The Consequences of Limiting the Tax Deductibility of R&D

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Abstract

We study the effects of limiting the tax deductibility of research and development ("R&D") expenditures. From 2022 through 2024, U.S. companies were 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; we estimate an aggregate reduction of $42 billion in the first year of the policy. This reduction is concentrated among research-intensive, domestic-only, and financially constrained firms. Third, we estimate decreases in domestic R&D employment of 1.4% to 2.6%, relative to domestic non-R&D employment. Finally, we observe decreased capital expenditures and share repurchases among affected companies, consistent with the R&D tax 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.

Keywords: R&D, Tax Incentives

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1 Introduction

This paper provides evidence on the consequences of a 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 to stimulate innovative activities, such as the ability to immediately deduct R&D expenditures (e.g., EY 2023). From 2022 through 2024, the U.S. departed significantly from its decades-long approach of permitting immediate R&D deductions, instead requiring firms to capitalize and amortize R&D expenditures. U.S. companies expressed concerns about the potential effects of this R&D tax 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" (Williams-Alvarez 2022). Although R&D capitalization was required for a relatively short time, we find sizeable impacts of this policy change: We measure a $42 billion reduction in R&D investment and a 2% decline in domestic R&D jobs. We also document the types of companies most impacted, as well as spillover effects on capital investments and firm payout.

Studying the U.S. R&D capitalization and amortization requirement (hereafter "R&D capitalization" or "R&D tax change") is important because it provides an opportunity to examine the effectiveness of U.S. innovation tax policies. Such policies aim to address underinvestment problems, which arise because firms do not capture all the financial returns from their innovation; rather, a significant portion of these benefits spill over to other firms, consumers, and society (e.g., Lucking et al. 2019; Stantcheva 2021; Glaeser and Lang 2024). Thus, to encourage private sector innovation, the U.S. has historically provided two main tax incentives: the R&D credit and the R&D deduction (see Appendix A for technical de-

tails). Prior literature focuses predominantly on the U.S. R&D credit, with findings generally pointing to increased investment in response to this incentive (e.g., Berger 1993; Hall 1993; Klassen et al. 2004; Finley et al. 2015; Rao 2016). However, the literature provides relatively little evidence about the effectiveness of the R&D deduction, which is surprising given that we estimate the aggregate annual tax savings from the R&D deduction were *twice* as large as those from the R&D credit prior to this tax R&D tax change.[1] Thus, we use the 2022 tax setting to provide some of the first evidence quantifying the effect of R&D deductibility on firms' innovation spending.

The R&D tax change required U.S. companies to capitalize and amortize domestic R&D investment over a five-year period instead of immediately deducting 100% of R&D costs. While the total *nominal* amount of deductions over time stayed the same (i.e., 100% of the investment cost would eventually be deducted), the *real* present value of the tax benefits was lower because the deductions were spread over time. As a result, the tax law change had significant adverse cash flow consequences and increased the after-tax cost of conducting R&D. Economic theory predicts that increases in tax burdens decrease investment spending (Hall and Jorgenson 1967; Rao 2016), and prior research on the timing of other tax deductions documents sizeable effects on corporate investment (e.g., Zwick and Mahon 2017; Ohrn 2019; Garrett et al. 2020; Curtis et al. 2022). Anecdotal evidence further suggests that companies would respond by cutting R&D; 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" (Rubin 2023a). Yelp's CFO David Schwarzbach similarly stated that the requirement to capitalize and amortize R&D "really creates an

[1] 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 2024b).

inhibitor for increasing investment" (Williams-Alvarez, 2023a).

Although prior work demonstrates the importance of immediate expensing for investment decisions, there are three factors that could attenuate the theoretically-predicted firm response to R&D capitalization. Most notably, many corporate managers expected the law to be repealed before it became effective (e.g., Bloomberg 2023; Rubin 2023b; Williams-Alvarez 2023b). In brief, R&D capitalization was included in the 2017 Tax Cuts and Jobs Act (TCJA) primarily to raise revenue to offset the costs of other TCJA provisions. However, because this change was unprecedented and inconsistent with other TCJA investment goals, the effective date was delayed until 2022, which allowed time for repeal. Despite bipartisan agreement—and to the surprise of many—Congress did not act to change the law by the end of 2021. Even after the provision took effect, many expected it would be repealed based on bipartisan legislation introduced in 2022 and 2023. However, Congress did not pass legislation to change the law until 2025 as part of the One Big Beautiful Bill Act (OBBBA).

Statements by corporate managers and the press validate that many expected a repeal of the capitalization requirement, potentially attenuating firms' responses. For example, Doyle Edwards, director of government programs for Brewer Science, stated, "Our understanding was that Congress was going to find a way to fix it, so we really didn't plan for it" (Rubin 2023b). Conference call transcripts reveal similar concerns. For example, CEO H. Lynn Moore explained during Tyler Technologies, Inc.'s fourth quarter 2022 earnings conference call, "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."[2] In further describing this unprecedented change, the Bloomberg Editorial Board stated: "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

[2]See Appendix B for additional examples.

revisit the matter before any harm was done. Congress never got around to it" (Bloomberg 2023). To the extent companies expected the law to be repealed before their 2022 taxes were due, companies may not have changed their R&D investment decisions.

A second factor that may mute firms' responsiveness to this policy is the high cost of adjusting R&D. Such costs imply that it may take time for R&D to respond to changes in its after-tax cost, as firms would prefer to smooth R&D spending than lay off valuable knowledge workers (e.g., Hall and Lerner 2010). Finally, given the critical role of innovation in long-term growth and competitiveness, firms may have prioritized sustaining their R&D spending and instead adjusted along other margins, such as capital investment or shareholder payouts. Thus, while we expect firms to reduce R&D investment in response to this tax 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 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 both tax payments and R&D investment.

Before examining the impact of R&D capitalization on R&D investment, we quantify 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 were required to capitalize an average of $496

million of R&D, which is equivalent to 14.2% of total assets. Second, coefficient estimates from regression analyses show that December fiscal-year-end 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 relative to treated firms' average cash ETR.

Next, we measure the magnitude of R&D capitalization's impact on U.S. companies' R&D investments. Compared to control firms, we observe that treated firms invest less after the R&D tax change. Specifically, we find an on-average decline in R&D among affected firms, relative to control firms, of approximately 0.6% of assets, which is equivalent to a 4.5% change relative to the sample mean and a reduction of $42 billion in R&D in aggregate. This estimate is based on the short-run impact of the policy in the first year and therefore is a lower bound estimate, as the effect on R&D investment levels intensified over time once it became clear the policy would in fact go into effect. In addition, the aggregate impact across all U.S. firms is likely greater when taking into account later-affected firms and private firms for which data are not publicly available to estimate the response.

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 firms, and (3) financially constrained firms, for whom the sudden increase in cash tax payments likely further restricted the resources available to fund R&D. For the most research-intensive firms, 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.[3] For domestic-only firms and financially constrained firms, we find reductions of 11.4% and 26.1% percent of these firms' average R&D (scaled by assets), respectively.

We next examine how R&D capitalization affects domestic R&D employment. Labor costs are the largest component of R&D spending (Glaeser et al. 2025). Therefore, declines

[3]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).

in R&D investment could lead to job losses. To investigate this possibility, we use the Workforce Dynamics dataset from Revelio Labs to implement a *within-firm* research design, in which we compare domestic R&D employment (scientists and engineers) to domestic non-R&D employment (all other job categories) around the R&D tax change. In addition to using each firm as its own control—thereby addressing any remaining concerns about differences between treatment and control firms for our R&D investment tests—this research design enables us to extend the analyses beyond the initial implementation year and also include firms with all fiscal year ends in the sample. We observe that firms appear to reduce the number of R&D jobs in response to this policy, but with a one-year delay. Specifically, we find that domestic R&D employment decreased by approximately 1.4% to 2.6% relative to domestic non-R&D employment during the second and third years of R&D capitalization. Beyond quantifying the human capital impact, the analysis measures how long it takes for firms' R&D to adjust to tax policy changes.

We next study whether the increased cash tax burden triggered by R&D capitalization had spillover effects on firms' other investment and payout decisions. We find declines in capital expenditures and share repurchases (both scaled by assets) of approximately 18.5% and 34.4%, respectively. These effects occur both in the full sample and in subsamples of unconstrained firms, even though these firms on average did not significantly reduce R&D investments in our cross-sectional tests. These findings suggest that unconstrained firms sustained R&D spending, at least in part, by cutting repurchases and capital expenditures.

We consider the possibility that the decline in R&D induced by this policy may have been beneficial insofar as it led firms to cut low-value projects. Ideally, we would study whether firms cut more incremental R&D projects, but unfortunately, publicly available data do not allow us to assess the impact of the tax change at the project-level. As an alternate approach, we separate firms based on several firm-level innovation quality proxies, such as innovative efficiency (Hirshleifer et al. 2013), R&D output elasticity (Cooper et al. 2022), and patent

value (Kogan et al. 2017), all measured prior to the tax change. Across five measures of innovation quality, we observe little to no variation in the policy's effect on R&D investment among firms with differing levels of innovation quality. While this implies that all firms (not just higher- or lower-quality innovators) reduced their R&D activities, we caveat that the existing proxies make it difficult to evaluate whether the foregone investments would have been value-increasing for firm stakeholders or society.

Finally, we examine whether our inferences are affected by anticipatory shifting of R&D expenditures by control firms into the pre-treatment period. We assess this possibility in two ways: by analyzing quarterly R&D spending around the enactment date and by comparing control groups with differing incentives to shift R&D. Across both approaches, we find no evidence that control firms accelerated R&D spending in 2022, mitigating concerns that our results are driven by anticipatory effects.

This paper contributes novel evidence to the academic literature on innovation tax policy by examining the economic effects of limiting R&D tax deductions. Glaeser and Lang (2024) highlight that "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 address this gap by providing evidence on how limiting the tax deductibility of R&D impacted short-run R&D investment decisions among U.S. firms, as well as identifying characteristics of firms most affected. Not only do we advance the R&D tax literature that has predominantly focused on the R&D credit, but we also provide new insights into a prevalent yet understudied aspect of innovation tax policy. This paper thus answers calls by Jacob (2022) and Lester and Olbert (2024) for more research on tax base elements.

Our paper also provides timely, policy-relevant evidence regarding the real economic consequences of R&D capitalization. Policymakers, U.S. firms, and the media expressed substantial concerns over the potential negative impacts of R&D capitalization, especially given the expansion of innovation-related tax incentives by countries around the globe (EY

2023). R&D capitalization was included in the TCJA to reduce the estimated cost of the legislation, but it was never expected to become effective. Although immediate expensing of domestic R&D was eventually reinstated by the OBBBA in 2025, our findings underscore that R&D capitalization had consequences for U.S. firms, including reductions in R&D investments and losses of human capital that are unlikely to be quickly reversed (Williams 2024). Even with reinstatement, firms will never fully recoup the foregone tax benefits, due to the present value differences and the interactions of this incentive with other components of tax law. Thus, our paper sheds light on how the political economy of tax policy-making, including legislative accounting maneuvers, has real economic effects on investment and employment.

2 Institutional Details and Research Questions

Under the 2022 U.S. R&D tax change, firms could no longer immediately deduct 100% of R&D costs in the year they were incurred. Instead, deductions were 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.[4]

This change in tax treatment significantly reduced the present value of the tax benefits associated with R&D deductions. Appendix C provides an illustrative example. Assuming R&D spending of $304 million in year 1 (the average amount for firms in our sample), and applying the U.S. corporate tax rate of 21% (allowing for full expensing under the pre-2022 law), the tax benefit would have been $63.8 million ($304 million $\times$ 21%). In contrast, under R&D capitalization, only 10% of the R&D expenditures ($30.4 million) could be deducted in the first year, with the remaining amount spread over the following five years. Thus, the tax

[4]The law imposes a five-year amortization period for domestic R&D, which occurs over six years in practice due to the technical tax "half-year convention." This convention only allows 50% of the deduction (20% $\times$ 50%) in the first year, as it accounts for the fact that firms' investment spending occurs throughout the year, and thus firms should only receive a partial year benefit.

law change decreased the tax benefit in the year of the R&D spending to only $6.4 million ($30.4 million × 21%), and decreased the present value of the total tax benefit from $63.8 million to $53.0 million.

Figure 1, Panel A depicts the differences in the 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 C shows that, when incurring $304 million of R&D costs annually for ten years, firms receive total tax benefits through year 10 of $638 million under the prior immediate expensing rules ($304 million × 21% × 10 years) versus $407 million under the capitalization rules (two-thirds of the amount). Figure 1, Panel B depicts this cumulative difference.

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 setting provides an important opportunity to study the effect of the R&D deduction on innovation. The change was relatively isolated from other tax policy changes, which enhances our ability to identify causal effects. Not only was this the first substantial change to the U.S. R&D tax deduction since its inception in 1954, but it also came into effect several years after the other TCJA changes and after the peak of the COVID-19 pandemic. Thus, 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 R&D capitalization, the extent of its effects 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 three reasons. First, as discussed above, many businesses and policymakers

expected Congress to repeal the requirement before it took effect. As such, 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 have impeded firms from immediately reducing R&D expenditures in response to its increased after-tax cost.[5] Third, innovation is important to firms' future growth and competitiveness. In the short-run, firms may have prioritized 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 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.

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

[5]Research finds 50% or more of R&D spending relates to compensation (Glaeser et al. 2025). 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).

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), i indexes the firm, and t indexes the event year. 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. Other variables are defined below and in Appendix D. The treatment timeline and event years are depicted in Appendix E. We include firm fixed effects (α) to address cross-sectional variation in effective tax rates not otherwise 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 *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 firms not yet subject to the change (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

(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 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 observables 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 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). Due to the larger number of treated firms than control firms, we assign weights to the treatment sample rather than the control sample as recommended by McMullin and Schonberger (2020).

3.2 R&D Investment Responses

To quantify 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 R&D expenditures as reported in a firm's financial statements, scaled by beginning-of-year total assets.[6] While R&D expense reported in financial statements (under ASC 730) and R&D expenditures reported on the tax return (under IRC

[6]The delay between patent filing and patent grant date, which averages approximately three years (Glaeser and Lang 2024), leads to data truncation bias and precludes use of these measures as innovation-related outcomes within our period of analysis.

Section 174) are not identical, they are similar in many respects.[7] Accordingly, we follow a large body of literature that uses Compustat-based financial statement R&D expense to estimate R&D expenses for tax purposes (e.g., Armstrong et al. 2019; Berger 1993; Klassen et al. 2004; Ljungqvist et al. 2017; Williams and Williams 2021). We scale R&D by assets to account for differences in R&D spending related 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), these control variables include *Log(Assets)*, *Log(Age)*, *Leverage*, *ROA*, *Sales Growth*, *MTB*, *Cash*, *Capex*, *PPE*, *NOL Indicator*, an estimate of industry concentration (*Industry Concentration*), and institutional ownership (*Institutional Ownership*). The other variables are as defined previously, and we retain firm and event-year fixed effects. A negative and significant β_1 coefficient indicates that R&D investment declines for treated firms relative to control firms in response to the R&D tax change.

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

[7]For example, as noted by the IRS, "Underlying both ASC 730 and IRC 41 is the recognition that research requires obtaining new knowledge or technical information in the development of a separate and distinct product or process..." (Internal Revenue Service 2018) Furthermore, despite differences between ASC 730 and IRC 41, the IRS has acknowledged the practical alignment between these reporting regimes for purposes of tax enforcement (Internal Revenue Service 2024a).

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 between January and August because of our identification strategy, which controls for macro-economic conditions by comparing firms with closely aligned fiscal year ends. We require non-missing R&D expense to calculate the dependent variable in Eq. 2. We further require firms to report positive R&D in at least one pre-period year. Finally, we require that each firm have requisite data 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 U.S. R&D capitalization is effective for December year-end firms). This sample selection procedure results in 3,710 observations for 1,011 firms (918 treated firms and 93 control 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 excerpt relates to this tax law change.[8] Appendix F provides examples of these disclosures. We use these disclosures to construct a "restricted" sample of treated firms that only includes December fiscal-year-end companies for whom we identify a capitalized R&D disclosure. Thus, this restricted sample 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 for 663 firms (570 treatment and 93 control firms).

[8]The keywords include the following: 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 require the firm to report an *increase* in the deferred tax asset from 2021 to 2022 to estimate the impact of the change.

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 missing and zero values of R&D, whereas we require positive R&D in at least one pre-period year. For the 570 December year-end treated 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 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; Figure 2 provides the amounts by industry.

We 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 December year-end firms and non-December year-end firms differ along several observable dimensions based on Column (5). After entropy balancing, the differences across all control variables are not statistically different from zero as seen in Column (6). Panel B reports tests of differences in means for dependent variables and cross-sectional variables, measured over the sample pre-period. Although treated firms have higher levels of *R&D Investment* and *Capex Investment* than control firms, the two groups exhibit statistically similar *R&D Investment Growth* and *Capex Investment Growth* in the pre-period. Thus, while the level of investment differs, the preceding trends were similar; we explicitly test the pre-period trends in Section 4.2. In addi-

tion, both sets of firms have statistically similar cash and current effective tax rates. Finally, untabulated analysis confirms a similar distribution of firms across industries, with both groups reporting over 90% of observations concentrated in the Construction, Manufacturing, and Retail industries (SIC = 2, 3, or 7).

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 (B) reports results of the cash (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 treated firms with requisite 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 9.6 to 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 firms.[9] In Panel B, we observe similarly large increases in current effective tax rates of 8.4 to 10.4 percentage points.

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. Figure 3, Panels A and B present the event study plots for

[9]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.

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 before and after entropy balancing on observables. The figures also depict the statistically significant increase in ETRs for treated firms in 2022 (t=0).

Second, we prepare example ETR calculations based on the average firm in our sample. Appendix G shows that this change reduces the average firm's cash ETR by approximately 8.9 to 10.0 percentage points, which is in line with our estimates.

Third, we review firm disclosures to further place the magnitudes in context. Consistent with the documented effects, examples in Appendix F show large increases in deferred tax assets specifically related to this tax law change.[10] These examples validate our estimated effects and demonstrate the range of potential impact.

4.2 R&D Investment Responses

Table 5 reports the results of examining the R&D investment response of U.S. firms to R&D capitalization. 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 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, Panel 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. Review of untabulated R&D investment patterns plotted separately for treatment and control firms show that, while both groups appear to increase investment

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

in the pre-period, control firms' R&D investment increases more than treated firms in the post-period. This contributes to the observed negative coefficient, which we interpret as treated firms investing less in R&D than they otherwise would have in the absence of R&D capitalization.

In Column (4), the coefficient estimate (-0.006) indicates lower R&D investment by treated firms' of approximately 0.6% of assets, compared to control firms. This represents a reduction of 4.5% relative to the sample mean of *R&D Investment* (0.006/0.132). Based on treated 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 as compared to control firms. There are 918 December fiscal-year-end firms in our main sample, which translates to 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 *Dec FYE Firm* $\times$ *Post* (-0.006) is equivalent to that estimated using the full sample (Column 4), but is not statistically significant (two-tailed $p = 0.110$). While not significant, likely due to lower statistical power attributable to the smaller sample, the overall results across Table 5 point to reduced R&D investment in response to the capitalization requirement.

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. for which all R&D is subject to this rule, and financially constrained firms. Observing that the results vary predictably across these subsamples would further confirm that the effects are attributable to 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. The coefficient on *Dec FYE Firm* $\times$ *Post* represents the

difference-in-differences (DiD) estimate for the benchmark group (i.e., the change in R&D investment for multinational treated 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 (i.e., the change in R&D for domestic treated 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 R&D investment response 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. We construct this variable using *R&D Investment* in the year that precedes the treatment period (i.e., event time *t-1*), and we sort firms into terciles using all available firm-year observations in Compustat North America with requisite data. This measure allows us to proxy for a firm's underlying R&D intensity prior to the implementation of the R&D capitalization requirement. *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). Use of this measure abstracts away from the R&D activity of the individual firm and reflects the broader research intensity of the firm's industry.

Table 6, Panel A, Columns (1) and (2) report the results of the R&D intensity cross-sectional tests. In Column (1), we observe a negative and significant coefficient on the triple interaction term, indicating R&D capitalization resulted in a greater decrease in R&D

investment among treated high R&D-intensive firms, as compared to less R&D-intensive 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* as reported in the middle of the table translates to a decrease in R&D investment of 3.7% of assets for treated high research-intensive firms, relative to high research-intensive control firms. This represents an 11.6% decline relative to these firms' average *R&D Investment* of 0.318 (0.037/0.318). Based on 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 intensity firms in our sample, which translates to an estimated aggregate decline in R&D investment among the most research-intensive sample firms of $18.0 billion.

Figure 4, Panel B presents the event study plot, confirming both the absence of differential pre-period trends and the decline in R&D among the high research-intensity subsample. The results in Table 6, 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. Untabulated R&D investment patterns plotted separately for treatment and control firms confirm that the effects are attributable to reductions among treated firms (based on either measure of R&D intensity) rather than increases among control firms.

4.3.2 Domestic Firms

We next compare the effects for domestic-only firms, for whom all R&D spending is impacted by this change, to U.S. multinationals. Multinational companies may conduct R&D activities outside of the U.S., and the tax treatment of R&D in the host country where R&D takes place is unaffected by the U.S. tax law change.[11] To test variation based on a

[11] Although U.S. R&D capitalization 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 the impact can vary. See, for example, Rubin

firm's geographic presence, 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.

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 treated domestic-only 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, implying an aggregate decline of $2.6 billion among domestic-only firms. Figure 4, Panel C reports the event study plot for domestic-only firms; untabulated separate plots confirm the effects are attributable to reductions among treated firms.[12]

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 financially constrained firms. Brown et al. (2009) provide

(2023a) for an example of a favorable impact.

[12]While the results indicate that domestic-only firms reduced R&D spending, a natural question is whether multinational firms responded differently, possibly by shifting R&D overseas. The statistically insignificant coefficient on *Dec FYE Firm* × *Post* implies no on-average decline in R&D among multinational firms in the first year of the policy. An alternative explanation is that the null effect is due to a decline in domestic R&D activity offset by an increase in foreign R&D activity. However, we are cautious about attributing the null response to such shifting given (i) the short time frame we examine, (ii) the high adjustment costs of relocating R&D functions, (iii) firms' expectations of repeal. Moreover, we are unaware of publicly-available data sources that would permit an assessment of R&D location choices, precluding our ability to further assess this possible effect.

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. Thus, 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.

We re-estimate Eq. 2 after including a triple interaction with *High Constraints*, an indicator variable equal to one for financially 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.[13] 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, respectively, and zero otherwise. Negative operating cash flows is a relevant constraint measure in this setting due to the substantial cash flow impact of the R&D tax change. A negative coefficient on the triple interaction term implies a larger decrease in R&D investment for constrained treated firms than for unconstrained treated 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* $\times$ *Post* $\times$ *High Constraints*. This indicates that the R&D capitalization requirement has a stronger impact

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

on financially 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 across four constraint proxies. These coefficients suggest declines in R&D ranging from 2.8% to 6.5% of assets for financially constrained U.S. December year-end firms relative to their respective financially constrained control firms. This translates 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 (untabulated), these effects translate to per-firm R&D reductions ranging from $5 million among the *High HP Index* subsample to $21 million among the *Negative OCF* sample. Figure 4, Panel D reports the event study plot for the *High HP Index* constraint proxy, confirming parallel pre-trends and plotting the post-period decline in R&D; untabulated separate plots confirm the effects are attributable to reductions among treated firms. Collectively, the Table 6 evidence documents reduced R&D spending among research-intensive, domestic-only, and financially constrained firms.

4.4 R&D Employment Responses

Next, we examine the impact of R&D capitalization on R&D employment. Labor costs comprise the largest component of R&D spending (Glaeser et al. 2025), and any reductions in R&D employment in response to the R&D tax change may indicate a loss of valuable human capital with potential adverse consequences for firms' future innovation activity. For these analyses, we utilize employment data from the Revelio Workforce Dynamics dataset (Version 6, Release data 2025-04-10), which includes the number of employees, by employment category, for our sample period.

While our primary research design relies on variation in fiscal year ends for identification, the Revelio data allows us to compare *within-firm* domestic R&D employment to domestic

non-R&D employment. In addition to using the firm as its own control, this design enables us to both include additional firms with fiscal years ending from January through August and to extend the sample period through year *t+1* for the full sample (and through year *t+2* for December fiscal-year-end firms for which Revelio includes a full year of data). We estimate the following specification:

$$Log(1 + Employee\ Count_{cit}) = \beta_0 + \sum_{k=0}^{2} \beta_{1+k}(R\&D\ Employees_{cit} \times Year_{t=k}) + \beta_4\ R\&D\ Employees_{cit} + R\&D\ Controls_{it-1} + \alpha_i + y_t + \epsilon_{cit} \quad (3)$$

where c indexes the employment category, i indexes the firm, and t indexes the event year. The unit of observation for this analysis is firm-year-employment category, where we characterize the Revelio job categories "Scientists" and "Engineers" as R&D employees. Non-R&D employment categories include Admin, Operations, Finance, Marketing, and Sales. The dependent variable is *Log(1+Employee Count)*, the logarithmic transformation of employee count. *Employee Count* is the number of the firm's domestic employees in an employment category at the fiscal year end, scaled to adjust for Revelio's sampling weights.[14] *R&D Employees* is an indicator equal to one for observations in the R&D employment category. *Year* is a vector of indicator variables equal to one for each year in the post period. We include separate indicators for years *t*, *t+1*, and *t+2* interacted with *R&D Employees* to allow for differential effects across years. All other variables are as previously described.

Table 7 presents the results for the full sample (Columns 1 through 3) and for the subsample of December fiscal-year-end firms for which an additional year of data are available (Columns 4 through 6). We report three specifications: (1) without controls or fixed effects, (2) with controls, and (3) with both controls and fixed effects. We observe a statistically significant decline in R&D employment starting in year *t+2*. In the two preceding years, we

[14]Per discussions with the data vendor, Revelio adjusts for sampling weights to account for occupation and location-based biases in the likelihood of a job being included in the dataset.

observe negative coefficients that increase in size and significance across time, consistent with firms incurring adjustment costs. For example, while the estimated coefficients for year t are not statistically significant, the coefficients are significant using a one-tailed test starting in year *t+1* for both the full and December fiscal-year-end samples. The evidence means that it takes firms approximately two years to adjust their employment levels to the new policy.

The estimated effects correspond to a reduction in domestic R&D employment of approximately 1.4% (Column 3, two-tailed p=0.106) to 2.6% (Column 6, two-tailed $p < 0.10$) relative to non-R&D employment. Figure 5, Panels A and B support the presence of pre-treatment parallel trends and visually confirm a post-treatment decline in R&D employment. Additional tests also confirm that the effects are robust to using the inverse hyperbolic sine transformation of *Employee Count* as the dependent variable (untabulated). Overall, these findings show that R&D capitalization led to a decline in R&D employment. Our finding that R&D expenses decline immediately following the tax law change, while R&D employment declines occur with a delay, suggests that firms initially cut expenses (e.g., compensation, contract labor, supplies) before reducing headcount—a pattern consistent with prior evidence that firms seek to smooth R&D over time to avoid layoffs (e.g., Hall and Lerner 2010).

4.5 Effects on Shareholder Payout and Capital Investment

We next explore whether the increased tax burden from R&D capitalization had spillover effects on other firm decisions. While we observed a decline in R&D investment among financially constrained December year-end firms, low constraint firms appear to sustain their R&D investment based on the statistically insignificant coefficients on *Dec FYE Firm* × *Post* in Table 6, Panel B. In this section, we test whether low constraint firms instead adjust along other (non-R&D) margins in response to the increased U.S. tax liability.[15] Specifically, we

[15]Our focus is not on a differential response by low constraint and high constraint firms, but rather on the potential effects among low constraint firms that did not reduce R&D investment, on average.

estimate the following specification:

$$Outcome_{it} = \beta_0 + \beta_1 \, Dec\ FYE\ Firm_i \times Post_t + Outcome\ Controls_{it-1} + \alpha_i + y_t + \epsilon_{it} \quad (4)$$

where *Outcome* is *Repurchases* or *Capital Investment*, and *Outcome Controls* is a vector of control variables (*Payout Controls* or *Capex Controls*), described below and in Appendix D. We include firm and event-year fixed effects and cluster standard errors by firm.

We first 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. *Payout Controls* 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 8, Panel A reports the results, with effects for the full sample with requisite data in Column (1). Event study plots in Figure 6, Panel A confirm parallel trends in this sample. Columns (2) through (6) present results for subsamples of *unconstrained* firms for which we did not observe an on-average R&D decline in Table 6, Panel B (i.e., financially unconstrained firms, larger firms, older firms, and firms with positive prior year operating cash flows).[16]

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 based on average *Repurchases* for December fiscal-year-end firms (0.032). In Columns (2) through (7), we further observe this decrease among the low constraint subsamples, with effect sizes ranging from -1.0 to -1.2% of assets.[17] In

[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]One concern is that the observed declines in repurchases is attributable to the 1% excise tax on repur-

contrast, untabulated analyses show no statistically significant effect for the likelihood a firm repurchases shares. Together, these analyses mean that firms adjusted repurchases on the intensive rather than extensive margin.

Panel B reports the results for *Capital Investment*, which is equal to capital expenditures divided by beginning of year property, plant, and equipment. Control variables (*Capex Controls*) follow those in prior work (e.g., Lester 2019) and include *Log(Assets), ROA, MTB, Leverage,* and *Cash Flow*. In Column (1), the statistically significant DiD coefficient of -0.052 indicates a decrease in capital expenditures of 5.2% of tangible assets, relative to control firms; Figure 6, Panel B is the corresponding event study plot. The 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) and (3), with slightly weaker results among larger, older, and positive cash flow firms in the remaining columns ($p = 0.126$ and $p = 0.104$ in Columns 4 and 5, respectively). Overall, the evidence in Table 8 points to low-constrained firms sustaining R&D spending and instead cutting repurchases and capex.

5 Additional Analyses

5.1 Innovation Quality

An important remaining question is whether the observed decline in R&D reflects a positive or negative economic outcome—for example, a reduction in marginal projects with limited value, or in projects that could have generated substantial benefits for the firm or society. Publicly available data do not permit us to observe the quality of R&D inputs at the project level. Given this data limitation, we instead use several publicly available firm-level measures of innovation quality to assess the extent to which the decline in R&D spending varies by whether a firm produces higher-quality innovation (as measured prior to the tax change). For

chases passed in the Inflation Reduction Act of 2022. However, this tax applies to repurchases made after December 31, 2022, which is after our sample period ends, and thus cannot explain these documented effects.

each cross-sectional test, we re-estimate Eq. 2 after including a triple interaction with one of five firm-level proxies for innovation quality (*Quality*), described below. We identify firms with high pre-period innovation quality using indicator variables representing the top tercile of innovation quality, computed across all Compustat North America firms with available data. A negative (positive) coefficient on the three-way interaction term (*Dec FYE Firm* $\times$ *Post* $\times$ *Quality*) indicates treated firms with higher innovation quality decrease R&D more (less) than treated firms with lower innovation quality, relative to their control groups.

Our innovation quality proxies 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), where R&D capital is the five-year cumulative R&D spend (measured two years before the patent grants), assuming a 20% annual depreciation rate.

Table 9 presents the results. Across all columns, the coefficient on the triple interaction term (*Dec FYE Firm* $\times$ *Post* $\times$ *Quality*) is statistically insignificant. Thus, we fail to observe evidence that the R&D tax change differentially affected firms conducting higher-quality innovation relative to other firms. This suggests that other factors, such as financial constraints and a firm's ability to meet the immediate increased cash tax liability, are more dominant considerations in the first year of the law. However, while we use firm-level innovation quality proxies following prior work, these proxies do not capture possible adjustments firms make *within* their R&D project portfolios, for example by continuing radical innovations and cutting incremental projects. Thus, future work using more detailed data on firm-specific projects, if or when available, is necessary to shed additional light on this question.

5.2 Anticipatory Effects

The delay between R&D capitalization enactment and implementation creates the potential for anticipatory effects. Specifically, firms have an incentive to shift R&D expenditures into the fiscal year prior to the effective date to maximize the present value of R&D tax benefits. Such anticipatory effects should be limited among our December fiscal-year-end treated firms because, as previously discussed, many expected the law to be repealed. However, control firms with fiscal years ending in 2022 may have accelerated R&D expenditures into their 2022 fiscal year to ensure full deductibility. If so, then the documented difference-in-differences effect of reduced R&D among treated firms may instead reflect *increased* R&D by control firms. While anticipatory behavior by control firms would be an interesting response to the policy, it would alter our inferences.

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 to better identify the timing of firms' adjustments. Specifically, we re-estimate Eq. 2 using quarterly data and replace the *Post* indicator with indicators for each quarter of the sample period.[18] The fourth quarter of 2021 serves as the base period. If control firms accelerated R&D expenditures before they became subject to R&D capitalization, we would observe positive and significant coefficients on the *2022 Q1, 2022 Q2, 2022 Q3,* and *2022 Q4* indicators.

Table 10 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 results

[18]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 that use annual data because many firms do not report quarterly R&D expense, which is necessary for measuring the outcome variable.

documenting a decline in R&D among treated firms. Most importantly, the coefficients at the bottom of the table on the standalone year-quarter indicators *2022 Q1, 2022 Q2, 2022 Q3,* and *2022 Q4* are insignificant, meaning that control firms did not increase R&D expenditures in 2022 in anticipation of becoming subject to R&D capitalization. The evidence does not support anticipatory behavior by control firms.

Figure 7 plots the coefficient point estimates from these regressions before and after 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). Consistent with our main tests, we observe a decline in R&D spending by December fiscal-year-end firms starting in Q1 2022 (orange line). Furthermore, if control firms engaged in anticipatory behavior, we expect to observe increases in R&D investment in 2022. In contrast, we observe that September, October, and November year-end firms' R&D spending is at or below the predicted level (green line).

The second analysis of anticipatory effects compares the control firms with June, July, and August fiscal-year-end firms. Like our September, October, and November fiscal-year-end control firms, firms with fiscal year-ends in June, July, and August will be impacted by the change in their 2023 (not 2022) fiscal years. Thus, both groups potentially have incentives 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 by the end of calendar year 2022. Thus, comparing these two groups helps to further assess any anticipatory effect among our control firms. In regression and event-study analyses (untabulated), we observe similar trends in R&D investment among these two groups, inconsistent with anticipatory behavior among our control sample. Overall, across both tests, we do not find evidence supporting an acceleration of deductions by control firms.

5.3 Robustness Analyses

5.3.1 Other Tax Policy Changes

One potential concern is that the documented effects are driven by events other than the R&D tax change. However, for another event to cause these effects, it would need to be effective at the same time as the R&D capitalization requirement, differentially affect December fiscal-year-end firms as compared to the control firms, and explain the observed heterogeneity in firms' responses based on research intensity and financial constraints. The only event we are aware of that could plausibly affect our sample is the 2022 change in the tax deductibility of interest expense under I.R.C Sec 163(j), which tightened the interest deductibility limitation for affected firms. While it is unlikely this provision drives our results, we re-estimate Eq. 2 excluding (1) Dec FYE 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) all Dec FYE firms affected by I.R.C Sec 163(j) in 2022. After dropping these firms, we continue to find statistically significant results; the coefficients on *Dec FYE* $\times$ *Post* across the two samples are -0.006 and -0.007, respectively ($p < 0.10$) (untabulated). Thus, our results are not explained by the change in interest limitation rules.

5.3.2 Selective Disclosure of R&D Expense

In our sample construction, we drop observations with missing R&D expense because this variable is necessary to calculate the dependent variable. However, prior work documents selective financial statement disclosure of R&D (i.e., Koh and Reeb 2015), which could impact the firms in our sample. We perform two additional tests to assess this potential issue. First, in additional analyses, we retain these observations by setting missing R&D values to zero. We then re-estimate the model including these observations, as well as an indicator for missing R&D in the model (e.g., Williams and Williams 2021), both requiring at least one pre-period year of positive R&D (as we require in our sample selection for the main

sample) and after relaxing the positive pre-period R&D requirement. We find statistically significant coefficients on *Dec FYE* × *Post* of -0.008 and -0.005, respectively ($p < 0.05$). Thus, all inferences are unchanged.

Second, we estimate a two-stage Heckman model. In the first stage, we model the likelihood of R&D disclosure using all Compustat firms. The specification includes the control variables from our main regressions and the proportion of firms within each industry reporting R&D to satisfy the exclusion restriction. The model has strong predictive power, with an ROC area of 0.9488, indicating excellent fit. In the second stage, we compute the inverse Mills ratio and include it as a control in our main specification. We again find a statistically significant coefficient on *Dec FYE* × *Post* of -0.006 ($p < 0.10$), confirming that results are robust to addressing this selective disclosure decision.

5.3.3 Falsification Test: GAAP ETR

The R&D tax change affects the *timing* of R&D deductions, but not the overall deductibility of the expense. Thus, we should expect to find little impact on the GAAP ETR due to direct effects of this change (see Appendix G). That said, the R&D tax change potentially has indirect effects on the GAAP ETR through its interaction with other tax and financial accounting issues, such as the valuation allowance and GILTI and FDII calculations. In additional tests, we calculate the effect of the change on the GAAP ETR, and as expected, the estimated treatment effect is significantly smaller for the GAAP ETR than for the cash or current ETR. For example, among firms with data to construct both the cash and GAAP ETRs, we find an insignificant effect of the R&D change on GAAP ETRs (coefficient = 0.007, $p > 0.10$). Among firms with data to construct both the current and GAAP ETRs, we observe a modest increase in GAAP ETRs (coefficient = 0.017, $p < 0.10$). Observing little to no change in the GAAP ETR provides additional confidence that the estimated effects are attributable to the R&D tax change rather than other possible events.

6 Conclusion

We study the consequences of limiting the R&D tax deduction on U.S. public firms. 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. In aggregate, we estimate a decrease in R&D investment of $42 billion. The effects on R&D investment are strongest among the most research-intensive firms, domestic-only firms, and financially constrained firms. We also find evidence of decreases in domestic R&D employment of approximately 2%, relative to domestic non-R&D employment, suggesting firms' decreases in R&D expenditures include reducing R&D-related human capital. 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 the 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, its differential effects across firms, and spillover effects on firms' other investing and payout decisions. The results also offer timely, policy-relevant insights into the real economic consequences of R&D capitalization. Policymakers, U.S. firms, and the media voiced concerns that the capitalization requirement would harm innovation, particularly given other incentives abroad (EY 2023). We show that this provision, included in the TCJA to reduce the estimated cost of the legislation, imposed real costs on U.S. firms. Although the OBBB Act subsequently reinstated immediate expensing, our evidence indicates that the capitalization requirement produced near-term reductions in R&D investment and losses of skilled human capital that are unlikely to be quickly restored. Our paper also informs the broader discussions about the effects of U.S. innovation tax policies and the role of these policies in stimulating innovation.

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A Tax Technical Details

A.1 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. Subsequent work (e.g., Hall 1993; Bloom et al. 2002; Wilson 2009; 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 problem arises because the returns to R&D extend beyond the investing firm, generating information spillovers and positive externalities that benefit the broader economy (e.g., Lucking et al. 2019; Stantcheva 2021; Glaeser and Lang 2024). Additionally, R&D projects are high-risk, making them difficult and costly to finance (Hall and Lerner 2010).

Innovation tax incentives intended to address the underinvestment problem 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). Historically, the U.S. has offered two key input-based innovation tax incentives: the R&D tax credit (I.R.C. Sec. 41) and the R&D tax deduction (I.R.C. Sec. 174). Below, we describe the details of these tax incentives.

A.2 U.S. R&D Tax Credit

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 G). 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% × (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.

R&D tax credits have been extensively examined in prior research, and work in this area 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). 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 reduce the effectiveness of the credit in stimulating additional R&D investment (Cowx 2025).

A.3 U.S. R&D Tax Deduction

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) (I.R.C. 174; Deloitte 2023). 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 provides a tax benefit equal to the amount of the expenditure multiplied by the federal corporate statutory tax

rate.

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. While research on the R&D deduction is scant, the tax benefit provided by the deduction is analogous to that of 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 (e.g., Zwick and Mahon 2017). The lack of research on the R&D deduction is notable given that the deduction provides more than *twice* the tax benefits of the U.S. R&D tax credit.

A.4 Recent Changes to the U.S. R&D Tax Deduction

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., Williams 2024; Bloomberg 2023). This legislation required that R&D be capitalized and amortized rather than immediately deducted. Specifically, from 2022 to 2024, U.S. companies were 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 were to be deducted in each of years two through five, and the remaining 10% deducted in year six.[19]

The law also required 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 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 was eventually able to deduct 100% of all R&D costs, this tax law change substantially reduced the present value of the tax benefit and had important cash flow consequences. Figure 1 and Appendix C illustrate the decrease in the present value of tax benefits under R&D capitalization relative to the previous immediate expensing regime. For

[19]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).

the average firm in our sample investing $304 million in R&D per year, this change 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%). This change in the tax deductibility of R&D in the U.S. is particularly noteworthy, as most countries allow for immediate R&D expensing. Furthermore, some jurisdictions such as Brazil and China offer "super-deductions" that exceed 100% of incurred R&D expenditures (EY 2023).[20]

In July 2025, the One Big Beautiful Bill Act restored immediate R&D expensing of domestic R&D expenditures for tax years beginning after December 31, 2024. However, foreign R&D will continue to be capitalized and amortized over 15 years. To address the existing amount of capitalized R&D, firms may elect to accelerate the deduction of the capitalized R&D under the following two options: (1) deduct all capitalized domestic R&D in the first tax year beginning after December 31, 2024 or (2) deduct the capitalized domestic R&D ratably over 2 years. Finally, smaller firms (defined as firms with average gross receipts during the previous three years of $25 million or less) have a third option available to file amended returns for 2022-2024 to claim refunds of taxes paid related to the capitalization requirement. This last option will be particularly beneficial for start-up firms that are not yet profitable, as it should generate a large cash inflow for those firms.

[20]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 U.S. R&D capitalization rules in place from 2022 through 2024, $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.

B 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.

C Present value (PV) calculation

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).

D Variable Descriptions

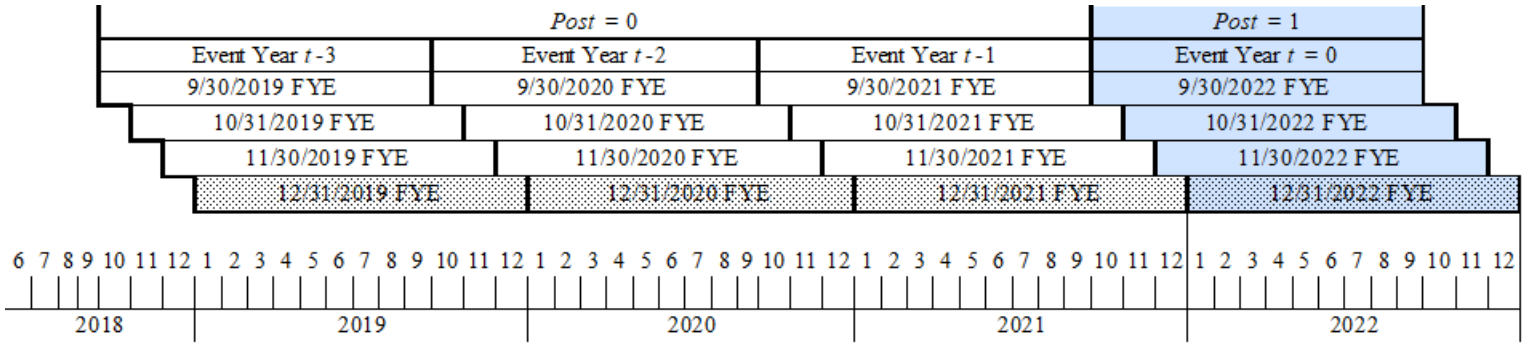
Variable	Description
Treatment & Post Variables	
Dec FYE Firm	An indicator variable set equal to one if the fiscal year end is December, and zero otherwise.
Post	An indicator variable set equal to one for fiscal years beginning on or after October 1, 2021, and zero otherwise.
R&D Employees	An indicator variable set equal to one for observations that relate to R&D employees, and zero otherwise. The Revelio Workforce Dynamics database categorizes jobs into seven categories: administrative, engineering, finance, marketing, operations, sales, scientist. We treat the scientist and engineering categories as R&D.
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.
Employee Count	The total number of domestic employees in a particular job category, scaled to adjust for sampling weights, obtained from the Revelio Workforce Dynamics database. We define job categories as R&D and non-R&D. For example, we characterize the Revelio job categories "Scientists" and "Engineers" as R&D employees.
ETR	Effective tax rate measures, including *Current ETR* and *Cash ETR*.
Log(1+Employee Count)	The logarithmic transformation of 1 plus the number of employees in a particular job category (*Employee Count*).
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).

Variable	Description
Cross-Sectional Variables	
Domestic	An indicator variable set equal to one for domestic-only corporations, and zero otherwise. Multinational status is defined 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. Size-age index is computed as (-0.737)×Log(Assets) + (0.043×Log(Assets)^2) - (0.040×Age), capped at $4.5 billion in assets and 37 years in age.
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. IE is computed as patent grants divided by a weighted sum of past R&D: (*XRDt-2 + 0.8×XRDt-3 + 0.6×XRDt-4 + 0.4×XRDt-5 + 0.2×XRDt-6*), with missing XRD set to zero.
High KZ Index	An indicator variable set equal to one for firms in the top tercile of the Kaplan and Zingales (1997) KZ Index in event-year t-1. The KZ Index is a weighted function of various financial ratios including leverage, cash holdings, dividends, and market value of equity.
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 data is from Kogan et al. (2017).
High Patent Value	An indicator variable set equal to one for firms with high patent values in the pre-period, defined as those in the top tercile. Data 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 firms in high R&D industries, defined as those in two-digit SIC codes 28, 36, 41, 59, and 73.
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 obtained from WRDS.
Negative OCF	An indicator variable set equal to one for observations with negative operating cash flows (OANCF) in event year t-1.
Quality	A composite innovation quality measure based on *High Patent Grants*, *High Forward Citations*, *High Patent Value*, *High Innovative Efficiency*, and *High Research Quotient*.
Sept/Oct/Nov FYE	An indicator variable set equal to one if the fiscal year end is in September, October, or November, and zero otherwise.
Small	An indicator variable set equal to one for observations in the lowest tercile of *Age* in event year t-1.
Young	An indicator variable set equal to one for observations in the lowest tercile of *Assets* in event year t-1.

Variable	Description
Control Variable Vectors:	
Capex Controls	A vector of control variables including *Log(Assets)*, *ROA*, *MTB*, *Leverage*, and *Cash Flow*.
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 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*.
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*.
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 *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.

Variable	Description
Other Variable (cont.):	
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$_{t-1}$.

E 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.

F 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

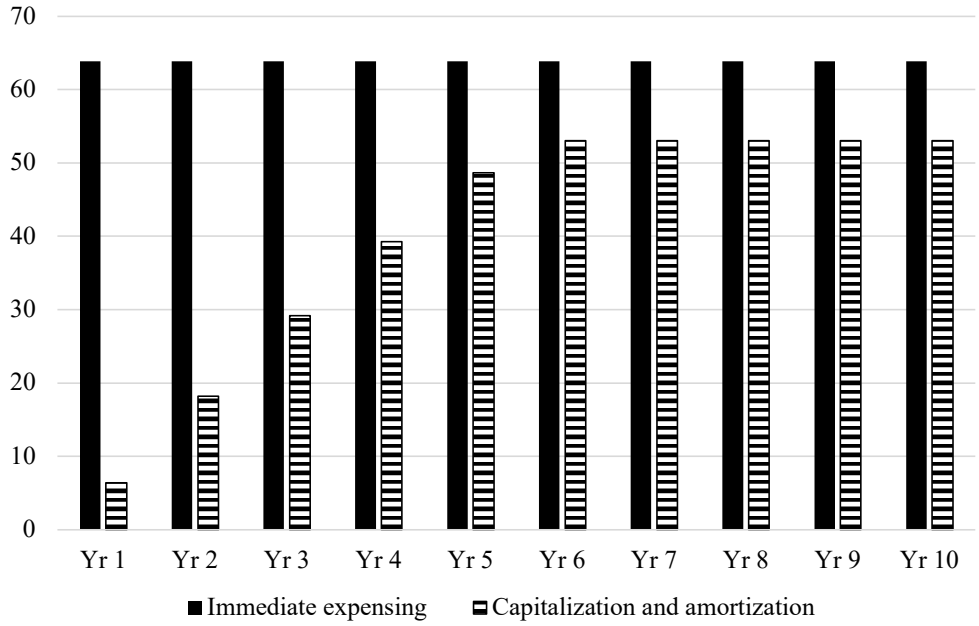
G Example Effective Tax Rate Calculations

(all amounts in millions)	(1) Pre period: R&D immediate expensing	(2) Post period: R&D capitalization and amortization Stable R&D	(3) 5% R&D Growth	(4) 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%	

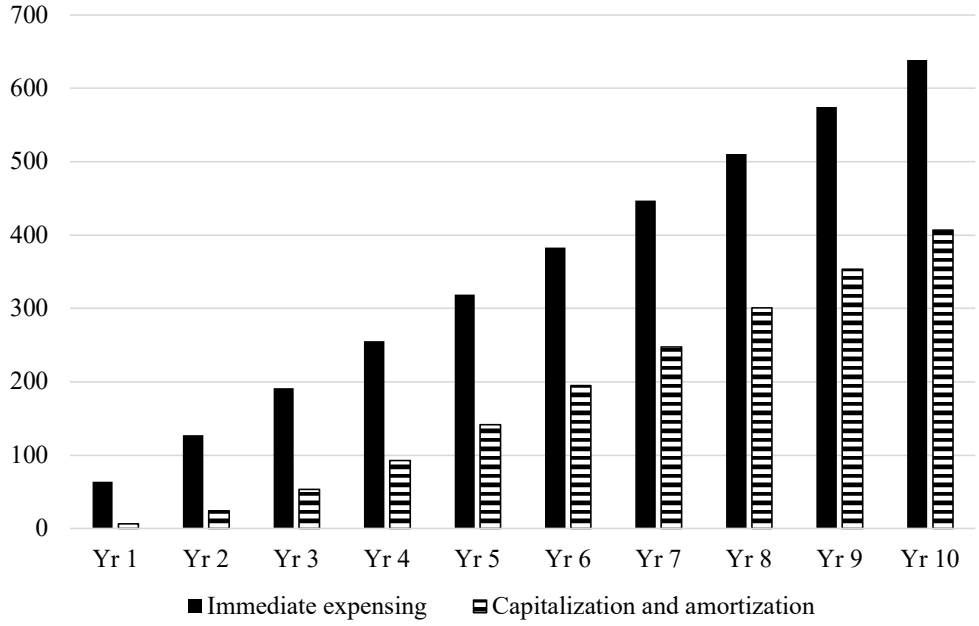
This appendix depicts how the R&D capitalization change affects effective tax rates. For simplicity, the calculations use the Alternative Simplified Credit method of computing the R&D tax credit. The calculation uses the average pre-tax book income and average R&D expenditures for the firms in our main 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).

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

A: Present value of current period R&D tax benefits

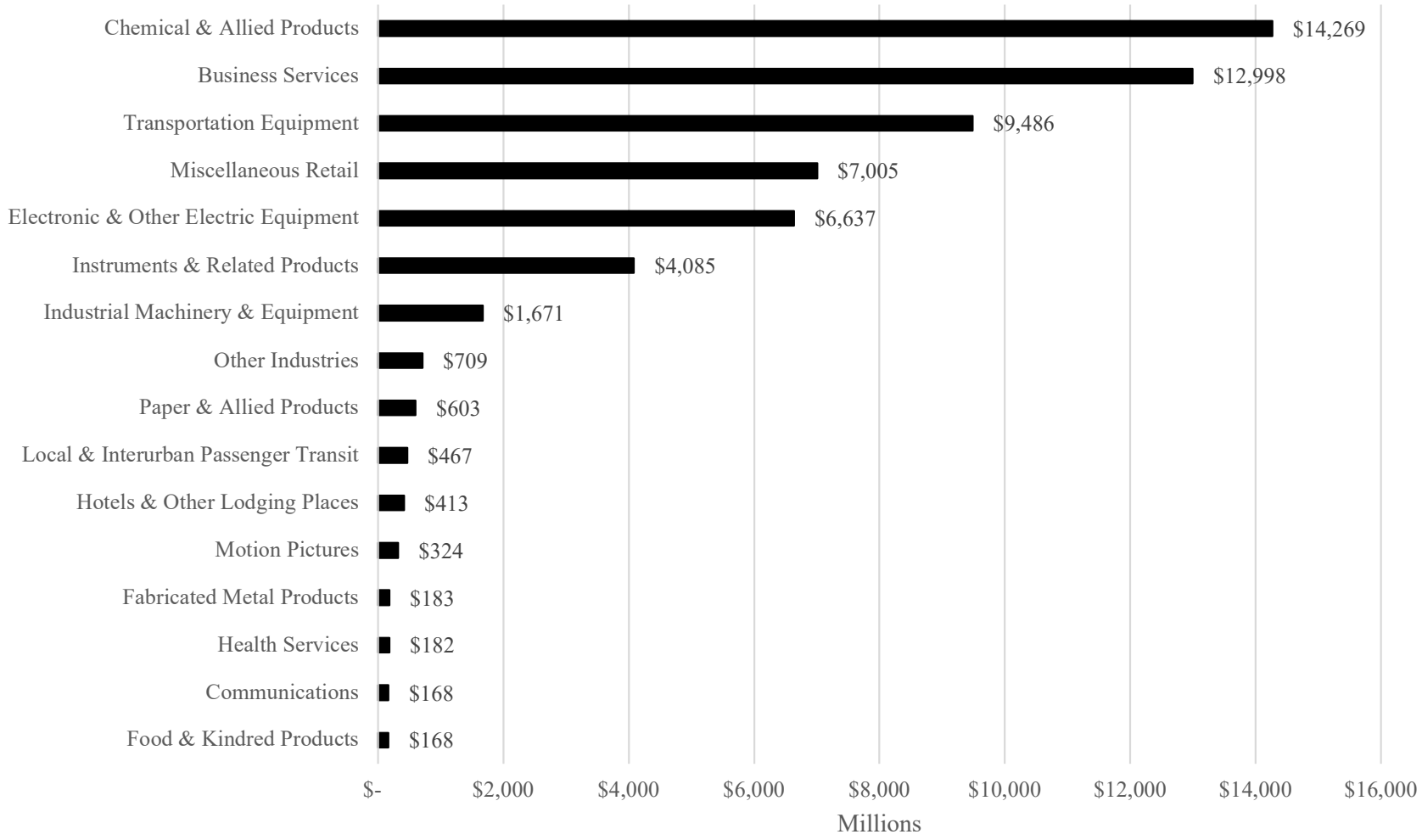


B: Cumulative present value of R&D tax benefits



These figures depict 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 C for additional details of the calculations.

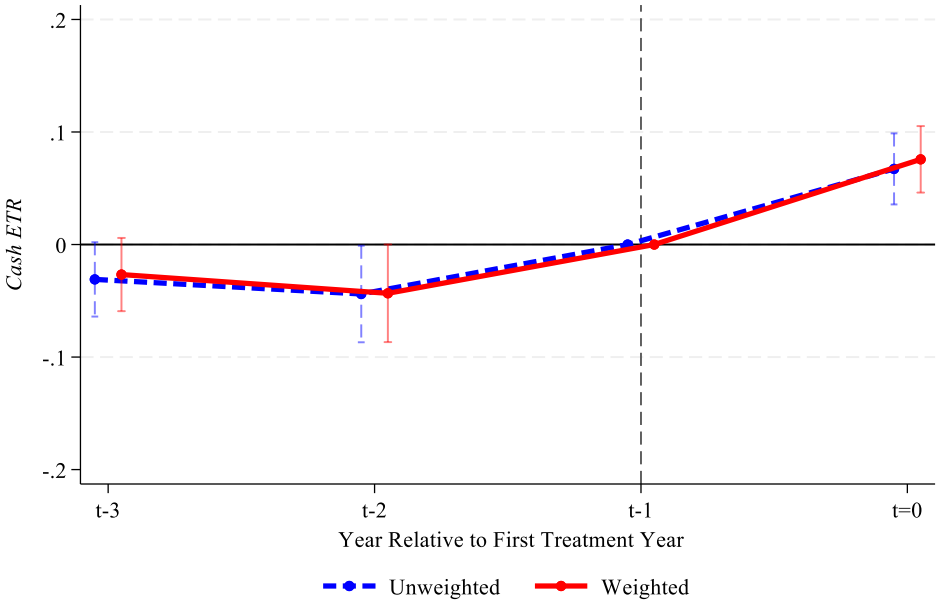
Figure 2: Aggregate Capitalized R&D Deferred Tax Assets by Industry



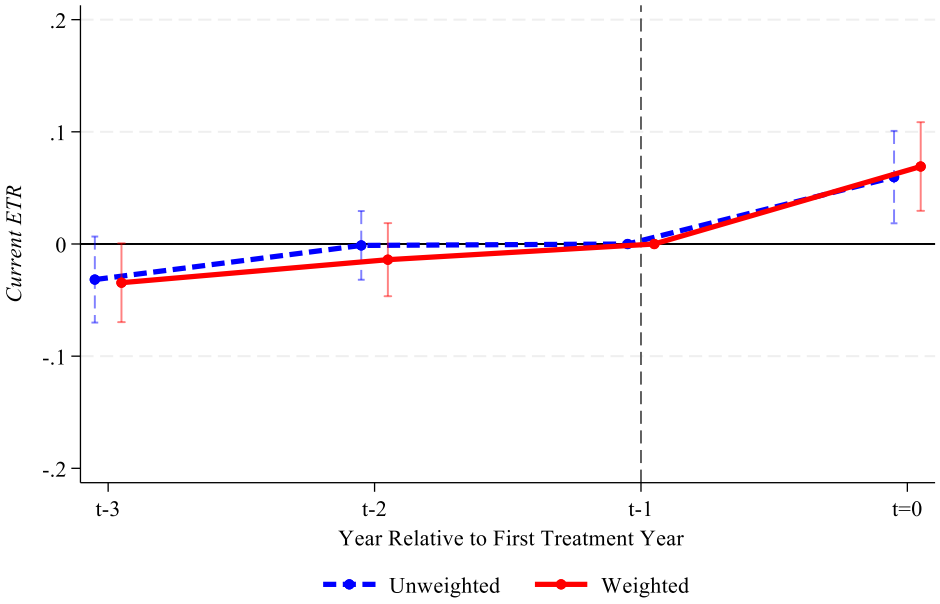
This figure depicts the aggregate capitalized R&D deferred tax assets by industry (2-digit SIC) in millions, as calculated using hand-collected data from financial statement deferred tax asset disclosures specifically related to the R&D capitalization requirement. We tabulate amounts for the fifteen 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

A: Cash ETR



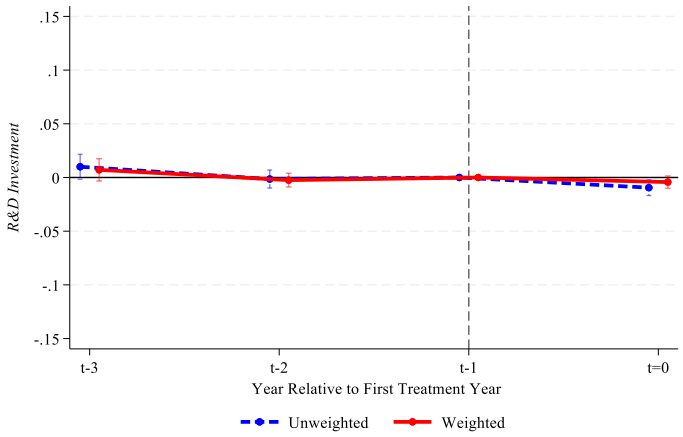
B: Current ETR



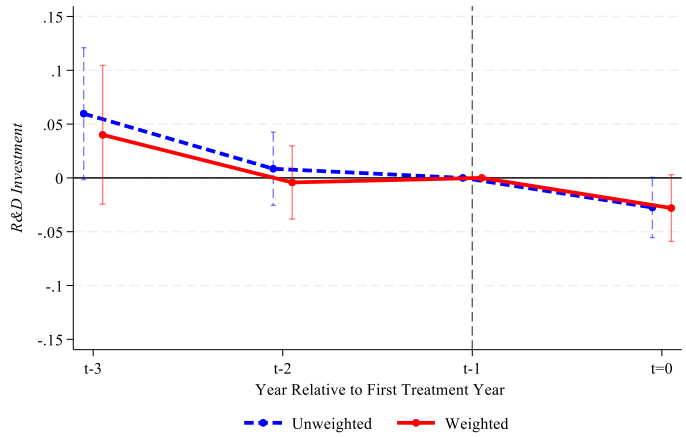
These figures depict coefficient estimates and 90% confidence intervals for our effective tax rate OLS regressions in event time (see Appendix E). The dependent variables are *Cash ETR* (Panel A) and *Current ETR* (Panel B). The regression models include all controls and firm fixed effects. The Y-axis 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

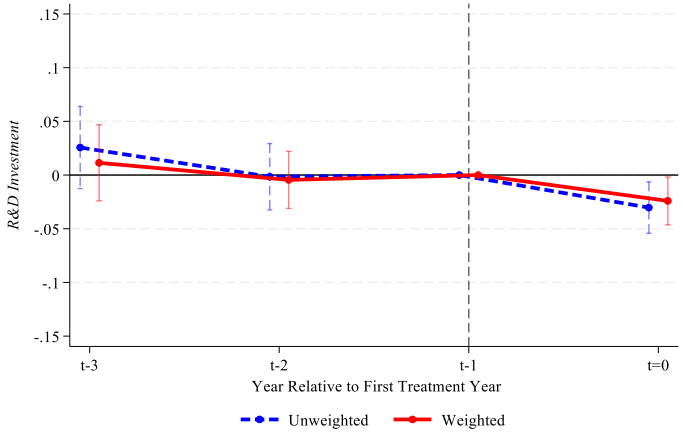
A: Main analysis



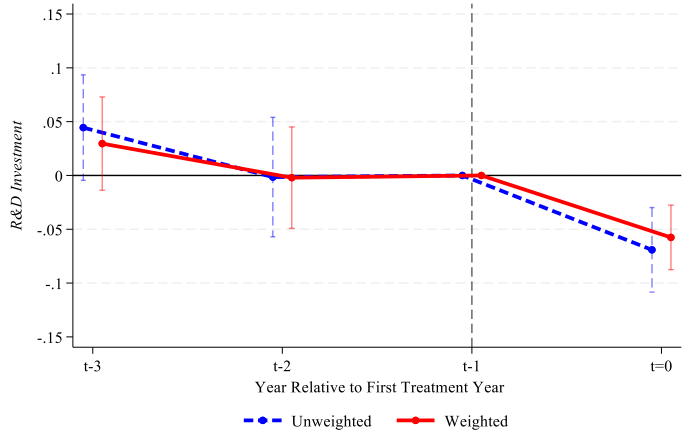
B: High R&D firm analysis



C: Domestic firm analysis



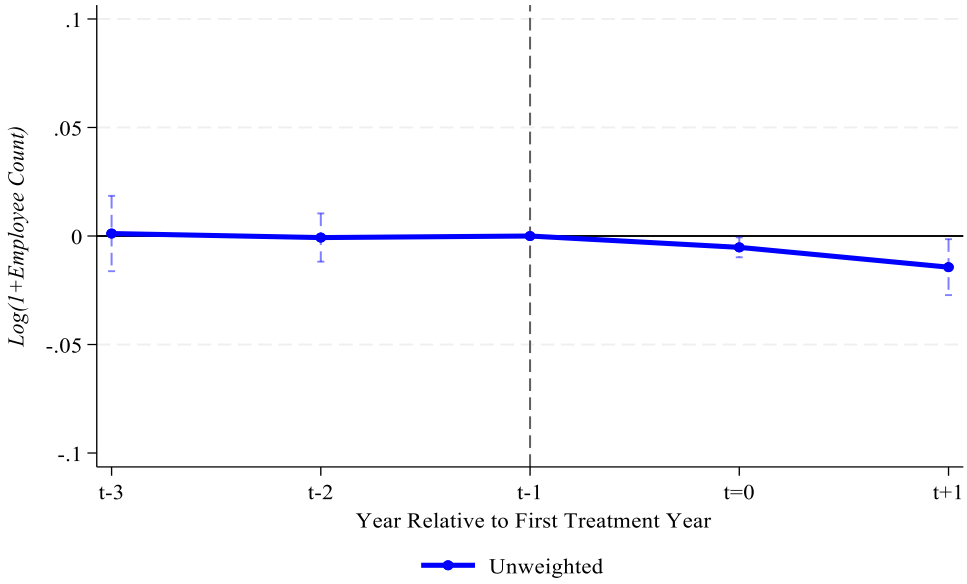
D: High HP Index analysis



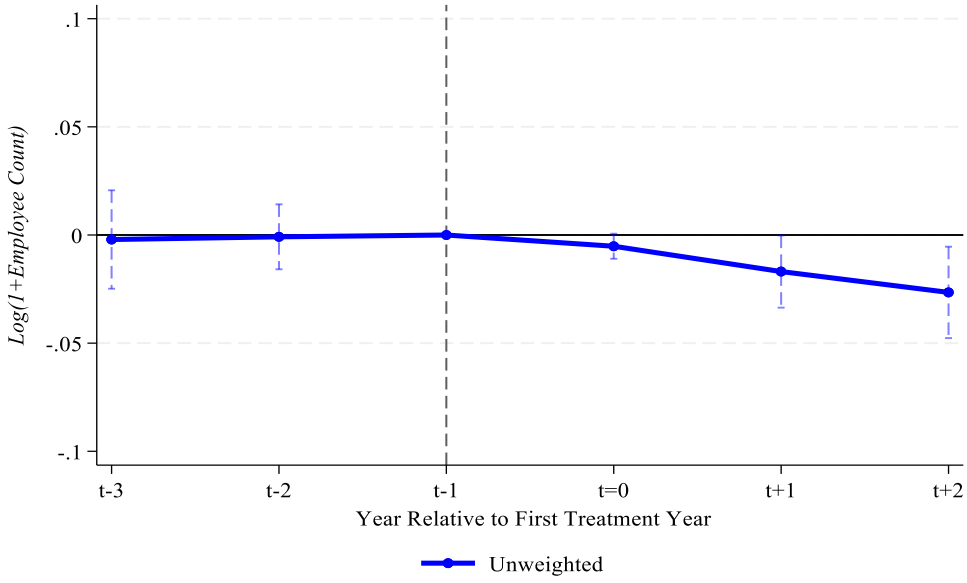
These figures depict coefficient estimates and 90% confidence intervals for our R&D investment analyses in event time (see Appendix E). In all panels, the dependent variable is *R&D Investment*. The regression models include all controls and firm and event-time fixed effects. In Panel A, the Y-axis represents 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: R&D Employment Parallel Trends

A: Within-firm comparison of R&D to non-R&D employment - all FYE firms



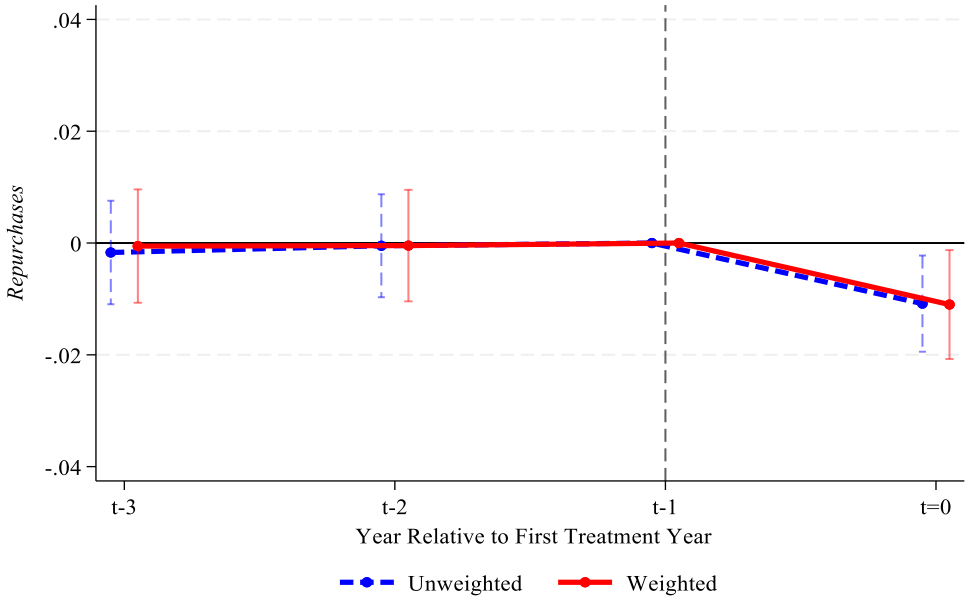
B: Within-firm comparison of R&D to non-R&D employment - Dec FYE Firms



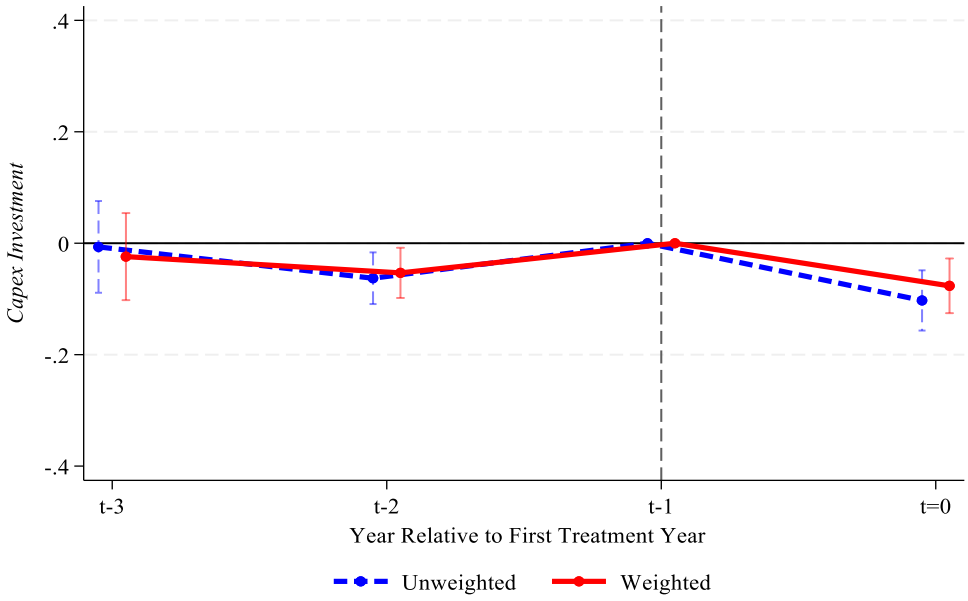
These figures depict coefficient estimates and 90% confidence intervals for our R&D employment analyses in event time (see Appendix E). Panel A reports results for event years $t-3$ to $t+1$ for firms with all fiscal year ends. Panel B reports results for event years $t-3$ to $t+2$ for December fiscal year end firms. In both panels, the dependent variable is *Log(1+Employee Count)*. 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 dots represent the coefficient point estimates. Standard errors are clustered at the firm level.

Figure 6: Other Outcomes

A: Repurchases



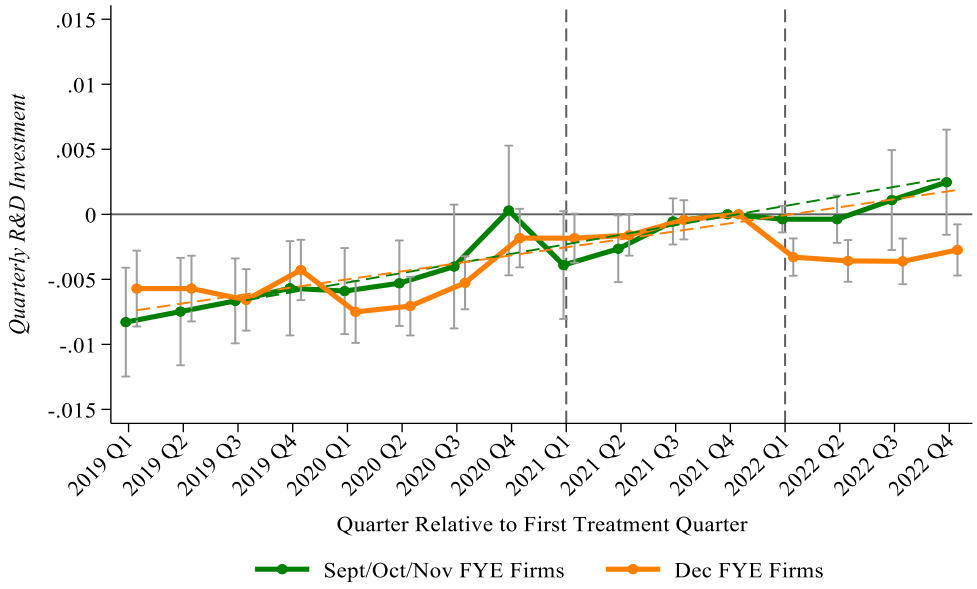
B: Capital Expenditures



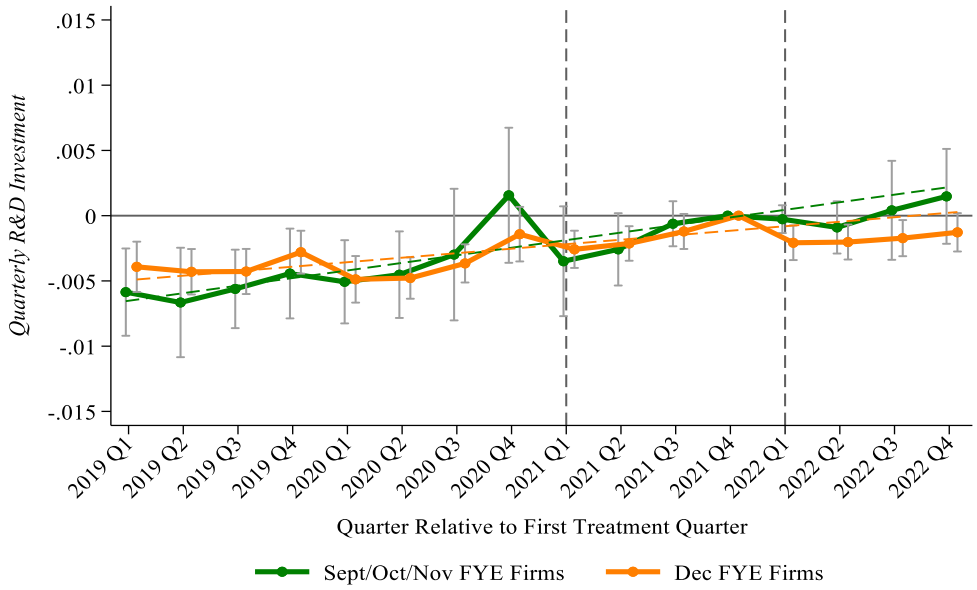
These figures depict coefficient estimates and 90% confidence intervals for our other outcomes analyses in event time (see Appendix E). The dependent variables are *Repurchases* (Panel A) and *Capex Investment* (Panel B). The regression models include all controls and firm and event-time fixed effects. 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 7: 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 dependent 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.

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 do report positive R&D expense in at least one pre-period year	-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	547	4	14	38
R&D DTA / Assets	570	0.030	0.031	0.007	0.019	0.043
Capitalized R&D	570	496	2,602	18	66	181
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	8,166	27,122	132	771	3,543
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
Employee Count	9,208	3,049	7,406	166	689	2,260
Log(1+Employee Count)	9,208	6.471	1.821	5.118	6.537	7.724
R&D Employees	9,208	0.500	0.500	0.000	0.500	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 unweighted descriptive statistics for variables used in the main analyses. Appendix D provides variable definitions.

Table 3: Comparison of Treatment and Control Firms

Panel A: Control variables measured across the full sample period

	(1)	(2)	(3)	(4)	(5)	(6)
	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

	(1)	(2)	(3)	(4)	(5)
	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

These tables report 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 D. 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	Rest. Sample
Method	OLS	OLS	OLS	EB	EB
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

	(1)	(2)	(3)	(4)	(5)
Variables			*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	0.011			
	[0.258]	[0.798]			
Post	0.004	0.005			
	[0.167]	[0.210]			
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	Rest. Sample
Method	OLS	OLS	OLS	EB	EB
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	0.193
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

These tables present 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 D. Columns (1) through (4) report results as estimated using the full sample; Column (5) reports results as estimated using a restricted sample that limits the treatment sample to firms that make R&D capitalization disclosures. While Columns (1) through (3) rely on OLS, Columns (4) and (5) in both Panel A and B use entropy balancing on the first and second moments as the estimation method. 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

Variables	(1)	(2)	(3)	(4)	(5)
	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]	[-6.885]	[-6.879]
$Log(Age)_{t-1}$		-0.013***	-0.040*	-0.032*	-0.036*
		[-2.721]	[-1.749]	[-1.655]	[-1.719]
$Leverage_{t-1}$		-0.105***	-0.003	0.015	0.019
		[-7.692]	[-0.268]	[1.304]	[1.414]
ROA_{t-1}		-0.107***	-0.034***	-0.018*	-0.009
		[-7.558]	[-3.456]	[-1.777]	[-1.194]
$Sales\ Growth_{t-1}$		0.002	-0.003***	-0.005***	-0.006***
		[1.330]	[-2.582]	[-3.200]	[-4.125]
MTB_{t-1}		0.002***	0.001***	0.001	0.001*
		[5.195]	[3.320]	[1.577]	[1.724]
$Cash_{t-1}$		0.001	-0.026***	-0.020***	-0.023***
		[0.099]	[-6.316]	[-5.917]	[-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]	[-0.136]	[0.227]
$NOL\ Indicator_{t-1}$		0.033***	0.015**	0.006	0.005
		[5.275]	[2.001]	[1.499]	[1.162]
$Industry\ Concentration_{t-1}$		-0.113***	-0.021	-0.028	-0.036
		[-8.906]	[-0.857]	[-0.791]	[-1.080]
$Institutional\ Ownership_{t-1}$		0.026**	0.041	0.025*	0.021
		[2.008]	[1.562]	[1.716]	[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	Rest. Sample
Method	OLS	OLS	OLS	EB	EB
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). Columns (1) through (4) report results as estimated using the full sample; Column (5) reports results as estimated using a restricted sample that limits the treatment sample to firms that make R&D capitalization disclosures. While Columns (1) through (3) rely on OLS, Columns (4) and (5) use entropy balancing on the first and second moments as the estimation method. All variables are defined in Appendix D. 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: Heterogeneity Analyses

Panel A: Variation Based on R&D Intensity and Domestic Status

Variables	(1)	(2) *R&D Investment*	(3)
Dec FYE Firm × Post	**-0.001**	**-0.001**	**-0.002**
	[-0.531]	**[-0.390]**	**[-0.656]**
Dec FYE Firms × Post× High R&D Firm	**-0.036****		
	[-2.223]		
High R&D Firm × Post	-0.008		
	[-0.545]		
Dec FYE Firm × Post × High R&D Industry		**-0.012***	
		[-1.836]	
High R&D Industry × Post		-0.002	
		[-0.343]	
Dec FYE Firm × Post × Domestic			**-0.023***
			[-1.701]
Domestic × Post			0.003
			[0.229]
Observations	3,710	3,710	3,710
R^2	0.929	0.928	0.928
Sample	Full Sample	Full Sample	Full Sample
Method	EB	EB	EB
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 High R&D Firms, Event Year t-1	0.318		
Dec FYE High R&D Industries, Event Year t-1		0.185	
Dec FYE Domestic Firms, Event Year t-1			0.220
Observations by group:			
Dec FYE firms:			
High R&D (Domestic)	977	1,871	913
Low R&D (MNC)	2,371	1,477	2,435
	3,348	3,348	3,348
Sept/Oct/Nov FYE firms:			
High R&D (Domestic)	56	168	71
Low R&D (MNC)	306	194	291
	362	362	362
Total observations	3,710	3,710	3,710

Panel B: Variation 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]	**[-1.336]**	**[0.306]**	**[-1.190]**	**[0.177]**
Dec FYE Firm × Post × High Constraints	**-0.065*** **	**-0.010**	**-0.034** **	**-0.024**	**-0.031** **
	[-3.120]	**[-0.486]**	**[-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	EB	EB	EB	EB
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	765	1,327
Low constraints	2,706	2,412	2,520	2,583	2,021
	3,348	3,068	3,348	3,348	3,348
Sept/Oct/Nov FYE firms:					
High constraints	37	35	73	28	62
Low constraints	325	311	289	334	300
	362	346	362	362	362
Total observations	3,710	3,414	3,710	3,710	3,710

These tables present 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). In all columns in both panels, we use entropy balancing on the first and second moments as the estimation method. All variables are defined in Appendix D. 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 Domestic R&D Employment

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	Log(1+Employee Count)					
R&D Employees × t=0	**-0.005**	**-0.005**	**-0.005**	**-0.004**	**-0.004**	**-0.004**
	[-0.990]	**[-0.990]**	**[-0.990]**	**[-0.611]**	**[-0.610]**	**[-0.610]**
R&D Employees × t+1	**-0.014**	**0.014**	**-0.014**	**-0.016**	**-0.016**	**-0.016**
	[-1.621]	**[-1.619]**	**[-1.619]**	**[-1.359]**	**[-1.358]**	**[-1.358]**
R&D Employees × t+2				**-0.026***	**-0.026***	**-0.026***
				[-1.869]	**[-1.868]**	**[-1.868]**
R&D Employees	-0.055**	-0.055**	-0.055**	-0.052**	-0.052**	-0.052**
	[-2.503]	[-2.502]	[-2.501]	[-1.995]	[-1.994]	[-1.994]
$t = 0$	-0.002	-0.173***		-0.005	-0.188***	
	[-0.159]	[-15.370]		[-0.320]	[-13.398]	
$t + 1$	0.086***	-0.195***		0.100***	-0.200***	
	[4.023]	[-12.349]		[3.638]	[-10.024]	
$t + 2$				0.178***	-0.225***	
				[5.266]	[-9.896]	
Observations	9,208	9,208	9,208	7,958	7,958	7,958
R^2	0.001	0.831	0.962	0.002	0.826	0.961
Sample	All FYE	All FYE	All FYE	Dec FYE	Dec FYE	Dec FYE
Method	OLS	OLS	OLS	OLS	OLS	OLS
Controls	N	Y	Y	N	Y	Y
Firm FE	N	N	Y	N	N	Y
Event-Year FE	N	N	Y	N	N	Y
Clustering	Firm	Firm	Firm	Firm	Firm	Firm
Dependent variable mean values:						
All Firms, Event Year t-1	3,409	3,409	3,409	2,962	2,962	2,962

This table presents results of testing whether R&D investment declines in response to the U.S. requirement to capitalize and amortize R&D. Columns (1) through (3) report results as estimated using the full sample; Columns (4) through (6) report results for December fiscal year end firms for whom data is available through $t + 2$. All variables are defined in Appendix D. Control variables and fixed effects 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 8: 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	EB	EB	EB	EB	EB
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	EB	EB	EB	EB	EB
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

These tables present 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. Columns (1) of Panel A, as well as Columns (1) through (6) of Panel B, use entropy balancing on the first and second moments as the estimation method. Columns (2) through (6) of Panel A use entropy balancing on the first moment as the estimation method. 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 D. 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 9: Heterogeneity in the Impact of R&D Capitalization on R&D Investment based on Innovation Quality

Quality measure	(1) *High Patent Grants*	(2) *High Forward Citations*	(3) *High Patent Value*	(4) *High Innovation Efficiency*	(5) *High Research Quotient*
Variables			*R&D Investment*		
Dec FYE Firm × Post	-0.006	-0.006	-0.006	-0.010*	-0.003
	[-1.478]	[-1.367]	[-1.379]	[-1.806]	[-0.832]
Dec FYE Firm × Post × Quality	**-0.001**	**0.002**	**-0.001**	**0.007**	**-0.001**
	[-0.096]	**[0.311]**	**[-0.083]**	**[1.146]**	**[-0.255]**
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	EB	EB	EB	EB
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). In all columns, we use entropy balancing on the first and second moments as the estimation method. All variables are defined in Appendix D. 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 10: Quarterly Analysis

Variables	(1)		(2)	
	Quarterly R&D Investment			
	Coefficient	*T-Stat*	*Coefficient*	*T-Stat*
Dec FYE Firm × 2019 Q1	0.003	[0.920]	0.002	[0.941]
Dec FYE Firm × 2019 Q2	0.002	[0.667]	0.002	[0.923]
Dec FYE Firm × 2019 Q3	0.000	[0.035]	0.001	[0.704]
Dec FYE Firm × 2019 Q4	0.001	[0.569]	0.002	[0.750]
Dec FYE Firm × 2020 Q1	-0.002	[-0.698]	0.000	[0.089]
Dec FYE Firm × 2020 Q2	-0.002	[-0.763]	-0.000	[-0.120]
Dec FYE Firm × 2020 Q3	-0.001	[-0.402]	-0.001	[-0.214]
Dec FYE Firm × 2020 Q4	-0.002	[-0.643]	-0.003	[-0.898]
Dec FYE Firm × 2021 Q1	0.002	[0.761]	0.001	[0.335]
Dec FYE Firm × 2021 Q2	0.001	[0.582]	0.000	[0.240]
Dec FYE Firm × 2021 Q3	0.000	[0.089]	-0.001	[-0.462]
Dec FYE Firm × 2022 Q1	**-0.003*** **	**[-2.802]**	**-0.002***	**[-1.705]**
Dec FYE Firm × 2022 Q2	**-0.003****	**[-2.207]**	**-0.001**	**[-0.741]**
Dec FYE Firm × 2022 Q3	**-0.005***	**[-1.872]**	**-0.002**	**[-0.829]**
Dec FYE Firm × 2022 Q4	**-0.005****	**[-1.987]**	**-0.003**	**[-1.159]**
2019 Q1	-0.008***	[-3.259]	-0.006***	[-2.882]
2019 Q2	-0.007***	[-2.979]	-0.007***	[-2.609]
2019 Q3	-0.007***	[-3.355]	-0.006***	[-3.069]
2019 Q4	-0.006**	[-2.581]	-0.004**	[-2.120]
2020 Q1	-0.006***	[-2.934]	-0.005***	[-2.615]
2020 Q2	-0.005***	[-2.652]	-0.005**	[-2.243]
2020 Q3	-0.004	[-1.389]	-0.003	[-0.973]
2020 Q4	0.000	[0.097]	0.002	[0.497]
2021 Q1	-0.004	[-1.549]	-0.003	[-1.365]
2021 Q2	-0.003*	[-1.698]	-0.003	[-1.532]
2021 Q3	-0.001	[-0.510]	-0.001	[-0.591]
2022 Q1	**-0.000**	**[-0.609]**	**-0.000**	**[-0.416]**
2022 Q2	**-0.000**	**[-0.341]**	**-0.001**	**[-0.740]**
2022 Q3	**0.001**	**[0.468]**	**0.000**	**[0.178]**
2022 Q4	**0.002**	**[1.005]**	**0.001**	**[0.670]**

Observations	9,425	9,425
R^2	0.835	0.853
Sample	Quarterly	Quarterly
Method	OLS	EB
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. While Column (1) relies on OLS, Column (2) uses entropy balancing on the first and second moments as the estimation method. All control variables are measured at a one-year lag. All variables are defined in Appendix D. 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 next to 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.