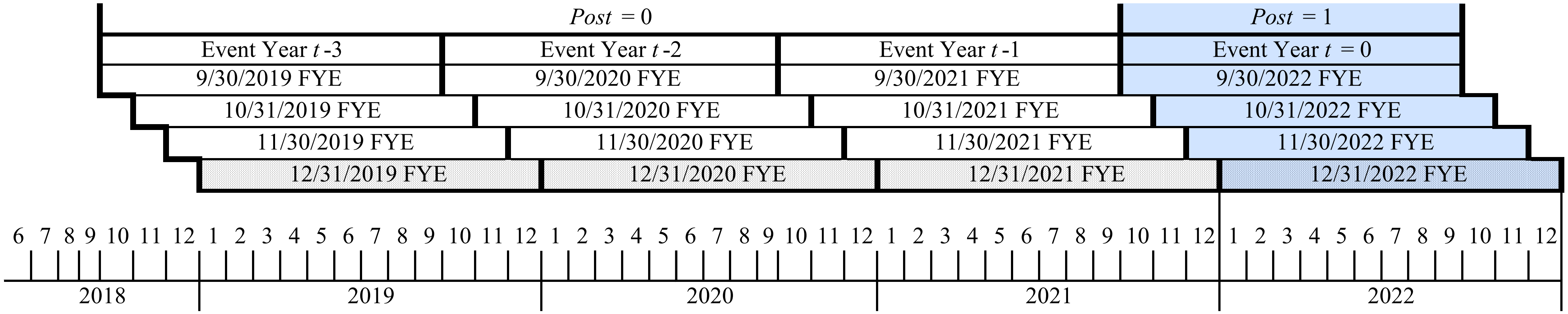
Other Variables:

Age	The number of years since the firm first appeared in Compustat with non-zero, non-missing assets.
Assets	Total assets (AT).

Capex	Total capital expenditures (CAPX) scaled by beginning of year assets (AT).
Capex Investment Growth	(*Capex Investment* $_t$ - Capex *Investment* $_{t-1}$)/*Capex Investment* $_{t-1}$.
Capitalized R&D	Capitalized R&D as estimated by grossing up Δ*R&D DTA* by the federal corporate statutory tax rate of 21%.
Capitalized R&D / Assets	*Capitalized R&D* scaled by beginning of year assets (AT).
Cash	Total cash holdings (CHE) scaled by beginning of year assets (AT).
Cash Flow	Operating cash flow (OANCF) scaled by beginning of year assets (AT).
Domestic ROA	Domestic pre-tax income (PIDOM) scaled by beginning of year total assets (AT).
Domestic ROA Volatility	The standard deviation of *Domestic ROA* over the past five years, requiring at least three non-missing values of *Domestic ROA.*
Foreign Income %	Pre-tax foreign income (PIFO) scaled by total pre-tax income (PI).
Foreign ROA	Pre-tax foreign income (PIFO) scaled by beginning of year total assets (AT).
Foreign ROA Volatility	The standard deviation of *Foreign ROA* over the past five years, requiring at least three non-missing values of *Foreign ROA.*
Industry Concentration	The sum of the squared market share for each firm in each four-digit SIC code industry-year. We compute market share as the firm's sales divided by the total sales of the SIC industry code.
Institutional Ownership	The percentage of shares held by institutional owners, as obtained from the Thomson-Reuters 13F database.
Leverage	Total debt (DLTT + DLC) divided by total beginning of year assets (AT).
Log(Age)	Log of 1 + *Age.*
Log(Assets)	Log of 1 + *Assets.*
Loss Firm	An indicator variable set equal to one if pre-tax income is negative, and zero otherwise.
MTB	Market to book ratio, computed as price (PRCC_F) × shares outstanding (CSHO) divided by the book value of equity (CEQ). This variable is set to missing for negative values of CEQ.
NOL Indicator	An indicator variable set equal to one for positive values of tax loss carryforward (TLCF), and zero otherwise.
PPE	Total property, plant, and equipment (PPENT) scaled by beginning of year assets (AT).
R&D DTA	Change in capitalized R&D deferred tax asset (DTA), measured in event year t =0, relative to event year t -1. We obtain R&D DTA data from financial statement disclosures via hand collection.
R&D DTA / Assets	*R&D DTA* scaled by beginning of year assets (AT).
R&D Investment Growth	(*R&D Investment* $_t$ - *R&D Investment* $_{t-1}$)/*R&D Investment* $_{t-1}$.
Retained Earnings	Retained earnings (RE) divided by the beginning of year book value of common equity (CEQ).
Returns	Stock return compounded monthly over the prior twenty-four months.
ROA	Sum of pre-tax income (PI) divided by total assets (AT).
Sales Growth	$(SALE_t$ - $Sale_{t-1})/SALE_{t-1}$.
Sept/Oct/Nov FYE	An indicator variable set equal to one if the fiscal year end is September, October, or November, and zero otherwise.

Appendix F: Treatment Timeline

This appendix depicts the treatment timeline. The patterned area represents the treatment sample. The shaded area represents the post-period. As our treatment sample is limited to December year-end U.S. firms, the post-period for the treatment group includes only the period ending December 31, 2022. The post-period for the control group includes fiscal years ending September 30, 2022 through November 30, 2022.



Appendix G: Example Disclosures

Example 1: Bristol-Myers Squibb Company (BMY) Form 10-K for the year ended 12/31/2022

From Note 7: INCOME TAXES

Deferred Taxes and Valuation Allowance

The components of deferred income tax assets/(liabilities) were as follows:

	December 31,	
Dollars in Millions	2022	2021
Deferred tax assets		
Foreign net operating loss and other carryforwards	$ 566	$ 945
State net operating loss and credit carryforwards	329	304
U.S. Federal net operating loss and credit carryforwards	236	226
Milestone payments and license fees	1,030	887
Capitalized research expenditures	1,573	—
Other	1,284	1,390
Total deferred tax assets	5,018	3,752
Valuation allowance	(873)	(1,056)
Deferred tax assets net of valuation allowance	$ 4,145	2,696
Deferred tax liabilities		
Acquired intangible assets	$ (4,362)	$ (4,867)
Goodwill and other	(605)	(891)
Total deferred tax liabilities	$ (4,967)	$ (5,758)
Deferred tax liabilities, net	$ (822)	$ (3,062)
Recognized as:		
Deferred income taxes assets – non-current	1,344	1,439
Deferred income taxes liabilities – non-current	(2,166)	(4,501)
Total	$ (822)	(3,062

Example 2: PepsiCo, Inc. (PEP) Form 10-K for the year ended 12/31/2022

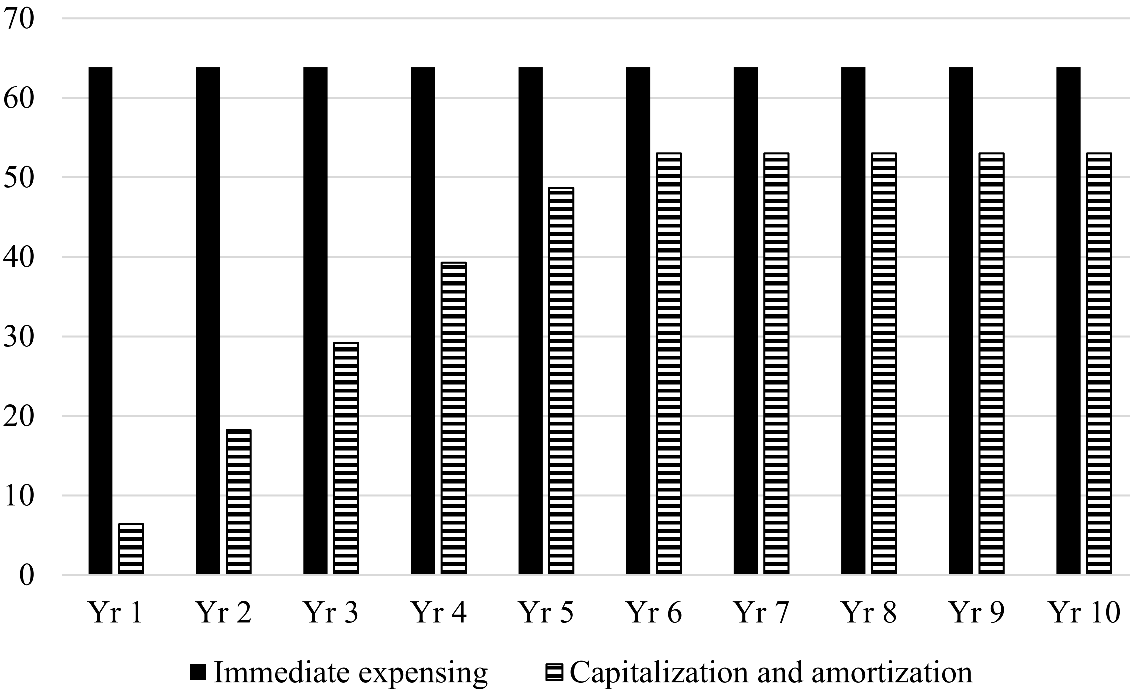
From Note 5: Income Taxes (amounts in millions)

Deferred tax liabilities and assets are comprised of the following:

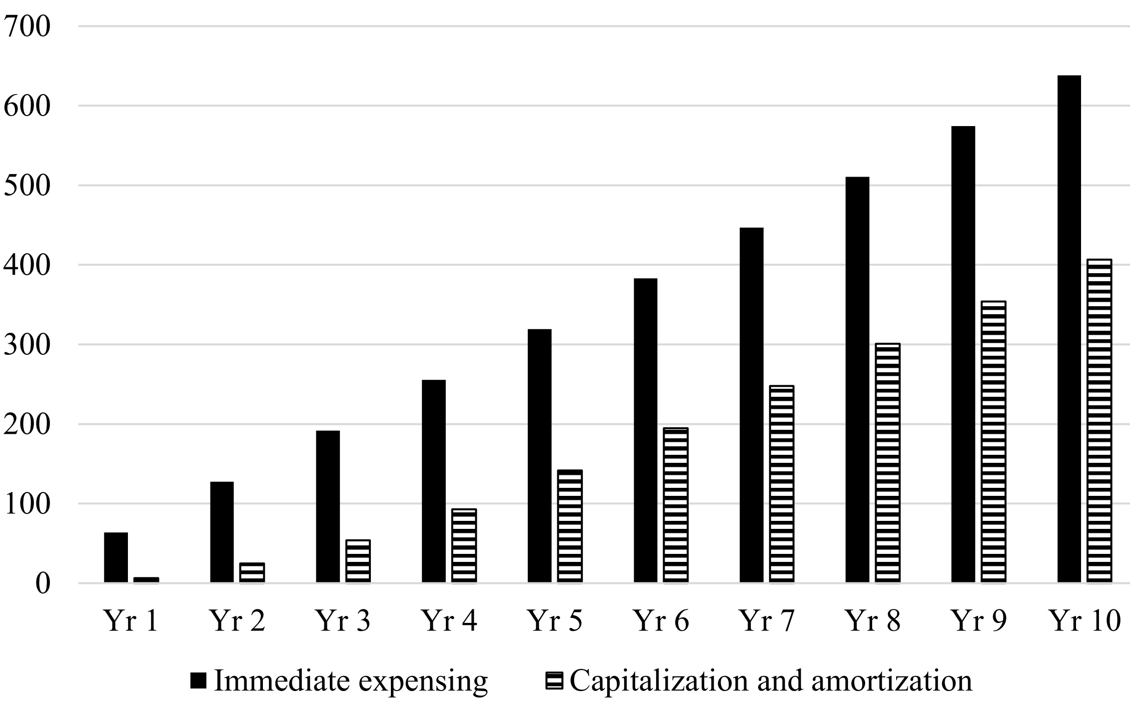
	2022	2021
Deferred tax liabilities		
Debt guarantee of wholly-owned subsidiary	**$ 578**	$ 578
Property, plant and equipment	**2,126**	2,036
Recapture of net operating losses	**492**	504
Pension liabilities	**189**	216
Right-of-use assets	**534**	450
Investment in TBG	**186**	—
Other	**232**	254
Gross deferred tax liabilities	**4,337**	4,038
Deferred tax assets		
Net carryforwards	**5,342**	4,974
Intangible assets other than nondeductible goodwill	**1,614**	1,111
Share-based compensation	**120**	98
Retiree medical benefits	**118**	147
Other employee-related benefits	**349**	379
Deductible state tax and interest benefits	**144**	149
Lease liabilities	**534**	450
Capitalized research and development	**150**	—
Other	**1,050**	842
Gross deferred tax assets	**9,421**	8,150
Valuation allowances	**(5,013)**	(4,628)
Deferred tax assets, net	**4,408**	3,522
Net deferred tax (assets)/liabilities	**$ (71)**	$ 516

Figure 1: Present value of R&D tax benefits: capitalization vs. immediate expensing

(a) Present value of current period R&D tax benefits

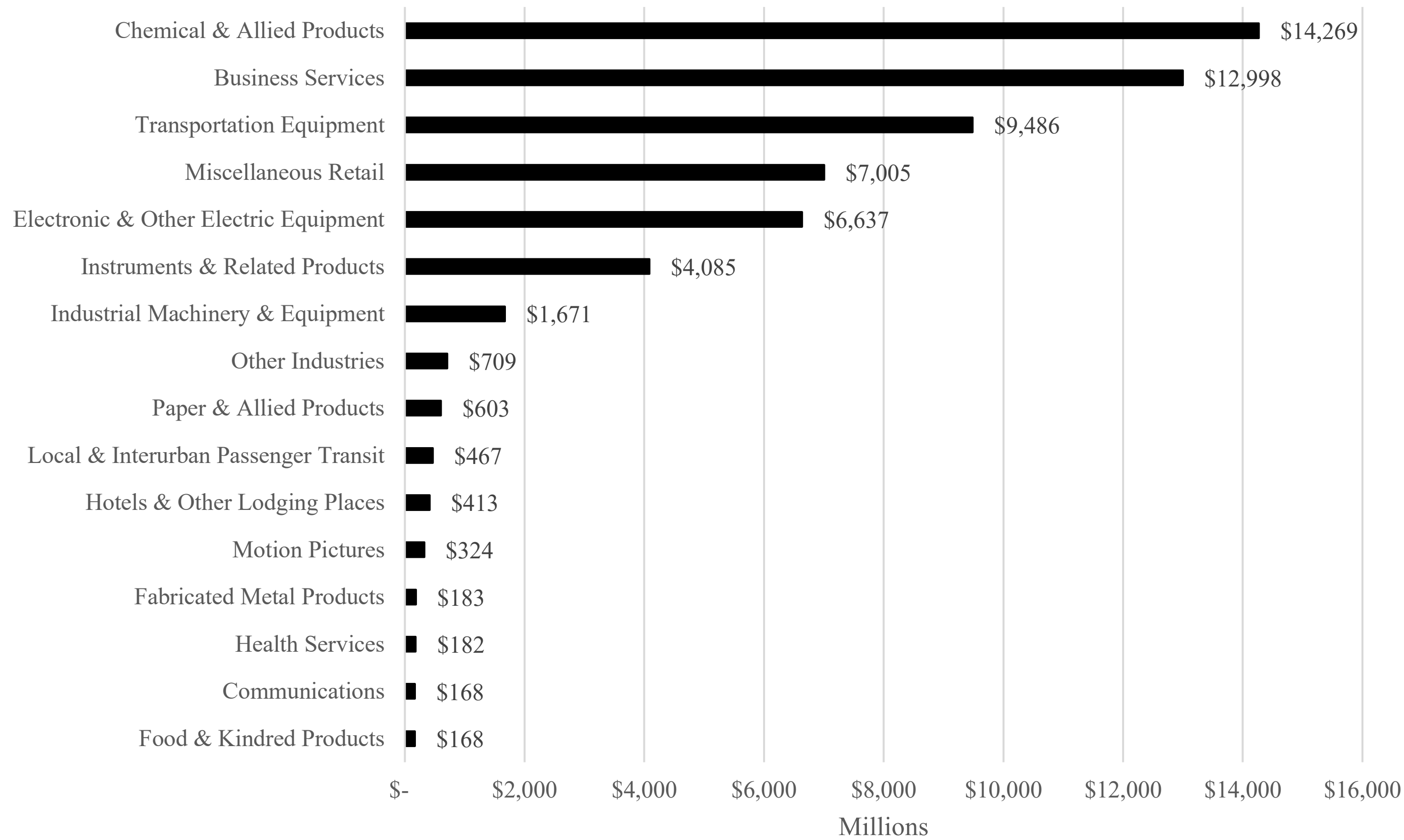


(b) Cumulative present value of R&D tax benefits



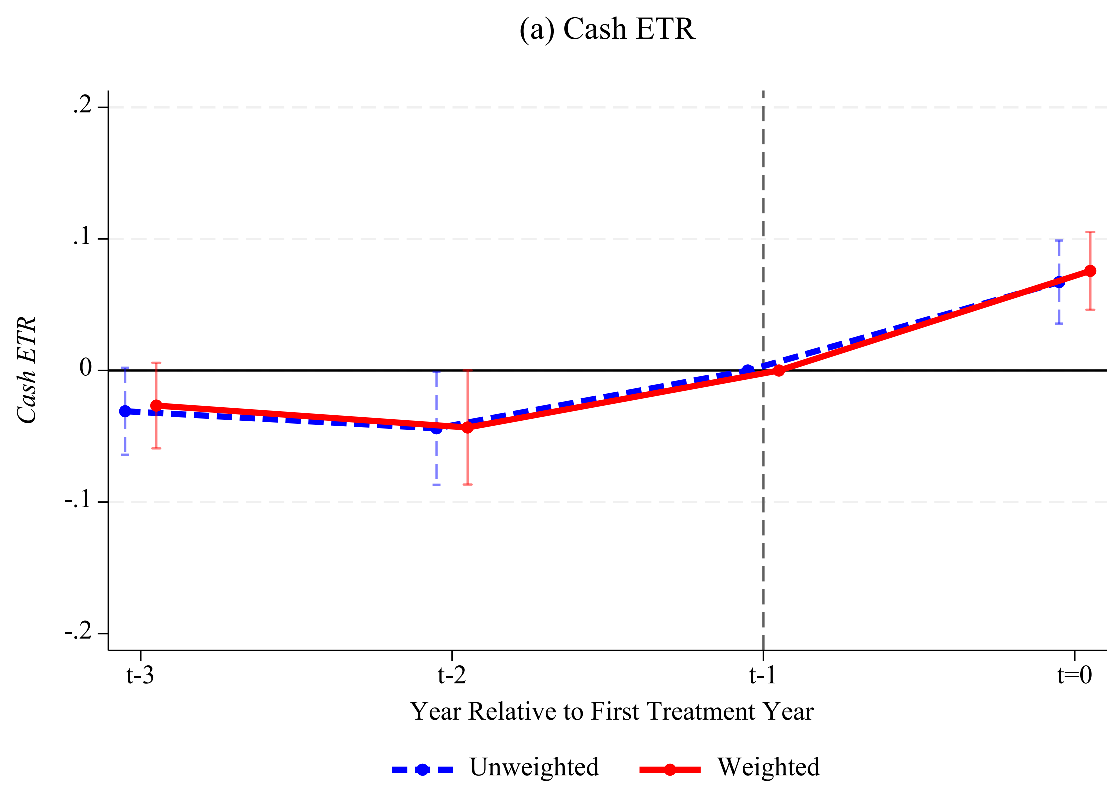
This figure depicts the present value of current period R&D tax benefits (Panel A) and cumulative R&D tax benefits (Panel B) under the R&D capitalization and amortization requirement, relative to immediate expensing, assuming stable R&D investment. All amounts are shown in millions. See Appendix B for additional details of the calculations.

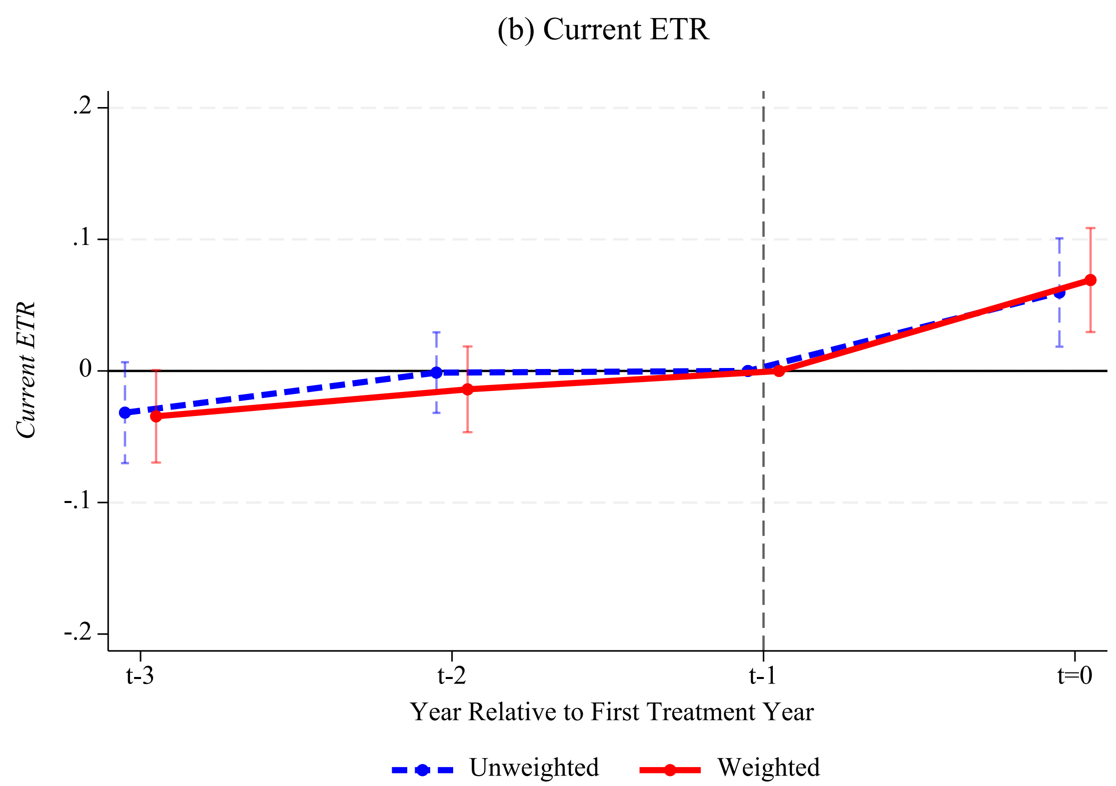
Figure 2: Aggregate Capitalized R&D Deferred Tax Assets by Industry



This figure depicts the aggregate capitalized R&D deferred tax assets by industry (2-digit SIC) in millions, as calculated using hand-collected data from financial statement deferred tax asset disclosures specifically related to the R&D capitalization requirement. We tabulate amounts for the fifteen industries comprising the largest share of R&D deferred tax assets. The subtotal for all other industries is reported as "Other Industries."

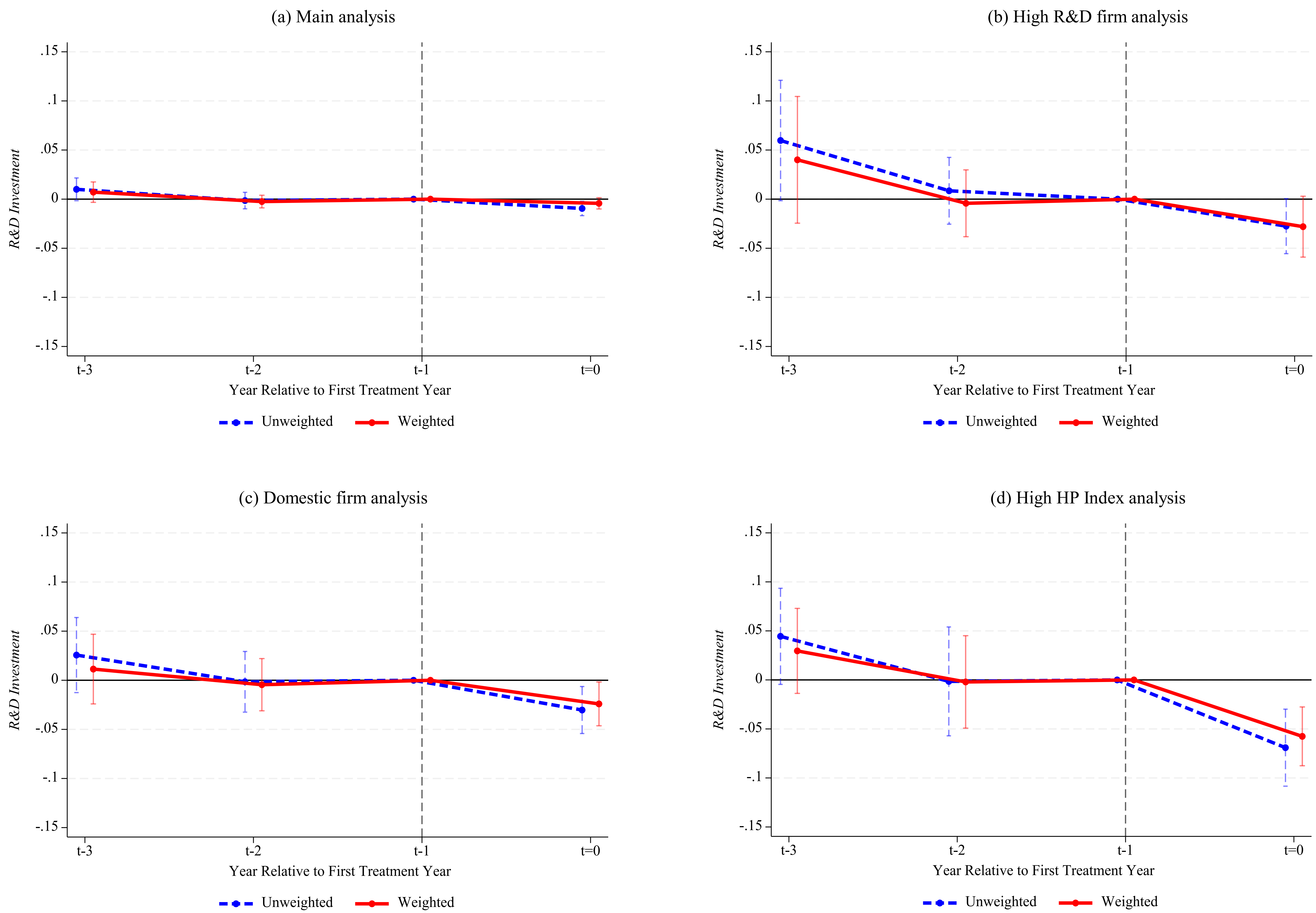
Figure 3: Effective Tax Rates Parallel Trends





These figures depict coefficient estimates and 90% confidence intervals for our effective tax rate OLS regressions in event time (see Appendix F). The dependent variables are *Cash ETR* (Panel A) and *Current ETR* (Panel B). The regression models include all controls and firm fixed effects. The Y-axis represents the difference-in-differences (DiD) estimate. The X-axis represents the year relative to the treatment year, where year $t = 0$ is the first year the U.S. R&D capitalization requirement takes effect. The dashed (solid) line reports results for the unweighted (weighted) model. The dots represent the coefficient point estimates. Standard errors are clustered at the firm level.

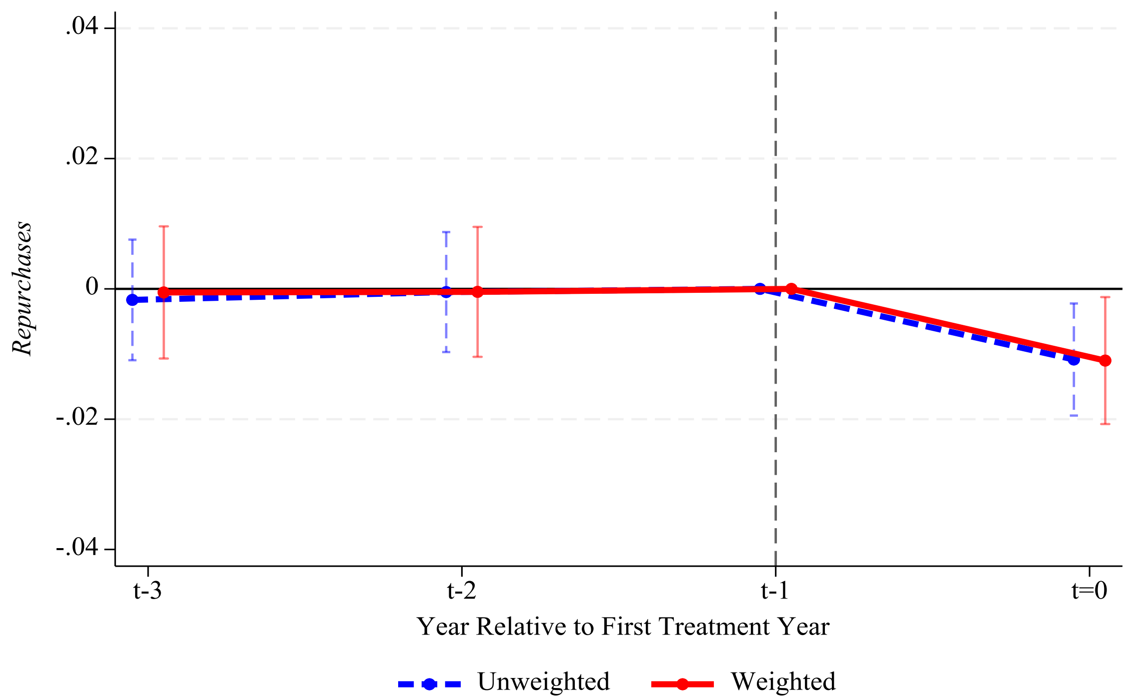
Figure 4: R&D Investment Parallel Trends



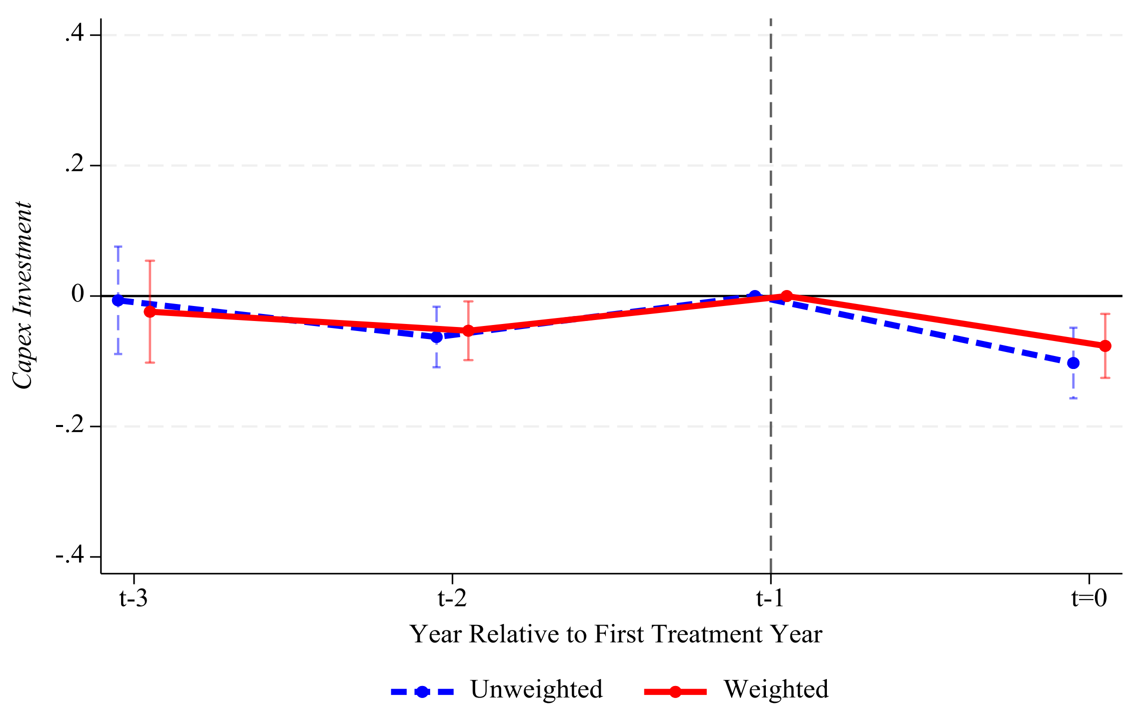
These figures depict coefficient estimates and 90% confidence intervals for our R&D investment analyses in event time (see Appendix F). In all panels, the dependent variable is *R&D Investment*. The regression models include all controls and firm and event-time fixed effects. In Panel A, the Y-axis represents the difference-in-differences (DiD) estimate. In Panels B, C, and D, the Y-axis represents the DiD estimate for high R&D firms, domestic-only firms, and financially constrained firms (measured by the HP Index), respectively. The X-axis represents the year relative to the treatment year, where year $t = 0$ is the first year the U.S. R&D capitalization requirement takes effect. The dashed (solid) line reports results for the unweighted (weighted) model. The dots represent the coefficient point estimates. Standard errors are clustered at the firm level.

Figure 5: Other Outcomes

(a) Repurchases



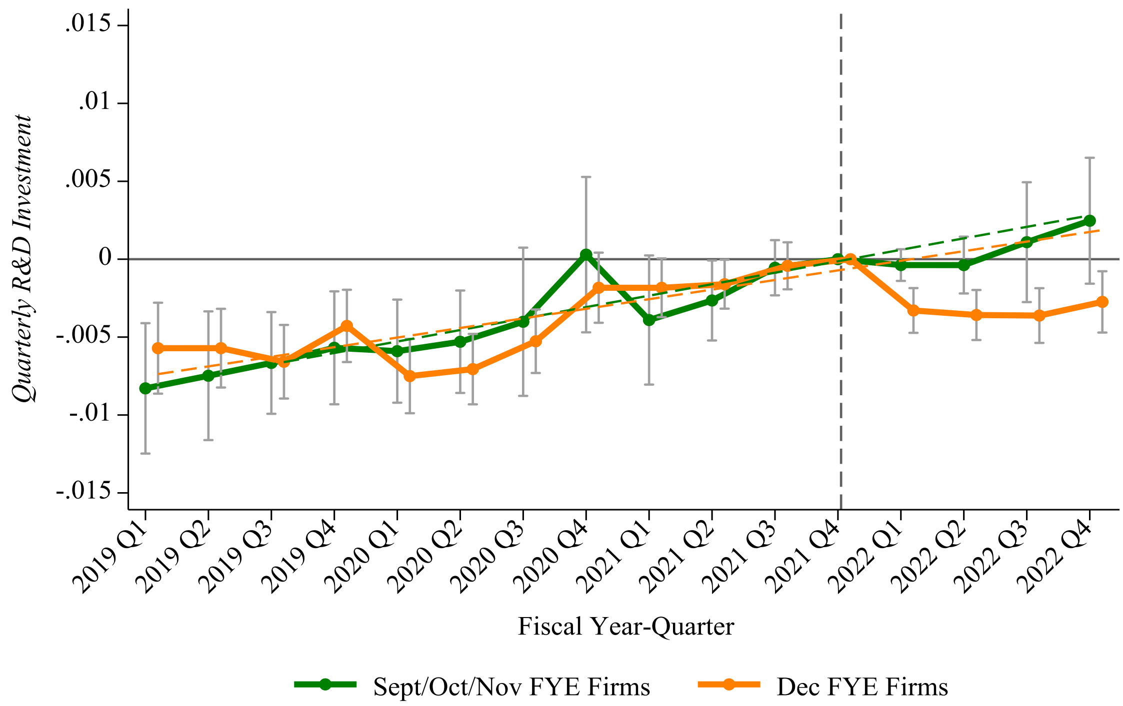
(b) Capital Expenditures



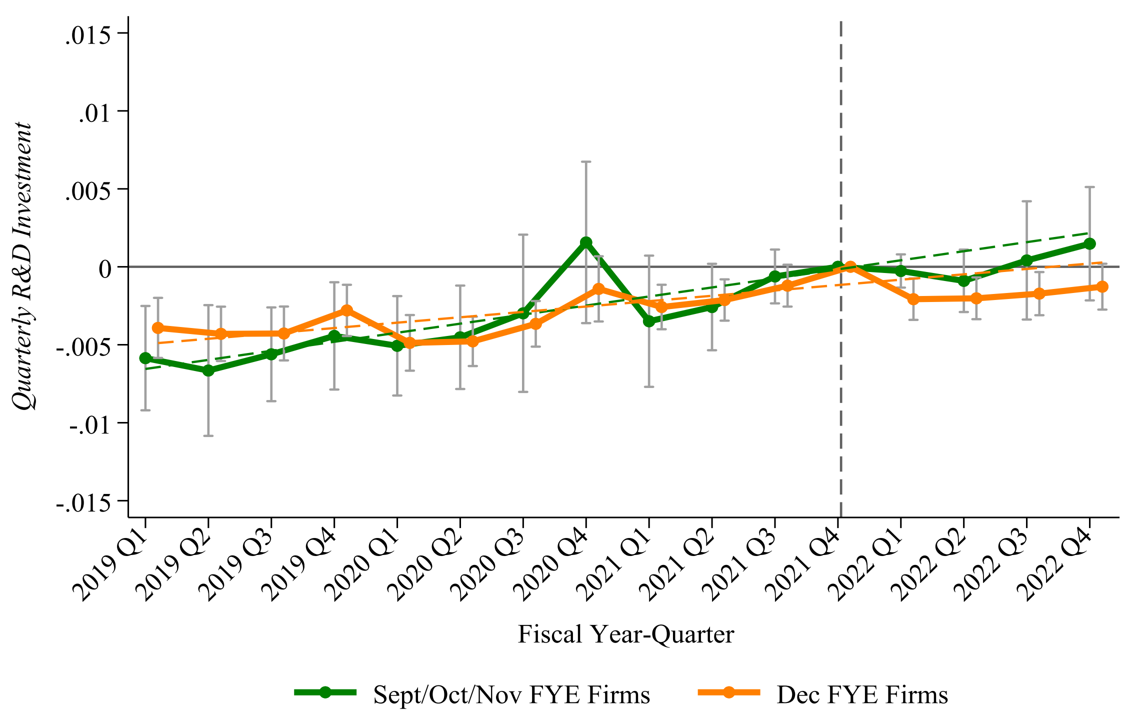
These figures depict coefficient estimates and 90% confidence intervals for our other outcomes analyses in event time (see Appendix F). The dependent variables are *Repurchases* (Panel A) and *Capex Investment* (Panel B). The regression models include all controls and firm and event-time fixed effects. The Y-axis represents the difference-in-differences (DiD) estimate. The X-axis represents the year relative to the treatment year, where year $t = 0$ is the first year the U.S. R&D capitalization requirement takes effect. The dashed (solid) line reports results for the unweighted (weighted) model. The dots represent the coefficient point estimates. Standard errors are clustered at the firm level.

Figure 6: Quarterly Analysis

(a) Unweighted

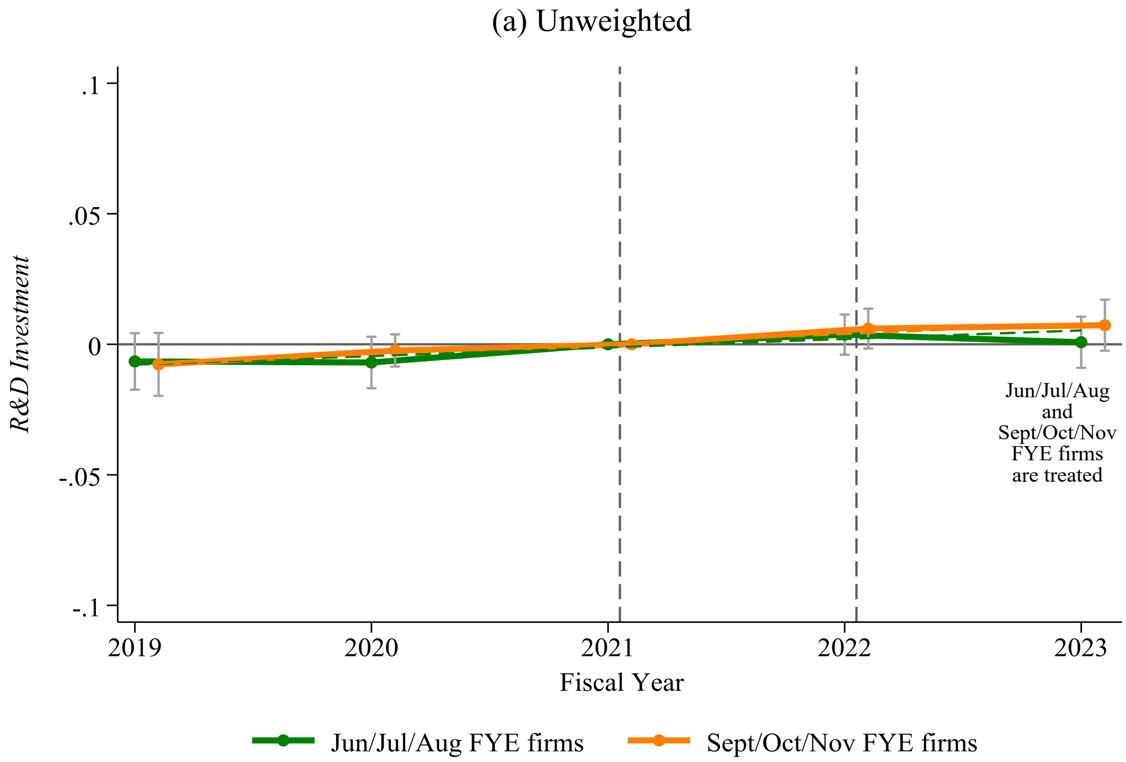


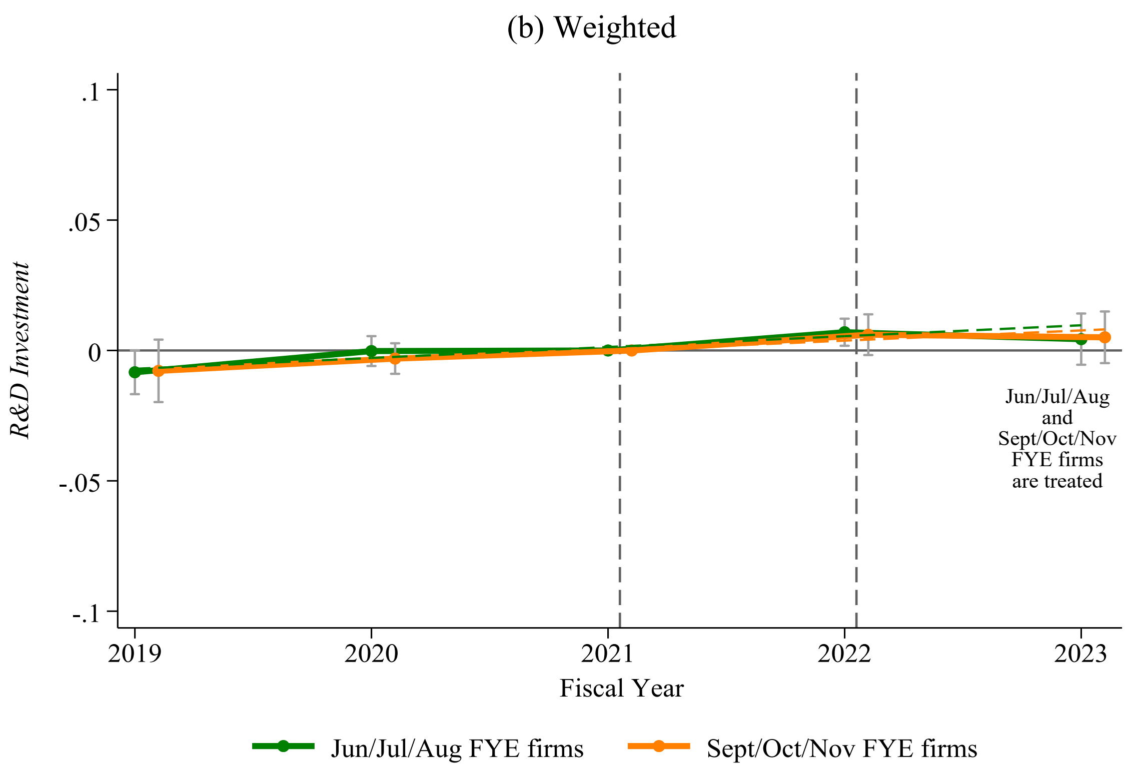
(b) Weighted



This figure depicts coefficient estimates for our analysis of possible anticipatory effects using quarterly data. In both panels, the depedent variable is quarterly R&D scaled by one-year lagged assets. The regression model includes all control variables and firm and year fixed effects. Entropy weights are included in the estimation where indicated. Standard errors are clustered at the firm level. The Y-axis represents the difference-in-differences (DiD) estimate. The X-axis represents the fiscal-quarter, where 2022 Q1 is the first quarter the U.S. R&D capitalization requirement takes effect for firms with fiscal years ending in December. The dots represent the point estimates of the DiD estimators. The bars represent the 90% confidence intervals.

Figure 7: Comparison of Sept/Oct/Nov FYE Firms to Jun/Jul/Aug FYE Firms





This figure depicts coefficient estimates for our analysis comparing Sept/Oct/Nov FYE firms to Jun/Jul/Aug FYE firms. In both panels, the dependent variable is *R&D Investment* and the regression model includes all control variables and firm and year fixed effects. Entropy weights are included where indicated. Standard errors are clustered at the firm level. The Y-axis represents the difference-in-differences (DiD) estimate. The X-axis represents the calendar year, where calendar year 2023 is the first year the U.S. R&D capitalization requirement takes effect for firms with fiscal years ending June through November. The dots represent the point estimates of the DiD estimators. The bars represent the 90% confidence intervals. The dashed lines represented expected R&D spending based on the coefficient point estimates from 2019 Q1 to 2021 Q4.

Table 1: Sample Selection

	Observations
Total observations for U.S. firms with fiscal years ending January 1, 2019 through December 31, 2022	21,222
Less observations missing industry code	-247
Less financial and utilities industries	-5,683
Less observations with missing data to construct control variables	-5,470
Less firms with missing or non-U.S. headquarters	-223
Less observations for January through August fiscal year ends	-1,812
Less observations with missing R&D expense	-2,731
Less observations for firms that report zero R&D expense in all pre-period years	-787
Less observations for firms missing event year t-1 or t=0 data	-559
Total observations in full sample	3,710
Less observations for December fiscal year-end firms that do not make an R&D amortization disclosure	-1,278
Total observations in restricted sample	2,432

This table reports the sample selection procedure.

Table 2: Descriptive Statistics

Variables	N	Mean	SD	p25	p50	p75
R&D Investment	3,710	0.126	0.159	0.018	0.066	0.172
R&D DTA	570	104.153	546.515	3.681	13.828	37.985
R&D DTA / Assets	570	0.030	0.031	0.007	0.019	0.043
Capitalized R&D	570	495.968	2,602.450	17.529	65.845	180.881
Capitalized R&D / Assets	570	0.142	0.149	0.034	0.093	0.205
Cash ETR	1,325	0.219	0.141	0.139	0.203	0.270
Current ETR	1,252	0.220	0.137	0.143	0.207	0.270
Assets	3,710	8,165.969	27,121.700	132.313	771.193	3,543.257
Log(Assets)	3,710	6.484	2.345	4.795	6.519	8.081
Age	3,710	23.801	19.560	8.000	19.000	31.750
Log(Age)	3,710	2.804	0.899	2.079	2.944	3.458
Leverage	3,710	0.274	0.253	0.069	0.234	0.398
ROA	3,710	-0.168	0.516	-0.271	-0.001	0.087
Sales Growth	3,710	0.461	2.107	-0.033	0.099	0.303
MTB	3,710	6.549	9.380	1.889	3.535	6.953
Cash	3,710	0.515	0.771	0.091	0.264	0.641
Capex	3,710	0.031	0.036	0.009	0.021	0.040
PPE	3,710	0.175	0.154	0.070	0.132	0.232
NOL Indicator	3,710	0.843	0.363	1.000	1.000	1.000
Industry Concentration	3,710	0.251	0.209	0.115	0.182	0.303
Institutional Ownership	3,710	0.644	0.328	0.397	0.755	0.910
Loss Firm	3,710	0.501	0.500	0.000	1.000	1.000
Domestic	3,710	0.277	0.447	0.000	0.000	1.000
Foreign Income %	3,710	0.254	0.774	0.000	0.003	0.457
High R&D Firm	3,710	0.278	0.448	0.000	0.000	1.000
High R&D Industry	3,710	0.550	0.498	0.000	1.000	1.000
High HP Index	3,710	0.183	0.387	0.000	0.000	0.000
High KZ Index	3,414	0.202	0.402	0.000	0.000	0.000
Small	3,710	0.243	0.429	0.000	0.000	0.000
Young	3,710	0.214	0.410	0.000	0.000	0.000
Negative OCF	3,710	0.374	0.484	0.000	0.000	1.000
Repurchases	2,260	0.029	0.056	0.000	0.006	0.031
Capex Investment	3,688	0.277	0.405	0.090	0.162	0.293
High Patent Grants	3,710	0.133	0.340	0.000	0.000	0.000
High Forward Citations	3,710	0.248	0.432	0.000	0.000	0.000
High Patent Value	3,710	0.139	0.346	0.000	0.000	0.000
High Innovative Efficiency	3,683	0.387	0.487	0.000	0.000	1.000
High Research Quotient	2,830	0.330	0.470	0.000	0.000	1.000

This table reports descriptive statistics for variables used in the main analyses. Appendix E provides variable definitions.

Table 3: Comparison of Treatment and Control Firms

Panel A: Control variables measured across the full sample period

	Dec FYE Firm = 0		*Dec FYE Firm* = 1		Diff. in Means	
	N	Mean	N	Mean	Unweighted	Weighted
Control Variables:						
Log(Assets)	362	7.019	3,348	6.427	0.593***	0.001
Log(Age)	362	3.271	3,348	2.754	0.517***	0.001
Leverage	362	0.257	3,348	0.275	-0.018	0.000
ROA	362	-0.033	3,348	-0.182	0.149***	0.000
Sales Growth	362	0.176	3,348	0.492	-0.316***	0.000
MTB	362	5.642	3,348	6.647	-1.005*	-0.001
Cash	362	0.282	3,348	0.540	-0.258***	0.000
Capex	362	0.032	3,348	0.031	0.001	0.000
PPE	362	0.178	3,348	0.174	0.004	0.000
NOL Indicator	362	0.771	3,348	0.851	-0.081***	0.000
Industry Concentration	362	0.352	3,348	0.240	0.112***	0.000
Institutional Ownership	362	0.674	3,348	0.641	0.033*	0.000

Panel B: Outcomes and cross-sectional variables measured across the sample pre-period

	Dec FYE Firm = 0		*Dec FYE Firm* = 1		Diff. in Means
	N	Mean	N	Mean	Unweighted
Outcomes:					
R&D Investment	269	0.081	2,430	0.136	-0.056***
R&D Investment Growth	268	0.010	2,412	-0.016	0.027
Cash ETR	146	0.212	807	0.207	0.005
Current ETR	144	0.200	750	0.203	-0.004
Repurchases	192	0.031	1,457	0.027	0.004
Capex Investment	269	0.239	2,415	0.300	-0.061**
Capex Investment Growth	267	0.248	2,379	0.731	-0.483
Cross-sectional variables:					
High R&D Firm	269	0.152	2,430	0.286	-0.133***
High R&D Industry	269	0.465	2,430	0.553	-0.089***
Domestic	269	0.193	2,430	0.264	-0.071**
High HP Index	269	0.100	2,430	0.184	-0.083***
High KZ Index	257	0.101	2,229	0.213	-0.112***
Small	269	0.201	2,430	0.243	-0.042
Young	269	0.071	2,430	0.214	-0.143***
Negative OCF	269	0.167	2,430	0.386	-0.218***
High Patent Grants	114	0.395	946	0.342	0.052
High Forward Citations	87	0.414	627	0.273	0.141***
High Patent Value	117	0.487	948	0.346	0.141***
High Innovative Efficiency	267	0.438	2,416	0.392	0.047
High Research Quotient	236	0.292	1,869	0.335	-0.043

This table reports descriptive statistics for the variables used in the main analyses with the sample split on the treatment indicator. Panel A reports control variables before and after considering entropy weights. Panel B reports other outcomes and cross-sectional variables. All continuous variables are winsorized at the 1st and 99th percentiles. Variable descriptions are available in Appendix E. Significance levels are based on two-sided t-tests and are indicated as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 4: Impact of R&D Capitalization on Effective Tax Rates
Panel A: Cash ETR

	(1)	(2)	(3)	(4)	(5)
Variables			*Cash ETR*		
Dec FYE Firm × Post	**0.091*** **	**0.087*** **	**0.088*** **	**0.096*** **	**0.109*** **
	[4.981]	**[4.672]**	**[4.710]**	**[5.006]**	**[5.589]**
Dec FYE Firm	-0.005	0.007			
	[-0.334]	[0.514]			
Post	-0.036**	-0.031*			
	[-2.270]	[-1.910]			
Log(Assets) $_{t-1}$		0.004	0.082***	0.123***	0.092***
		[1.203]	[3.372]	[3.148]	[2.760]
Log(Age) $_{t-1}$		0.012*	-0.019	-0.261**	-0.294**
		[1.724]	[-0.225]	[-2.126]	[-2.332]
Leverage $_{t-1}$		0.002	-0.048	-0.058	-0.094
		[0.096]	[-1.007]	[-0.840]	[-1.412]
Loss Firm $_{t-1}$		-0.000	0.000	0.016	0.009
		[-0.002]	[0.019]	[0.475]	[0.213]
ROA $_{t-1}$		0.040	0.169***	0.219*	0.229
		[0.945]	[3.251]	[1.661]	[1.647]
Sales Growth $_{t-1}$		-0.020**	-0.030**	-0.040	-0.046**
		[-2.305]	[-2.556]	[-1.025]	[-2.084]
MTB $_{t-1}$		-0.001***	-0.000	-0.000	-0.000
		[-2.841]	[-0.703]	[-0.251]	[-0.307]
Cash $_{t-1}$		-0.055***	-0.058**	-0.020	-0.037
		[-2.791]	[-2.181]	[-0.256]	[-0.586]
R&D Investment $_{t-1}$		-0.206***	0.124	-0.770**	-0.464
		[-3.097]	[0.750]	[-2.136]	[-1.512]
Capex $_{t-1}$		-0.200	-0.098	0.454	0.106
		[-1.130]	[-0.408]	[1.568]	[0.344]
PPE $_{t-1}$		-0.014	-0.024	-0.025	0.041
		[-0.308]	[-0.258]	[-0.134]	[0.214]
Domestic $_{t-1}$		-0.032*	-0.039	0.144	0.069
		[-1.935]	[-0.478]	[1.232]	[0.660]
Foreign Income % $_{t-1}$		0.009	-0.009	-0.008	-0.010
		[1.143]	[-1.162]	[-0.692]	[-0.924]
NOL Indicator $_{t-1}$		0.001	0.002	-0.035	-0.031
		[0.095]	[0.066]	[-0.935]	[-0.791]
Total observations	1,325	1,325	1,325	1,325	852
R^2	0.031	0.127	0.540	0.562	0.568
Sample	Full Sample	Full Sample	Full Sample	Full Sample	Restricted Sample
Method	OLS	OLS	OLS	EB 1st and 2nd Moment	EB 1st and 2nd Moment
Controls	N	Y	Y	Y	Y
Firm FE	N	N	Y	Y	Y
Event-Year FE	N	N	Y	Y	Y
Clustering	Firm	Firm	Firm	Firm	Firm

Dependent variable mean values:

Dec FYE Firms, Event Year t-1	0.202	0.202	0.202	0.202	0.192

Observations by group:

Dec FYE firms	1,122	1,122	1,122	1,122	649
Sept/Oct/Nov FYE firms	203	203	203	203	203
Observations	1,325	1,325	1,325	1,325	852

Panel B: Current ETR

Variables	(1)	(2)	(3)	(4)	(5)
			Current ETR		
Dec FYE Firm × Post	**0.067*** **	**0.063** **	**0.069*** **	**0.084*** **	**0.104*** **
	[2.777]	**[2.571]**	**[2.951]**	**[3.758]**	**[4.260]**
Dec FYE Firm	0.004	0.005			
	[0.167]	[0.210]			
Post	0.004	0.011			
	[0.258]	[0.798]			
Observations	1,252	1,252	1,252	1,252	771
R^2	0.049	0.117	0.545	0.553	0.584
Sample	Full Sample	Full Sample	Full Sample	Full Sample	Restricted Sample
Method	OLS	EB 1st and 2nd Moment	EB 1st and 2nd Moment	EB 1st and 2nd Moment	EB 1st and 2nd Moment
Controls	N	Y	Y	Y	Y
Firm FE	N	N	Y	Y	Y
Event-Year FE	N	N	Y	Y	Y
Clustering	Firm	Firm	Firm	Firm	Firm
Dependent variable mean values:					
Dec FYE Firms, Event Year t-1	0.202	0.202	0.202	0.202	0.194
Observations by group:					
Dec FYE firms	1,051	1,051	1,051	1,051	570
Sept/Oct/Nov FYE firms	201	201	201	201	201
Observations	1,252	1,252	1,252	1,252	771

This table presents results of testing the impact of the R&D capitalization requirement on effective tax rates. The dependent variable is *ETR* , measured by cash effective tax rates (Panel A) and current effective tax rates (Panel B). All variables are defined in Appendix E. Column (1) is estimated without weights; all other columns are entropy-balanced within the sub-sample of observations with available data using all control variables included in the regression model. All continuous variables are winsorized at the 1st and 99th percentiles. Control variables, fixed effects, and entropy weights are included as indicated. Standard errors are clustered at the firm level. T-statistics are reported in brackets beneath the coefficients. Significance levels are based on two-sided t-tests and are indicated as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 5: Impact of R&D Capitalization on R&D Investment

	(1)	(2)	(3)	(4)	(5)
Variables			*R&D Investment*		
Dec FYE Firm × Post	**-0.012****	**-0.016*****	**-0.012*****	**-0.006***	**-0.006**
	[-1.995]	**[-3.034]**	**[-2.706]**	**[-1.741]**	**[-1.601]**
Dec FYE Firm	0.056***	0.012			
	[4.397]	[1.102]			
Post	-0.006	0.005			
	[-1.272]	[1.046]			
Log(Assets) $_{t-1}$		-0.010***	-0.085***	-0.065***	-0.068***
		[-5.804]	[-10.884]	[-6.882]	[-6.879]
Log(Age) $_{t-1}$		-0.013***	-0.040*	-0.032*	-0.036*
		[-2.721]	[-1.749]	[-1.652]	[-1.719]
Leverage $_{t-1}$		-0.105***	-0.003	0.015	0.019
		[-7.692]	[-0.268]	[1.303]	[1.414]
ROA $_{t-1}$		-0.107***	-0.034***	-0.018*	-0.009
		[-7.558]	[-3.456]	[-1.778]	[-1.195]
Sales Growth $_{t-1}$		0.002	-0.003***	-0.005***	-0.006***
		[1.330]	[-2.582]	[-3.201]	[-4.125]
MTB $_{t-1}$		0.002***	0.001***	0.001	0.001*
		[5.195]	[3.320]	[1.576]	[1.724]
Cash $_{t-1}$		0.001	-0.026***	-0.020***	-0.023***
		[0.099]	[-6.316]	[-5.911]	[-6.263]
Capex $_{t-1}$		-0.052	0.063	-0.143*	-0.187**
		[-0.584]	[0.643]	[-1.875]	[-2.434]
PPE $_{t-1}$		-0.112***	0.029	-0.004	0.008
		[-4.832]	[0.649]	[-0.138]	[0.227]
NOL Indicator $_{t-1}$		0.033***	0.015**	0.006	0.005
		[5.275]	[2.001]	[1.502]	[1.162]
Industry Concentration $_{t-1}$		-0.113***	-0.021	-0.028	-0.036
		[-8.906]	[-0.857]	[-0.792]	[-1.080]
Institutional Ownership $_{t-1}$		0.026**	0.041	0.024*	0.021
		[2.008]	[1.562]	[1.715]	[1.311]
Observations	3,710	3,710	3,710	3,710	2,432
R^2	0.012	0.384	0.891	0.927	0.932
Sample	Full Sample	Full Sample	Full Sample	Full Sample	Restricted Sample
Method	OLS	OLS	OLS	EB 1st and 2nd Moment	EB 1st and 2nd Moment
Controls	N	Y	Y	Y	Y
Firm FE	N	N	Y	Y	Y
Event-Year FE	N	N	Y	Y	Y
Clustering	Firm	Firm	Firm	Firm	Firm
Dependent variable mean values:					
Dec FYE Firms, Event Year t-1	0.132	0.132	0.132	0.132	0.162
Observations by group:					
Dec FYE firms	3,348	3,348	3,348	3,348	2,070
Sept/Oct/Nov FYE firms	362	362	362	362	362
Observations	3,710	3,710	3,710	3,710	2,432

This table presents results of testing whether R&D investment declines in response to the U.S. requirement to capitalize and amortize R&D. The dependent variable is *R&D Investment* (R&D expense scaled by beginning of year assets). All variables are defined in Appendix E. Control variables, fixed effects, and entropy weights are included as indicated. All continuous variables are winsorized at the 1st and 99th percentiles. Standard errors are clustered at the firm level. T-statistics are reported in brackets beneath the coefficients. Significance levels are based on two-sided t-tests and are indicated as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 6: Cross-Sectional Analyses

Panel A: Heterogeneity in the Impact of R&D Capitalization Based on R&D Intensity and Domestic Status

	(1)	(2)	(3)
Variables		*R&D Investment*	
Dec FYE Firm × Post	**-0.001**	**-0.001**	**-0.002**
	[-0.533]	**[-0.386]**	**[-0.653]**
Dec FYE Firm × Post × High R&D Firm	**-0.036****		
	[-2.216]		
High R&D Firm × Post	-0.008		
	[-0.544]		
Dec FYE Firm × Post × High R&D Industry		**-0.012***	
		[-1.845]	
High R&D Industry × Post		-0.002	
		[-0.343]	
Dec FYE Firm × Post × Domestic			**-0.023***
			[-1.696]
Domestic × Post			0.003
			[0.230]
Observations	3,710	3,710	3,710
R^2	0.929	0.928	0.928
Sample	Full Sample	Full Sample	Full Sample
Method	EB 1st and 2nd Moment	EB 1st and 2nd Moment	EB 1st and 2nd Moment
Controls	Y	Y	Y
Firm FE	Y	Y	Y
Event-Year FE	Y	Y	Y
Clustering	Firm	Firm	Firm
Within-group difference-in-differences estimate:			
Dec FYE Firm × Post × High R&D Firm + Dec FYE Firm × Post	-0.037**		
Dec FYE Firm × Post × High R&D Industry + Dec FYE Firm × Post		-0.013**	
Dec FYE Firm × Post × Domestic + Dec FYE Firm × Post			-0.025*
Dependent variable mean values:			
Dec FYE Firms, Event Year t-1			
Dec FYE High R&D Firms, Event Year t-1	0.318		
Dec FYE High R&D Industries, Event Year t-1		0.186	
Dec FYE Domestic Firms, Event Year t-1			0.220
Observations by group:			
Dec FYE firms:			
High R&D (Domestic)	913	977	1,871
Low R&D (MNC)	2,435	2,371	1,477
	3,348	3,348	3,348
Sept/Oct/Nov FYE firms:			
High R&D (Domestic)	71	56	168
Low R&D (MNC)	291	306	194
	362	362	362
Total observations	3,710	3,710	3,710

Panel B: Heterogeneity in the Impact of R&D Capitalization on R&D Investment based on Financial Constraints

	(1)	(2)	(3)	(4)	(5)
High constraints measure	*High HP Index*	*High KZ Index*	*Small*	*Young*	*Negative OCF*
Variables			*R&D Investment*		
Dec FYE Firm × Post	**0.000**	**-0.004**	**0.001**	**-0.004**	**0.000**
	[0.139]	**[-1.345]**	**[0.307]**	**[-1.190]**	**[0.177]**
Dec FYE Firm × Post × High Constraints	**-0.065*****	**-0.010**	**-0.034****	**-0.024**	**-0.031****
	[-3.120]	**[-0.484]**	**[-2.539]**	**[-1.636]**	**[-2.086]**
High Constraints × Post	0.021	0.002	0.008	0.018	0.013
	[1.154]	[0.111]	[0.650]	[1.527]	[0.907]
Observations	3,710	3,414	3,710	3,710	3,710
R^2	0.929	0.929	0.928	0.928	0.928
Sample	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample
Method	EB 1st and 2nd Moment	EB 1st and 2nd Moment	EB 1st and 2nd Moment	EB 1st and 2nd Moment	EB 1st and 2nd Moment
Controls	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y
Event-Year FE	Y	Y	Y	Y	Y
Clustering	Firm	Firm	Firm	Firm	Firm
Within-group difference-in-differences estimate:					
Dec FYE Firm × Post × High Constraints + Dec FYE Firm × Post	-0.065***	-0.014	-0.033**	-0.028*	-0.031**
Dependent variable mean values:					
Constrained Dec FYE Firms, Event Year t-1	0.249	0.121	0.214	0.192	0.221
Observations by group:					
Dec FYE firms:					
High constraints	642	656	828	828	765
Low constraints	2,706	2,412	2,520	2,520	2,583
	3,348	3,068	3,348	3,348	3,348
Sept/Oct/Nov FYE firms:					
High constraints	37	35	73	73	62
Low constraints	325	311	289	289	300
	362	346	362	362	362
Total observations	3,710	3,414	3,710	3,710	3,710

This table presents results of our cross-sectional analyses. Panel A reports results of the cross-sectional tests on past R&D intensity (*High R&D Firm*), high R&D industry membership (*High R&D Industry*), and domestic-only status (Domestic). Panel B reports results of our financial constraints analyses. We measure constraints (*High Constraints*) using financial constraints indices (*High HP Index* and *High KZ Index*), firm characteristics (*Small* and *Young*), and cash flow constraints (*Negative OCF*). We measure all cross-sectional variables as of event year *t-1* . In both panels, the dependent variable is *R&D Investment* (R&D expense scaled by beginning of year assets). All variables are defined in Appendix E. Control variables, fixed effects, and entropy weights are included as indicated. All continuous variables are winsorized at the 1st and 99th percentiles. Standard errors are clustered at the firm level. T-statistics are reported in brackets beneath the coefficients. Significance levels are based on two-sided t-tests and are indicated as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 7: Impact of R&D Capitalization on Share Repurchases and Capital Investment
Panel A: Repurchases

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	Full sample	*High HP Index* = 0	*High KZ Index* = 0	*Small* = 0	*Young* = 0	*Negative OCF* = 0
Variables			*Repurchases*			
Dec FYE Firm × Post	**-0.011****	**-0.011****	**-0.012****	**-0.011****	**-0.010****	**-0.012****
	[-2.275]	**[-2.505]**	**[-2.372]**	**[-2.390]**	**[-2.253]**	**[-2.563]**
Observations	2,260	2,146	1,663	2,052	2,037	1,751
R^2	0.754	0.759	0.719	0.759	0.752	0.771
Sample	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample
Method	EB 1st and 2nd Moment	EB 1st and 2nd Moment	EB 1st Moment	EB 1st and 2nd Moment	EB 1st and 2nd Moment	EB 1st and 2nd Moment
Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Event-Year FE	Y	Y	Y	Y	Y	Y
Clustering	Firm	Firm	Firm	Firm	Firm	Firm
Dependent variable mean values:						
Dec FYE Firms, Event Year t-1	0.032	0.032	0.035	0.033	0.035	0.037
Observations by group:						
Dec FYE firms	2,001	1,891	1,423	1,801	1,786	1,516
Sept/Oct/Nov FYE firms	259	255	240	251	251	235
Observations	2,260	2,146	1,663	2,052	2,037	1,751

Panel B: Capital Expenditures

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	Full sample	*High HP Index* = 0	*High KZ Index* = 0	*Small* = 0	*Young* = 0	*Negative OCF* = 0
Variables			*Capex Investment*			
Dec FYE Firm × Post	**-0.052***	**-0.051****	**-0.078*****	**-0.027**	**-0.044**	**-0.031**
	[-1.960]	**[-2.118]**	**[-2.761]**	**[-1.532]**	**[-1.630]**	**[-1.183]**
Observations	3,688	3,031	2,720	2,809	2,904	2,319
R^2	0.449	0.463	0.463	0.482	0.432	0.467
Sample	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample
Method	EB 1st and 2nd Moment	EB 1st and 2nd Moment	EB 1st and 2nd Moment	EB 1st and 2nd Moment	EB 1st and 2nd Moment	EB 1st and 2nd Moment
Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Event-Year FE	Y	Y	Y	Y	Y	Y
Clustering	Firm	Firm	Firm	Firm	Firm	Firm
Dependent variable mean values:						
Dec FYE Firms, Event Year t-1	0.281	0.278	0.338	0.276	0.253	0.232
Observations by group:						
Dec FYE firms	3,326	2,706	2,409	2,520	2,570	2,019
Sept/Oct/Nov FYE firms	362	325	311	289	334	300
Observations	3,688	3,031	2,720	2,809	2,904	2,319

This table presents results of our analyses of the effect of R&D capitalization on repurchases (Panel A) and capital expenditures (Panel B). In all panels, Column (1) reports results for the full sample with available data. Columns (2) through (6) report results for various subsamples of unconstrained firms. We measure constraints using financial constraints indices (*High HP Index* and *High KZ Index*), firm characteristics (*Small* and *Young*), and cash flow constraints (*Negative OCF*). All constraints are measured as of event year *t-1*. All variables are defined in Appendix E. All models are entropy-balanced within the sub-sample of observations with available data using all control variables included in that particular regression model. All continuous variables are winsorized at the 1st and 99th percentiles. Fixed effects are included as indicated. Standard errors are clustered at the firm level. T-statistics are reported in brackets beneath the coefficients. Significance levels are based on two-sided t-tests and are indicated as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 8: Heterogeneity in the Impact of R&D Capitalization on R&D Investment based on Innovation Quality

	(1)	(2)	(3)	(4)	(5)
Quality measure	*High Patent Grants*	*High Forward Citations*	*High Patent Value*	*High Innovative Efficiency*	*High Research Quotient*
Variables			*R&D Investment*		
Dec FYE Firm × Post	-0.006	-0.006	-0.006	-0.010*	-0.003
	[-1.479]	[-1.367]	[-1.379]	[-1.810]	[-0.833]
Dec FYE Firm × Post × Quality	**-0.001**	**0.002**	**-0.001**	**0.007**	**-0.001**
	[-0.096]	**[0.311]**	**[-0.083]**	**[1.147]**	**[-0.253]**
Quality × Post	0.006	0.001	0.008	0.003	0.003
	[1.219]	[0.148]	[1.320]	[0.540]	[0.637]
Observations	3,710	3,710	3,710	3,683	2,830
R^2	0.928	0.927	0.928	0.927	0.929
Method	EB 1st and 2nd Moment	EB 1st and 2nd Moment	EB 1st and 2nd Moment	EB 1st and 2nd Moment	EB 1st and 2nd Moment
Controls	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y
Event-Year FE	Y	Y	Y	Y	Y
Clustering	Firm	Firm	Firm	Firm	Firm
Within-group difference-in-differences estimate:					
Dec FYE Firm × Post × Quality + Dec FYE Firm × Post	-0.007	-0.004**	-0.007	-0.003	-0.004
Observations by group:					
Dec FYE firms:					
High Quality	434	791	440	1,271	843
Low quality	2,914	2,557	2,908	2,053	1,672
	3,348	3,348	3,348	3,324	2,515
Sept/Oct/Nov FYE firms:					
High Quality	60	128	76	156	92
Low quality	302	234	286	203	223
	362	362	362	359	315
Total observations	3,710	3,710	3,710	3,683	2,830

This table presents results of testing whether the effects of R&D capitalization differ based on innovation quality, where *DEC FYE × Post* interacts with several measures of research quality (*Quality*). In all columns, the dependent variable is *R&D Investment* (R&D expense scaled by beginning of year assets). All variables are defined in Appendix E. All cross-sectional variables are measured as of event year t-1. All models are entropy-balanced within the sub-sample of observations with available data using all control variables included in the regression model. All continuous variables are winsorized at the 1st and 99th percentiles. Fixed effects are included as indicated. Standard errors are clustered at the firm level. T-statistics are reported in brackets beneath the coefficients. Significance levels are based on two-sided t-tests and are indicated as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 9: Quarterly Analysis

	(1)	(2)
Variables	*Quarterly R&D Investment*	
Dec FYE Firm × 2019 Q1	0.003	0.002
	[0.920]	[0.941]
Dec FYE Firm × 2019 Q2	0.002	0.002
	[0.667]	[0.923]
Dec FYE Firm × 2019 Q3	0.000	0.001
	[0.035]	[0.703]
Dec FYE Firm × 2019 Q4	0.001	0.002
	[0.569]	[0.750]
Dec FYE Firm × 2020 Q1	-0.002	0.000
	[-0.698]	[0.089]
Dec FYE Firm × 2020 Q2	-0.002	-0.000
	[-0.763]	[-0.120]
Dec FYE Firm × 2020 Q3	-0.001	-0.001
	[-0.402]	[-0.214]
Dec FYE Firm × 2020 Q4	-0.002	-0.003
	[-0.643]	[-0.898]
Dec FYE Firm × 2021 Q1	0.002	0.001
	[0.761]	[0.335]
Dec FYE Firm × 2021 Q2	0.001	0.000
	[0.582]	[0.240]
Dec FYE Firm × 2021 Q3	0.000	-0.001
	[0.089]	[-0.463]
Dec FYE Firm × 2022 Q1	**-0.003*** **	**-0.002***
	[-2.802]	**[-1.705]**
Dec FYE Firm × 2022 Q2	**-0.003****	**-0.001**
	[-2.207]	**[-0.741]**
Dec FYE Firm × 2022 Q3	**-0.005***	**-0.002**
	[-1.872]	**[-0.829]**
Dec FYE Firm × 2022 Q4	**-0.005****	**-0.003**
	[-1.987]	**[-1.159]**
2019 Q1	-0.008***	-0.006***
	[-3.259]	[-2.882]
2019 Q2	-0.007***	-0.007***
	[-2.979]	[-2.609]
2019 Q3	-0.007***	-0.006***
	[-3.355]	[-3.069]
2019 Q4	-0.006**	-0.004**
	[-2.581]	[-2.119]
2020 Q1	-0.006***	-0.005***
	[-2.934]	[-2.615]
2020 Q2	-0.005***	-0.005**
	[-2.652]	[-2.243]
2020 Q3	-0.004	-0.003
	[-1.389]	[-0.973]
2020 Q4	0.000	0.002
	[0.097]	[0.497]
2021 Q1	-0.004	-0.003

	[-1.549]	[-1.365]
2021 Q2	-0.003*	-0.003
	[-1.698]	[-1.532]
2021 Q3	-0.001	-0.001
	[-0.510]	[-0.591]
2022 Q1	**-0.000**	**-0.000**
	[-0.609]	**[-0.416]**
2022 Q2	**-0.000**	**-0.001**
	[-0.341]	**[-0.740]**
2022 Q3	**0.001**	**0.000**
	[0.468]	**[0.178]**
2022 Q4	**0.002**	**0.001**
	[1.005]	**[0.670]**
Observations	9,425	9,425
R^2	0.835	0.853
Sample	Quarterly	Quarterly
Method	OLS	EB 1st and 2nd Moment
Controls	Y	Y
Firm FE	Y	Y
Event-Year FE	N	N
Clustering	Firm	Firm
Observations by group:		
Dec FYE firms	8,493	8,493
Sept/Oct/Nov FYE firms	932	932
Observations	9,425	9,425

This table presents results of our quarterly R&D investment analysis. All control variables are measured at a one-year lag. All variables are defined in Appendix E. Control variables, fixed effects, and entropy weights are included as indicated. All continuous variables are winsorized at the 1st and 99th percentiles. Fixed effects are included as indicated. Standard errors are clustered at the firm level. T-statistics are reported in brackets beneath the coefficients. Significance levels are based on two-sided t-tests and are indicated as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 10: Comparison of Sept/Oct/Nov FYE Firms to Jun/Jul/Aug FYE Firms

	(1)	(2)
Variables	*R&D Investment*	*R&D Investment*
Sept/Oct/Nov FYE × Year 2019	**-0.001**	**0.001**
	[-0.131]	**[0.063]**
Sept/Oct/Nov FYE × Year 2020	**0.005**	**-0.003**
	[0.836]	**[-0.538]**
Sept/Oct/Nov FYE × Year 2022	**0.002**	**-0.001**
	[0.432]	**[-0.220]**
Sept/Oct/Nov FYE × Year 2023	**0.007**	**0.001**
	[1.156]	**[0.132]**
Year 2019	-0.007	-0.008
	[-0.997]	[-1.633]
Year 2020	-0.007	-0.000
	[-1.158]	[-0.066]
Year 2022	0.004	0.007**
	[0.791]	[2.218]
Year 2023	0.001	0.004
	[0.134]	[0.727]
Observations	960	960
R^2	0.915	0.927
Method	OLS	EB 1st and 2nd Moment
Controls	Y	Y
Firm FE	Y	Y
Event-Year FE	N	N
Clustering	Firm	Firm
Observations by group:		
Sept/Oct/Nov FYE firms	510	510
Jun/Jul/Aug FYE firms	450	450
Observations	960	960

This table reports the results of our analysis of possible anticipatory effects. The sample includes firms with fiscal years ending June through November. The sample does not include our main treatment group (i.e., December fiscal year end firms). In all columns, the dependent variable is R&D Investment (R&D expense scaled by beginning of year assets). All variables are defined in Appendix E. All continuous variables are winsorized at the 1st and 99th percentiles. Fixed effects and entropy weights are included as indicated. Standard errors are clustered at the firm level. T-statistics are reported in brackets beneath the coefficients. Significance levels are based on two-sided t-tests and are indicated as follows: * p<0.10, ** p<0.05, *** p<0.01.