The Effect of Tax Policies on Corporate Risk-Taking: Evidence From Bonus Depreciation*

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Abstract

This study investigates the impact of accelerated tax depreciation on corporate risk-taking decisions in the United States. Economic theory suggests that risky investments face high effective tax burdens, but bonus depreciation — a tax policy introduced in 2001 that induced industry-specific variation in accelerated depreciation schedules — could reduce such distortions. Using a generalized Difference-in-Differences framework, I find that the average U.S. public firm increases risk by 17.93% in response to bonus depreciation. I also provide evidence of a channel underlying the observed link. Specifically, firms respond to the policy by investing in capital stock with volatile future prices. Moreover, small and financially constrained firms, low productivity firms, and firms without tax loss carryforwards respond more strongly to the policy. The results imply that phasing out bonus depreciation might expose firms to inflation and time value of money factors, potentially resulting in reduced risk-taking.

Keywords: bonus depreciation; investments; risk-taking; taxation; tax policy

JEL Classifications: D22, G32, H25, H32

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1 Introduction

Corporate risk-taking is a vehicle for economic growth.[1] However, the well-documented upward trend in earnings volatility — i.e., a broadly used proxy that captures firms' risk-taking efforts — during the late 20^{th} century reversed in the early 2000's. This stylized fact is depicted in Fig. 1a that plots the evolution of return on assets (ROA) volatility over time. Typical earnings volatility increased from 3.7% in 1990 to 4.6% in 2000; in 2003, typical volatility fell below 1990 levels, reaching a local trough of 2.9%. After 2003, median earnings volatility stabilized between 2.4% and 3.5%. The observed slowdown in earnings volatility has led to significant debate amongst policymakers, practitioners, and academics.

In this study, I explore how taxable income variations affect corporate risk-taking preferences in U.S. firms. In particular, I ask the following question: Does accelerated tax depreciation affect risk-taking? The IMF (2023) projects that economic growth will decelerate in the near future and think tanks consider tax policy an essential component of packages aimed at fostering riskier investments (see Tax Foundation, 2019; Furman, 2020). Hence, the study might be timely from a policy making viewpoint. In addition, economic theory suggests that risk-taking preferences vary with taxation (see Poterba, 2002). Recent empirical studies further document that corporate income taxes (Ljungqvist, Zhang and Zuo, 2017; Langenmayr and Lester, 2018), capital gains taxes (Yost, 2018), and personal income taxes (Armstrong, Glaeser, Huang and Taylor, 2019; Glenn, 2022) affect ex ante investment risk. I contribute to this line of literature by examining the risk-taking implications of accelerated tax depreciation. Thus, the study could be informative from an academic standpoint.

In this study, I exploit the U.S. federal tax policy of bonus depreciation as a plausibly exogenous shock to accelerated tax depreciation schedules (House and Shapiro, 2008; Zwick and Mahon, 2017). Bonus depreciation was first enacted in September 2001 to temporarily stimulate corporate investment in capital stock during economic downturns, and has since been extended several times by the U.S. Congress. The policy allows U.S. firms to deduct (for tax purposes) greater percentages of a depreciable asset's value in the purchase year of the asset, thus allowing firms to reduce their taxable income in the earlier stages of an asset's recovery period without affecting the total deductible amount (Zwick and Mahon, 2017). From the corporation's (government's) perspective, the amount of tax depreciation allowances (tax revenue) remains constant, but its present value (PV) increases (decreases). Therefore, bonus depreciation offers firms rapid (ex ante) tax depreciation schedules (House and Shapiro, 2008).

It is ex ante unclear whether bonus depreciation incentives stimulate riskier investments. Theory suggests that accelerated tax depreciation mutes the importance of risk profiles in investment decisions. This effect comes predominantly from a reduction in the marginal effective tax rate imposed on risk-taking (Auerbach, Aaron and Hall, 1983; Auerbach, 1983). Alternatively,

[1] I use the terms "risk-taking" and "earnings volatility" interchangeably to refer to risk attitudes on corporate investments.

the government taxes accounting profits (i.e., gross income less a fixed ex ante depreciation allowance) instead of taxing economic income (i.e., gross income less economic depreciation). Hence, the tax system imposes a higher tax burden on physical capital with fluctuations in economic income (i.e., capital risk) because the tax liability varies with fluctuations in accounting profits (Bulow and Summers, 1984). Bonus depreciation ensures that tax depreciation is faster than economic depreciation (Desai and Goolsbee, 2004). Without loss of generality, the policy bridges the gap between accounting and economic income and should make riskier investments more attractive. Overall, I expect an increase in risk-taking in response to bonus depreciation tax incentives ("*substitution hypothesis*").

Nevertheless, the tax depreciation system in the U.S. ensures that firms recover at least 89% of the real investment (Desai and Goolsbee, 2004). Consequently, the code is designed to minimize distortions in investment choices with respect to depreciable assets. In addition, firms strategically trade capital assets to minimize exposure to states of the world where risky investments fail (Williams, 1985). Assuming that the investment experiences a sharp drop in future economic income stream, the firm could sell the underlying asset. By doing so, the firms adjusts the asset's tax basis (i.e., the tax liability) and forces the government to share in the asset's downside. Thus, firms might not alter risk-taking behavior in response to bonus depreciation ("*unresponsive hypothesis*").

I empirically test these competing predictions using panel data of U.S. public firms from 1995 to 2012 with two measures of asset risk. Following Ljungqvist et al. (2017), I measure the volatility of future quarterly returns net of depreciation on total (or net operating) assets with adjustment to reduce the effect of seasonal trends. I then implement a generalized continuous treatment Difference-in-Differences (DD) framework that exploits an advantageous empirical feature of the implementation of bonus depreciation: exposure to the policy varies across industries (House and Shapiro, 2008; Zwick and Mahon, 2017). Firms operating in industries that, typically, invest in long-duration assets (longer-lived industries) see a significant increase in the PV of tax shields generated from new capital assets and serve as the treatment group. In contrast, firms residing in industries that invest in short-duration assets (shorter-lived industries) experience a negligible policy effect and serve as the control group. Thus, the identification strategy compares corporate risk-taking in firms in longer-lived industries relative to firms in shorter-lived industries.

The empirical results are threefold. To begin with, the DD estimate is narrowly defined between 23.05 – 25.11 across various specifications. Ceteris paribus, this estimate implies that each standard deviation increase in an industry's exposure to bonus depreciation — or a 0.76 percentage points increase in the PV of tax shields generated from new capital investments due to the tax policy — increases ROA volatility by 15% in standard deviation units. Thus, the evidence indicates that bonus depreciation is positively associated with firm risk-taking attitudes and lends support to the *substitution hypothesis*.

Based on theory (Bulow and Summers, 1984), I then explore the underlying economic mechanism. I expect that bonus depreciation encourages firms to invest in assets with higher capital risk. The empirical evidence supports this prediction. In particular, I find that relative to firms in shorter-lived industries, capital risk — measured as the volatility of future changes in the replacement cost of physical capital (McKenzie, 1994; Eberly, Rebelo and Vincent, 2012) and the unlevered equity beta (Bulow and Summers, 1984; McKenzie and Mintz, 1992) — increases in firms residing in longer-lived industries by 7.6% – 18.48% in standard deviation units.

Last but not least, I find evidence of heterogeneous risk-taking responses to bonus depreciation. Firms facing financing frictions postpone investment projects (Lyandres, 2007) or fly to safer investments projects (Almeida, Campello and Weisbach, 2011). I argue and find that small and financially constrained firms benefit the most from the increased PV of investment tax shields due to bonus depreciation. Next, low productivity firms have high user costs (Hall and Jorgenson, 1967) but limited downside risk. Bonus depreciation reduces the user cost of capital and should make riskier investments attractable to unproductive firms. Consistent with my prediction, I find that low efficiency firms are significantly more responsive to the tax policy. Finally, loss offset provisions can either reduce the perceived benefit of the tax policy (Auerbach and Poterba, 1987) or increase the absorptive capacity of tax deductions. The empirical evidence from this test reveals a substitution effect between bonus depreciation and tax loss carryforwards.

A primary challenge to the identification strategy stems from the possibility that industry-specific confounding trends with heterogeneous risk-taking effects on longer-lived and shorter-lived industries coincide with bonus depreciation. I address this concern in a number of ways. In all model specifications, I control for an extensive vector of covariates and fixed effects, and cluster standard errors at the level of policy variation, that is, at the industry level (Bertrand, Duflo and Mullainathan, 2004). Graphical event study DD analyses showcase that the parallel trends assumption holds in the pre-2001 period, implying that the risk-taking trends between firms in longer-lived and shorter-lived industries would evolve in parallel in the absence of the tax policy. Placebo treatment analyses indicate that firms in longer-lived industries that do not qualify for bonus depreciation tax allowances did not exhibit substitution towards riskier investments, reinforcing the earlier argument that bonus depreciation might have risk-taking implications. Binary DD analyses also show a quantitatively consistent picture with the continuous DD framework. Block permutation tests further highlight that the DD estimate is weakly defined for 5,000 placebo treatment samples.

Recent advances on generalized DD research designs further question the empirical validity of the identification strategy. All firms that are subject to U.S. federal tax are eligible for bonus depreciation. However, bonus depreciation treatment effects vary both across industries and over time, highlighting potential for negative or non-convex weights bias (see de Chaisemartin and D'Haultfœuille, 2020; Sun and Abraham, 2021). I implement the de Chaisemartin and D'Haultfœuille (2020), Callaway and Sant'Anna (2021), and Sun and Abraham (2021) DD estimators to address treatment effect heterogeneity. Finally, bonus depreciation coincides with a number of business and investor friendly changes to tax policy. The results hold when I control (1) for tax policies that might covary with bonus depreciation, i.e., Section 179, Domestic Production Activities Deduction (DPAD) and Extraterritorial Income Exclusion (ETI), and (2) for business cycle trends.

The findings of this study should be informative to academics and policymakers. From an academic (theoretical) standpoint, the study contributes to several literature streams. First, it contributes a new angle to the accounting literature that is primarily focused on the risk-taking consequences of taxes. Based on well-developed theoretical frameworks, recent studies examine the interplay between corporate taxes and risk-taking (e.g., Ljungqvist et al., 2017; Bethmann, Jacob and Müller, 2018; Langenmayr and Lester, 2018). Several studies have also considered personal taxes (Armstrong et al., 2019; Glenn, 2022), capital gains taxes (Yost, 2018), while others focus on corporate tax planning (Rego and Wilson, 2012; Goh, Lee, Lim and Shevlin, 2016; Guenther, Matsunaga and Williams, 2017). I add to this literature by shedding new light on a previously unidentified component of the corporate tax system that shapes risk-taking attitudes — namely, accelerated tax depreciation. Provided that the documented risk-taking responses to the policy are attributable to variation in accelerated depreciation schedules and not to confounding events, then the evidence hints towards an unintended externality of bonus depreciation.

By extension, the findings add to the growing literature on the economic consequences of bonus depreciation tax incentives. House and Shapiro (2008) provide evidence that the first two episodes of bonus depreciation in the U.S. had significant short-term investment responses. Subsequent studies use bonus depreciation to explore long-term investment responses (Zwick and Mahon, 2017), employment (Garrett, Ohrn and Suárez Serrato, 2020; Curtis, Garrett, Ohrn, Roberts and Suárez Serrato, 2023), payout policy (Ohrn, 2018), and executive compensation (Ohrn, 2023). This study abstracts from prior work and focuses on volatility, which an important determinant of firm economic growth. In doing so, I also complement an emerging literature on heterogeneous responses to U.S. bonus depreciation (Edgerton, 2010; Zwick and Mahon, 2017; Eichfelder, Jacob and Schneider, 2023), as the evidence points towards financially distressed firms, low efficiency firms, and firms without tax loss carryforwards as the most responsive to the tax policy.

The findings of this study should also be timely and relevant from a policy making perspective. With inflation reaching a 40-year peak of 9.1% in June 2022, GDP exhibiting a 1.6% annualized contraction in 2022:I, and geopolitical uncertainty on the rise, economists fear that the U.S. economy might face stagflation. Meanwhile, Section 168(k) of the Tax Cuts and Jobs Act of 2017 will phase out bonus depreciation over the 5-year period 2023 – 2027. Failing to extend the policy could detrimentally expose firms not only to time value of money factors (Zwick and Mahon, 2017), but also to inflation effects (Auerbach and Jorgenson, 1980), which may together stunt economic growth. Fig. 1b presents firm risk-taking trends in a simulated U.S. economy with and without bonus depreciation incentives. The divergence in risk-taking is striking between the two states of the U.S. economy. Without bonus depreciation, my findings then (1) suggest that corporations could shift investments towards safer projects, and (2) potentially provide an explanation for the projected decline in economic growth (Congressional Budget Office, 2020).

The remainder of the study is organized as follows. Section 2 reviews the prior literature, describes the bonus depreciation tax policy, and outlines the empirically testable hypotheses. Section 3 describes the empirical research design and sample. Sections 4, 5, and 6 discuss the main empirical findings, investigate the underlying economic mechanism, and examine heterogeneous responses to bonus depreciation, respectively. Section 7 concludes.

2 Prior Research, Institutional Setting, and Hypotheses

My research question is motivated by a large literature debating whether and how corporate taxation affects corporate risk-taking attitudes (e.g., Domar and Musgrave, 1944; Auerbach et al., 1983; Bulow and Summers, 1984; Poterba, 2002; Ljungqvist et al., 2017; Bethmann et al., 2018; Langenmayr and Lester, 2018). The presence of tension within the relevant literature presents a challenge in predicting the (if any) responses to accelerated tax depreciation. I discuss prior research in Section 2.1. I describe the institutional setting in Section 2.2. I develop the competing hypotheses in Section 2.3.

2.1 Prior Research

Much of the prior literature that examines the interplay between taxation and risk-taking focuses on the asymmetric treatment of tax losses. Corporate taxes reduce the after-tax expected project return. The reduction is greater for projects with more volatile payoffs due to tax law asymmetries. Economic theory posits that full loss offsets will flip the negative relation between the corporate tax rate and risk attitudes (Domar and Musgrave, 1944). The argument in favor of a proportional income tax with full loss offset provisions is stated in terms of compensation for risk-bearing: part of the project's downside is shifted to the government.

Nevertheless, the corporate tax system offers limited (instead of full) loss offset provisions to (1) encourage risk-taking, and to (2) pre-empt self-serving loss firms from benefiting from the tax refunds (Poterba, 2002). With respect to the former proposition, several studies provide empirical results in opposing directions. To elaborate, Ljungqvist et al. (2017) exploit staggered state corporate tax rate variations in the U.S. to identify asymmetric risk-taking sensitivity to the tax rate. They find that the average Compustat firm reduces risk by 2.6% for each 1.36 percentage point increase in the tax rate, but does not alter risk-taking behavior in response to a tax rate cut. In addition, Ljungqvist et al. (2017) show that loss offsets moderate the negative risk-taking response to tax rate increases. On the contrary, Langenmayr and Lester (2018) exploit cross-country variation on loss offsets and find that the average sample firm increases (reduces) risk-taking by 14% (23%) in response to an increase (decrease in the loss offset period). Consistent with Domar and Musgrave (1944), Langenmayr and Lester (2018) also show that increases in the tax rate stimulate risk-taking only in presence of loss offsets.

Regarding the latter prediction, Kaymak and Schott (2019) theorize that loss offsets induce heterogeneity in the effective tax rate on the marginal $1 investment. Productive firms are subject to a high marginal tax rate, whereas unproductive firms face a lower rate. Hence, loss offsets distort investment decisions because productive firms underinvest while unproductive firms overinvest in capital. Furthermore, Bethmann et al. (2018) provide empirical evidence that tax loss carryback generosity increases the misallocation of resources to constrained and unproductive firms without investment opportunities. The authors find that the average tax loss carryback firm will use 33 (33) [26] cents of each €1 of tax refunds to invest (pay dividends) [increase cash balances].

Several other studies look at how various tax types affect corporate risk. Yost (2018) focuses on the *indirect* risk-taking effects of capital gains taxation. In particular, Yost (2018) argues that capital gains taxation induces a lock-in effect — CEOs are discouraged from selling vested equities and are exposed to firm risk. Therefore, locked-in CEOs have an incentive to reduce firm risk in an attempt to lower personal risk. Consistent with this prediction, Yost (2018) provides evidence that CEOs facing a higher capital gains tax liability reduce corporate risk-taking, while capital gains tax rate cuts dampen the reduction. Armstrong et al. (2019) also investigate the *direct* effect of personal income taxes on corporate risk preferences. Armstrong et al. (2019) argue and show that managers' personal taxes reduce managerial risk aversion and increase incentives to bear corporate risk. Similar to Armstrong et al. (2019), Glenn (2022) evidences that shareholders' personal taxes stimulate risk-taking in banks, and that this relation varies with shareholders' loss offset capacity.

Studies have also considered the risk implications of corporate tax planning. For instance, Albertus, Glover and Levine (2019) model risk-taking within a multinational transfer pricing setting. Based on this framework, the firm can circumvent convex tax liabilities by transferring risky projects in low tax jurisdictions. In essence, the effective tax rate on project payoffs drops because profits are taxed at lower foreign rates, and the firm has an implicit incentive to undertake more risk. On the empirical side, Goh et al. (2016) document a negative link between tax planning and the cost of equity financing, whereas Hasan, Hoi, Wu and Zhang (2014) evidence a positive relation between tax planning and the cost of debt financing. Similarly, Rego and Wilson (2012) find that tax planning increases stock return volatility, whereas Guenther et al. (2017) provides evidence for the opposite result. Finally, Hutchens, Rego and Williams (2021) find that 19% (42%) [39%] of U.S. public firms exhibit a positive (negative) [weak] association between tax planning and risk-taking. Overall, it appears that taxes shape firms' risk behavior. Taken together, previous studies have mainly focused on the tax rate, loss offsets, and tax planning. This study complements the literature on firms' ex ante risk-taking preferences by considering accelerated tax depreciation, an empirically unaddressed element of the tax system.

2.2 *Institutional Setting*

I provide empirical evidence by examining bonus depreciation, a base-narrowing tax policy that accelerated tax depreciation. Bonus depreciation was first introduced as a business provision of the Job Creation and Worker Assistance Act of 2002. Corporations could immediately deduct a "bonus" 30% of the purchase price of qualifying capital from taxable income, and the remaining portion could be deducted based on the depreciation schedules stated in IRS Publication 946. The recovery period of qualifying capital was capped at 20 years and the corporation should purchase the said capital after September 11, 2001 and prior to January 1, 2005. The Jobs and Growth Tax Relief Reconciliation Act of 2003 further increased the bonus depreciation rate to 50% for capital purchased after May 5, 2003. Bonus depreciation incentives were shut down during 2005 – 2007, and the Economic Stimulus Act of 2008 re-enacted the incentive at a 50% bonus depreciation rate for qualifying assets placed in service between December 31, 2007 and December 31, 2008. Then, the American Recovery and Reinvestment Act of 2009 and the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 extended the incentive through 2012, and only for 2011 allowed corporations to immediately write-off the purchased capital. The American Taxpayer Relief Act of 2012 and the Tax Increase Prevention Act of 2014 further extended bonus depreciation until 2017, while the Tax Cuts and Jobs Act of 2017 doubled the bonus depreciation rate to 100% through 2022. Finally, the policy is expected to phase-out during 2023 – 2027. Appendix A illustrates the effect of bonus depreciation on the tax depreciation schedules for assets with 3 and 7 years of useful life.

In my analysis, I exploit bonus depreciation as an arguably exogenous shock to tax depreciation allowances (House and Shapiro, 2008; Zwick and Mahon, 2017). The U.S. Congress enacted or extended the policy during periods of economic contraction to "… promote capital investment, modernization, and growth" (JCT, 2005, p. 17). However, the policy's magnitude varies over time, and exposure to the policy varies across industries. In particular, an industry's exposure to bonus depreciation depends on the types of qualifying assets purchased by all firms in the industry (House and Shapiro, 2008; Zwick and Mahon, 2017). Some industries invest in long-duration assets (e.g., Accommodation; 20-year assets), whereas other industries in short-duration assets (e.g., Construction; 5-year assets). In the example above, industries typically investing in 7-year assets are more exposed to bonus depreciation that industries typically investing in 3-year assets. Therefore, the cross-sectional variation in tax depreciation allowances plausibly isolates the risk-taking implications of bonus depreciation from contemporaneous economy-wide or regulatory factors.

Apart from bonus depreciation incentives, the U.S. Congress has enacted other contemporaneous corporate tax policies that also intend to stimulate investments. Such tax policies are Section 179, the ETI, and the DPAD. Section 179 allows U.S. firms to immediately expense for tax purposes the value of qualifying assets up to a given threshold. ETI was effective during

2000 – 2004 and allowed U.S. firms to deduct a portion of income generated from export activity from taxable income. DPAD was effective during 2005 – 2014 and allowed U.S. firms to deduct income generated from domestic production from taxable income. In the Online Appendix, I ensure that the employed identification strategy controls for concurrent tax policies that might confound the analysis.

2.3 Empirically Testable Hypotheses

I consider the marginal effective tax rate ($METR$) on capital to understand whether and how bonus depreciation relates to firms' risk decision. I derive the $METR$ following the Hall and Jorgenson (1967) user cost of capital framework (see Auerbach et al., 1983):

$$METR = 1 - \frac{r \times (1-\tau_f)}{(r+\delta) \times [1-(\kappa+z) \times \tau_f] - \delta \times (1-\tau_f)}$$

where r is the required rate to discount investment cash flows (which is a function of the risk-free rate plus a risk premium), δ is the asset's economic depreciation rate, κ is the proportion of the investment eligible for tax credit, z is the PV of depreciation deductions, and τ_f is the federal corporate tax rate. $METR$ measures the tax distortion in investment decisions due to taxation. Bonus depreciation incentives increase the PV of depreciation deduction, and thus, reduce the effective tax burden on asset returns. Ceteris paribus, the reduction is greater for riskier assets due to the interaction between r and z. In addition, the faster depreciation schedules ensure that a larger portion of the real investment cost is recovered. Hence, the government shares in a higher fraction of asset cost, return, and risk. In Appendix B, I show through numerical simulations that the percentage drop in $METR$ due to bonus depreciation incentives is greater for riskier investments.

Furthermore, Bulow and Summers (1984) extend the effective taxation of capital stock to account for income and capital risk. Bulow and Summers (1984) argue that assets have volatile income streams (income risk) and volatile economic depreciation streams (capital risk). The tax system offers ex ante tax depreciation deductions that depend on the historical purchase cost of the asset, while ex post economic depreciation depends on the current market value of the asset. Meanwhile, the government absorbs a fraction of the gross yield less a fixed ex ante depreciation, when it should be absorbing a fraction of the gross yield less actual ex post depreciation. Hence, the effective tax burden is greater for risky assets because the tax liability varies with accounting profits instead of economic profits. Bulow and Summers (1984) then predict that the tax code should offer accelerated ex ante tax depreciation deductions to compensate firms early for bearing risk in future periods. Overall, I expect firms to substitute safer for riskier projects following bonus depreciation tax incentives, and I formally state this in the following hypothesis.

SUBSTITUTION HYPOTHESIS. *All else equal, firms increase risk-taking in response to bonus depreciation tax incentives.*

Nevertheless, several factors create tension over the predicted association. Absent bonus depreciation, the PV of depreciation deductions for the average U.S. establishment is approximately 90% of the original purchase price ($z \approx 0.9$). In essence, firms already retrieve a substantial portion of the real investment under the current tax system. Due to this observation, Desai and Goolsbee (2004) argue that bonus depreciation incentives provide limited tax benefits. With respect to risk, this figure implies that the effective tax burden on risk-taking is already low, and any further decrease due to bonus depreciation would be marginal.

Furthermore, firms engage in strategic trading of depreciable assets for tax purposes. Specifically, firms claim (pay) a balancing allowance (charge) for depreciable assets sold below (above) the corresponding tax book values. Strnad (1999) argues that the government fully shares in risk from depreciable assets through ex ante tax depreciation deductions and ex post balancing allowances/charges. Assuming that a risky investment fails (e.g., due to an exogenous drop in economic income), the asset's market value will decline faster that its tax value. The firm can then sell the asset to claim a balancing allowance. By doing so, the firm forces the government to share in the asset's downside. Provided that the risky investment succeeds, the asset's market value declines slower than its tax value. In this case, the firm opts to hold the asset and benefit from the increased PV of depreciation allowances.

The strategic trading argument of Strnad (1999) is also consistent with the Williams (1985) theoretical framework, which models the interplay between asset trading and tax depreciation. In tax systems with high tax depreciation rates, Williams (1985) theorizes that rational investors sell depreciable assets only to realize capital gains, implying that the government always shares in returns and risks generated from depreciable assets. Thus, bonus depreciation incentives might not affect risk-taking preferences. Given the theoretical tension, I state a competing hypothesis below.

UNRESPONSIVE HYPOTHESIS. *All else equal, firms do not increase risk-taking in response to bonus depreciation tax incentives.*

3 Research Design

I discuss in detail the research design employed to test the competing hypotheses. I present the identification strategy in Section 3.1. I describe the risk-taking measures in Section 3.2. I explain the tax policy variable in Section 3.3, and I provide details on the control variables in Section 3.4. Finally, I discuss the sample selection process in Section 3.5.

3.1 Identification Strategy

I follow Zwick and Mahon (2017), Ohrn (2018), and Ohrn (2023) in implementing a generalized continuous treatment DD framework to measure the effect of bonus depreciation incentives on risk-taking:

$$Y_{it} = \beta_0 + \beta_1 \times BONUS_{jt} + X_{it} \times \Gamma + \Psi_{it} \times \gamma + \varepsilon_{it} \quad (1)$$

where subscripts i, t, and j index firm, time, and NAICS 4-digit industries, respectively. $Y_{it} \in \{ROA\ Vol_{it},\ RNOA\ Vol_{it}\}$ denotes the outcome of interest for firm i in year t. $BONUS_{jt}$ denotes the percentage point increase in the PV of tax shields generated by $1 of new capital investments due to bonus depreciation for industry j in year t. X_{it} is the vector of time-varying covariates and Γ is the coefficient vector of those covariates. Ψ_{it} denotes a vector of fixed effects that vary across model specifications. The fixed effects array consists of firm and year fixed effect, plus flexible trends for observable firm characteristics. In particular, I incorporate fixed effects that control for time-varying heterogeneity relating to firm scale, growth opportunities, and marginal income tax rates. I cluster ε_{it} at the 4-digit NAICS level because the tax policy magnitude varies by industry (Bertrand et al., 2004). Finally, coefficient β_1 on $BONUS_{jt}$ is the generalized DD estimate that captures risk-taking differences between firms in longer-lived industries and firms in shorter-lived industries. I winsorize all continuous variables yearly at the 1% and 99% levels. I provide a description of all risk-taking, tax policy, and control variables in Appendix C.

3.2 Risk-Taking Variables

Conceptually, economic theory uses asset substitution frameworks to model corporate risk-taking (e.g., Domar and Musgrave, 1944). In essence, risk-taking firms substitute projects with stable yields for projects that offer varying payoffs across different states of the world. Operationally, empirical studies use the volatility of corporate profits to proxy for risk-taking (see Faccio, Marchica and Mura, 2011; Ljungqvist et al., 2017; Langenmayr and Lester, 2018). The intuition is that riskier firms have volatile outcomes because profits surge in good economy states and plummet in bad economy states.

I use two earnings volatility measures based on seasonally adjusted quarterly ROA and RNOA, which I denote as $ROA\ Vol_{it}$ and $RNOA\ Vol_{it}$ respectively. I also implement the seasonality adjustment proposed in Ljungqvist et al. (2017) for forward-looking earnings volatility measures. In each quarter q of year t, I measure firm i's profitability as (1) the return on assets (ROA_{itq}), defined as the ratio of earnings before interest and taxes to total assets, or (2) the return on net operating assets ($RNOA_{itq}$), defined as the ratio of earnings before interest and taxes to net operating assets. Next, I adjust current quarter profitability against the profitability in the same quarter of the previous year to remove the effect of seasonality on corporate outcomes, such that $\Delta ROA_{itq} = ROA_{itq} - ROA_{it-1,q}$ and $\Delta RNOA_{itq} = RNOA_{itq} - RNOA_{it-1,q}$. I then calculate $ROA\ Vol_{it}$ and $RNOA\ Vol_{it}$ as the standard deviations of ΔROA_{itq} and $\Delta RNOA_{itq}$ over the period q to q+11, respectively. Finally, I annualize the two volatility measures by multiplying by $\sqrt{4}$.

Note that I follow previous studies (John, Litov and Yeung, 2008; Ljungqvist et al., 2017; Langenmayr and Lester, 2018) and use net operating earnings yields to estimate earnings volatilities. Operating earnings pre-empt the DD estimate from loading on financial risk. On a different note, operating earnings ensure that the DD estimate captures variation in the net yield (gross yield less depreciation). Nevertheless, I investigate various measures of corporate risk-taking in Section 4.4.

3.3 Tax Policy Variable

The Tax Reform Act of 1986 set in place the Modified Accelerated Cost Recovery System (MACRS), which is the depreciation system U.S. firms must comply with to deduct capital equipment for tax purposes (see IRS Publication 946). MACRS specifies depreciation schedules for assets of varying recovery periods; the recovery period can be 3, 5, 7, 10, 15, or 20 years. Under MACRS, the PV of depreciation deductions for each \$1 of capital equipment, denoted as z^0, is equal to:

$$z^0 = \sum_{t=0}^{T} \frac{1}{(1+\rho_\delta)^t} \times \delta_t^{MACRS} \times A$$

where T denotes the recovery period of the asset (in years), δ_t^{MACRS} denotes the MACRS depreciation rate in year t, A denotes the dollar value of the asset, and ρ_δ denotes the required rate to discount future depreciation deductions. Note that z^0 is decreasing in T for the same \$1 investment due to discounting, such that $z^0_{T+x} < z^0_T$ with $x \in (0, \infty)$. I collect z^0 estimates at the 4-digit NAICS level from Zwick and Mahon (2017).

Bonus depreciation incentives allow firms to deduct an additional bonus percent (θ) of the asset's dollar value in year $t = 0$ for tax purposes. The remaining $1-\theta$ percent of the asset's dollar value is depreciated over the remaining recovery period according to MACRS. Under bonus depreciation incentives, the PV of depreciation deductions for each \$1 of capital equipment, denoted as z^{BONUS}, is equal to:

$$z^{BONUS} = \theta + (1-\theta) \times \sum_{t=0}^{T} \frac{1}{(1+\rho_\delta)^t} \times \delta_t^{MACRS} \times A = \theta + (1-\theta) \times z^0$$

The bonus depreciation rate exhibits time-series variation due to changes in the magnitude of bonus depreciation incentives over time. Federal θ was set to 30% for new capital equipment purchases after September, 2001, 50% in 2003 – 2004, 0% in 2005 – 2007, 50% in 2008 – 2010, 100% in 2011 (i.e., immediate expensing), and 50% in 2012. Following Ohrn (2018) and Ohrn (2023), the identification variable, denoted as $BONUS_{jt}$, captures the increase in the PV of the tax shields for each \$1 of new eligible investment for industry j in year t and equals to:

$$BONUS_{jt} = (z_{jt}^{BONUS} - z_j^0) \times \tau_f = \theta_t \times (1 - z_j^0) \times \tau_f$$

where τ_f is set at 35% over the sample period. Effectively, $BONUS_{jt}$ delivers the identification strategy through variation in the magnitude of bonus depreciation incentives (variation in θ_t) across industries (variation in z_j^0). For instance, $BONUS_{j,2003} = 0.175 - 0.175 \times z_j^0$. In presence of firm and year fixed effects, $BONUS_{jt}$ is a continuous treatment variable that captures variation in the magnitude of bonus depreciation between industries that invest in long-duration assets (e.g., 20-year assets) and industries that invest in short-duration assets (e.g., 3-year assets).

The first two panels of Fig. 2 depict substantial sector-level variation in z_j^0 and, by construction, $BONUS_{jt}$. The longest-lived sectors (NAICS sector) are: Agriculture, Forestry, Fishing, and Hunting (11), Arts, Entertainment, and Recreation (71), Accommodation and Food Services (72), Real Estate, Rental, and Leasing (53), and Mining (21). The shortest-lived sectors are: Professional, Scientific, and Technical Services (54), Information (51), Construction (23), Administrative, Support, Waste Management, and Remediation Services (56), and Health Care and Social Assistance (62). The distribution of z_j^0 also exhibits a structural break at 0.875 (Fig. 2 Panel C) (see also Curtis et al., 2023). Finally, the last panel illustrates the identification strategy. The magnitude of bonus depreciation is increasing in θ_t and decreasing in z_j^0.

INSERT FIG. 2 ABOUT HERE

3.4 Covariates

In Eq. (1), I control for an extensive array of factors that previous studies identify as important determinants of corporate risk-taking. Firm size ($Size_{it}$) captures the effect of firm rigidity on risky investments (John et al., 2008; Ljungqvist et al., 2017). Profitability (ROA_{it}) controls for volatile investment outcomes due to poor managerial choices (Coles, Daniel and Naveen, 2006; Faccio et al., 2011). Tobin's marginal q ($Marg.\ Q_{it}$) and sales growth ($Sales\ Growth_{it}$) capture the risk-taking effects of investment opportunity shocks (Faccio et al., 2011). Leverage ($Leverage_{it}$) and financial distress ($F.\ Constraints_{it}$) control for the effects of financial risk on corporate growth (Levine and Warusawitharana, 2021). Marginal taxation on corporate income ($Marg.\ TR_{it}$) controls for the effect of taxes on the required rate of return from risky projects (Domar and Musgrave, 1944; Ljungqvist et al., 2017), and effective tax rate volatility ($Tax\ Risk_{it}$) captures the potential role of tax risk in shaping risky investments (Guenther et al., 2017). Finally, net operating loss carryforwards (NOL_{it} and $DNOL_{it}$) control for the influence of partial loss offsets on risk-taking preferences (Domar and Musgrave, 1944; Bethmann et al., 2018).

3.5 Data

I use Compustat to collect financial data for firms listed in the U.S. between 1995 and 2012. The outcomes of interest require twelve quarters of data, so I start the DD window in 1995 to allow for a sufficient number of pre-treatment periods. I then end the DD window in 2012 to be consistent with previous studies (Garrett et al., 2020; Curtis et al., 2023; Ohrn, 2023), and to ensure that the American Taxpayer Relief Act (ATRA) does not confound the analysis.[2] I exclude regulated industry sectors: utilities (NAICS 22) and financial services (NAICS 52). I also remove firms without stock price information, and with negative total assets or net sales. The final unbalanced panel consists of 34,817 firm-year observations for 3,674 firms with non-missing data for the risk-taking, tax policy, and control variables.

4 Results

I start the empirical analysis with a description of the sample firm-years. Next, I report results relating to tests of the competing hypotheses. I then assess the validity of the identification assumption, explore alternative explanations due to unobservable confounding trends, and perform a battery of robustness tests.

4.1 Descriptive Statistics

Table 1 presents the summary statistics. The distribution parameters of the earnings volatility measures are close to those of previous studies that use similar measures (e.g., Ljungqvist et al., 2017). In particular, the mean sample firm exhibits a 4.55% (6.79%) volatility in quarterly *ROA* (*RNOA*). The standard deviations of $ROA\ Vol_{it}$ and $RNOA\ Vol_{it}$ are 5.54% and 8.64%, respectively, indicating significant cross-sectional variation in overall risk-taking. I log-transform the two measures to account for the right skewness of their distributions ($ROA\ Vol_{it}^{P50} = 2.82\%$; $RNOA\ Vol_{it}^{P50} = 4.06\%$).

Consistent with Garrett et al. (2020), the bonus depreciation rate (θ_t) is 37.40% during 2002 – 2012. Ceteris paribus, sample firms could deduct 37.40% of the asset's value in year t = 0, and deduct the outstanding 62.60% over the remaining recovery period according to MACRS. Furthermore, the mean industry recovers 89% of the real investment cost via MACRS depreciation deductions (mean z_j^0 = 0.89). Mean $BONUS_{jt}$ is equal to 1.97, indicating that bonus depreciation increased the PV of tax shields for each \$1 of new capital investment by 1.97 percentage points over the 2002 to 2012 period. Accordingly, bonus depreciation raised the PV of depreciation deductions of the average industry by 5.63 percentage points ($\approx \frac{1.97}{0.35}$). The magnitude of bonus depreciation also varies significantly across industries: the 25^{th} (75^{th}) percentile of $BONUS_{jt}$ is 1.38% (2.12%). The average industry saw a 2 percentage points increase in the PV of the tax shields from new capital investments in periods 2003 – 2004, 2008

[2] The ATRA of 2012, effective on January 2nd 2013, intended to address the U.S. fiscal cliff and extended the tax provisions of previous tax acts. The latter acts are referred to collectively as the Bush Tax Cuts, and consisted of the Economic Growth and Tax Relief Reconciliation Act of 2001 and the Jobs and Growth Tax Relief Reconciliation Act of 2003. Among other tax or spending provisions, ATRA increased the top marginal tax rate for taxable income and capital gains, increased the estate tax rate from 35% to 40%, modified the Alternative Minimum Tax, and extended Section 179 expensing and bonus depreciation. The empirical evidence remains unchanged when I expand the sample period to cover years 1995 – 2017 or 1995 – 2020.

– 2010, and 2012 ($\theta_t = 50\%$). The increase is 4 percentage points in 2011 when immediate expensing was allowed ($\theta_t = 100\%$).

With respect to the covariates, average (in levels) $Size_{it}$ is \$2,478m, indicating that sample firms are comparable to those in prior studies (e.g., Ljungqvist et al., 2017; Yost, 2018; Ohrn, 2023). The mean firm-year earns \$8 pre-tax for every \$100 of total assets (mean $ROA_{it} = 0.08$), has a market capitalization 2 times its replacement cost (mean $Marg.\ Q_{it} = 1.92$), and exhibits an 11% annual growth in net sales (mean $Sales\ Growth_{it} = 0.11$). The average firm is financially healthy (mean $F.\ Constraints_{it} = 0.28$) and holds 21% of its total assets in debt (mean $Leverage_{it} = 0.21$). Focusing on corporate tax outcomes, the average firm reports net operating loss carryforwards in 39% of the sample years (mean $NOL_{it} = 0.39$) and faces a 27% post-financing marginal income tax rate (mean $Marg.\ TR_{it} = 0.27$).

INSERT TABLE 1 ABOUT HERE

4.2 Difference-in-Differences Estimation

Table 2 reports the results from the analyses of the relation between bonus depreciation and corporate risk-taking using Eq. (1). These analyses allow me to examine the *substitution* vs. *unresponsive hypotheses*. The DD estimate, β_1, is the coefficient of main interest. A significantly positive β_1 would be consistent with the *substitution hypothesis*, whereas an insignificant β_1 would be consistent with the *unresponsive hypothesis*.

I use $ROA\ Vol_{it}$ and $RNOA\ Vol_{it}$ as the primary outcomes in Columns (1) – (5) and (6) – (10), respectively. Each set of columns follows the same structure. I focus the discussion on model specifications in Columns (1) – (5) for brevity. In Column (1), I report the β_1 estimate from a parsimonious specification that regresses the outcome variable on $BONUS_{jt}$ in the presence of firm and year fixed effects only. I do so to ensure that the tax policy has a first order effect on risk-taking and that the inclusion of covariates does not confound the DD estimate (Roberts and Whited, 2013). I incorporate the vector of covariates in Column (2), and progressively incorporate the vector of fixed effects in Columns (3) – (5).

The DD estimate is positive and statistically significant at the 1% level across specifications, implying an increase in corporate risk-taking for firms in longer-lived industries relative to firms in shorter-lived industries. To gauge economic magnitudes, I then combine the estimate in Column (5) with a standard deviation increase in bonus depreciation incentives. Based on the standard deviation statistics from Table 1, the 23.59 estimate is associated with a 17.93% ($= 23.59 \times 0.76$) increase in $ROA\ Vol_{it}$, which is 14.73% of the variable's standard deviation. Thus, the empirical findings in Table 2 provide evidence supporting the *substitution hypothesis*.

Furthermore, the coefficient vector of the covariates is consistent with economic theory. Large and profitable firms exhibit lower earnings volatility (Faccio et al., 2011; Langenmayr and Lester, 2018). Firms with investment opportunities invest in riskier projects (Ljungqvist et al., 2017; Langenmayr and Lester, 2018). Firms that utilize loss offset provisions also have volatile earnings (Bethmann et al., 2018; Langenmayr and Lester, 2018), whereas firms subject to a higher marginal tax rate have stable earnings. The latter finding is consistent with theory predicting that taxes reduce risk-taking in presence of partial loss offsets (see Poterba, 2002).

INSERT TABLE 2 ABOUT HERE

4.3 *Internal Validity Confirmation*

4.3.1 *Parallel Trends Assumption*

The underlying identification strategy assumes that the risk-taking trend of firms in industries that invest in long-duration assets would evolve in parallel to that of firms in industries that invest in short-duration assets in the absence of the tax policy. Visual inspection of the time series evolution of risk-taking for firms in longer-lived and shorter-lived industries will highlight violations of the identification assumption (Roberts and Whited, 2013). Fig. 3 Panels A and B plot the time-series evolution of the main risk-taking outcomes for firms in longer-lived vs. shorter-lived industries. The two panels suggest that the parallel trends assumption is plausibly satisfied. In particular, the evolution of longer-lived firms' risk-taking closely tracks the evolution of shorter-lived firms' risk-taking during the pre-2001 period, indicating that the two time series would evolve in parallel trends absent bonus depreciation incentives.

I then perform a dynamic DD analysis along the guidelines of Roberts and Whited (2013) and Ohrn (2023) to formalize the visual evidence in Fig. 3 Panels A and B, and to empirically validate the key identification assumption of the setting. The baseline model is:

$$Y_{it} = \beta_0 + \sum_{\substack{\xi=1995 \\ \xi\neq 2001}}^{2012} \{\beta_\xi \times [\overline{\theta} \times (1-z_j^0) \times \tau_f \times \mathbb{1}(t=\xi)]\} + X_{it} \times \Gamma + \Psi_{it} \times \gamma + \varepsilon_{it} \tag{2}$$

where $\overline{\theta} \times (1-z_j^0) \times \tau_f$ is the percentage point increase in the PV of tax shields generated by \$1 of new capital investments for industry j based on a flat 37.40% bonus depreciation rate ($\overline{\theta}$ = 37.40%), $\mathbb{1}(t=\xi)$ are yearly indicators, and all other model specification choices are identical to those in Eq. (1). Coefficients $\{\beta_{1995}, \ldots, \beta_{2000}\}$ capture treatment anticipation effects, $t = 2001$ is the omitted baseline period, and coefficients $\{\beta_{2002}, \ldots, \beta_{2012}\}$ identify dynamic treatment effects. Each of those β_ξ estimates translates into risk-taking differences at time $t = \xi$ between firms in longer-lived industries and firms in shorter-lived industries relative to risk-taking differences between the two groups of firms at time $t = 2001$.

In Fig. 3 Panels C and D, I plot the dynamic DD estimates $\{\beta_{1995}, \ldots, \beta_{2012}\}$ along with 95% confidence intervals on standard errors clustered at the 4-digit NAICS industries (Bertrand et al., 2004). *ROA Vol*$_{it}$ (*RNOA Vol*$_{it}$) is the outcome variable of interest in Panel C (D). Visual inspection of the $\{\beta_{1995}, \ldots, \beta_{2001}\}$ estimates further suggests that the identification assumption plausibly holds. The counterfactual treatment effect is statistically insignificant during the pre-2001 period. However, $\{\beta_{2002}, \ldots, \beta_{2012}\}$ estimates are large and statistically significant at conventional levels ($p < 0.005$). The dynamic DD estimates during the post-2001 period imply a sharp risk-taking effect of bonus depreciation for firms that benefit the most from the tax policy. Overall, the dynamic DD analysis suggests (1) that differential ex ante risk-taking growth trends do not drive the estimated tax policy effect, and (2) that the generalized DD estimator reported in Table 2 represents a fairly accurate estimate of risk-taking responses to the incentive.

INSERT FIG. 3 ABOUT HERE

4.3.2 Placebo Treatment

Next, I perform a placebo treatment test to reduce concerns that unobservable confounding trends with heterogeneous effects between longer-lived industries and shorter-lived industries explain significant variation in corporate risk-taking. Garrett et al. (2020) identify industries that mainly invest in long-duration assets that do not qualify for bonus depreciation.[3] These industries have the property of a placebo treatment group (Roberts and Whited, 2013). In the spirit of Ohrn (2023), I assume that firms operating in the placebo industries receive average bonus depreciation incentives and estimate the following DD framework:

$$Y_{it} = \beta_0 + \beta_1 \times \theta_t \times \tau_f \times \mathbb{1}(Placebo\ NAICS) + X_{it} \times \Gamma + \Psi_{it} \times \gamma + \varepsilon_{it} \tag{3}$$

where $\mathbb{1}(Placebo\ NAICS)$ is an indicator taking the value 1 for industries that invest in long-duration assets that do not qualify for bonus depreciation tax deductions, and 0 otherwise. All other specification choices are identical to those in Eq. (1).

I present the results from the estimated association of placebo bonus depreciation with corporate risk-taking in Table 3. $ROA\ Vol_{it}$ is the dependent variable in Panel A and $RNOA\ Vol_{it}$ is the dependent variable in Panel B. Across specifications, the placebo DD estimate is small, negative, and statistically indistinguishable from zero. In Column (5) of Panel A, the placebo DD estimate indicates that a 50 percentage points increase in θ_t is associated with a negligible 2.10% decrease in ROA volatility for firms in placebo industries, which is 2.25% of the variable's standard deviation.

INSERT TABLE 3 ABOUT HERE

Fig. 4 further plots the dynamic DD estimates for the placebo treatment group. Estimates $\{\beta_{1995}, \ldots, \beta_{2012}\}$ of the placebo incentive are small, statistically insignificant at conventional levels, and do not exhibit any pattern. Based on the DD estimates reported in Table 3 and the dynamic DD estimates plotted in Fig. 4, I conclude that ex ante unobservable trends in longer-lived industries do not appear to confound the generalized DD estimator in Eq. (1).

INSERT FIG. 4 ABOUT HERE

[3] These assets are structured investment products and intellectual property. The NAICS codes of placebo longer-lived industries are 2111, 4821, 5311, 7111, 7112, 7211, 7212, and 81.

4.3.3 Binary Difference-in-Differences Estimation

The identification variable, $BONUS_{jt}$, depends on estimation of z_j^0, which in turn requires assumptions about the required rate to discount future depreciation deductions, ρ_δ.[4] Tax shields from depreciation deductions are safe cash flows and should be discounted at the U.S. treasury rate. Hence, assumptions about ρ_δ could bias the DD estimate in Eq. (1) upwards (downwards) assuming that firms discount depreciation deductions at a rate higher (lower) than the Zwick and Mahon (2017) estimate. Garrett et al. (2020) argue that the estimate from a dichotomous treatment indicator conditional on the distribution of z_j^0 is orthogonal to assumptions about ρ_δ. Similar to Curtis et al. (2023), I showcase a structural cutoff at the distribution of z_j^0 at 0.875 (see Fig. 2). I exploit this natural break to implement a DD framework with binary treatment (Garrett et al., 2020; Curtis et al., 2023):

$$Y_{it} = \beta_0 + \beta_1 \times \mathbb{1}(z_j^0 \leq 0.875) \times \mathbb{1}(t > 2001) + X_{it} \times \Gamma + \Psi_{it} \times \gamma + \varepsilon_{it} \tag{4}$$

where $\mathbb{1}(z_j^0 \leq 0.875)$ is an indicator taking the value 1 if industry j has a z_j^0 value below 0.875, and 0 otherwise. $\mathbb{1}(t > 2001)$ is an indicator taking the value 1 in the post-2001 period, and 0 otherwise. All other specification parameters mimic the specification parameters in Eq. (1).

Table 4 presents the results from the binary DD analysis using Eq. (4). Panel A presents results for $ROA\ Vol_{it}$. In Column (1), the coefficient on $\mathbb{1}(z_j^0 \leq 0.875) \times \mathbb{1}(t > 2001)$ implies that firms in longer-lived industries increase risk-taking by 26% relative to firms in shorter-lived industries in response to bonus depreciation incentives ($p_{\beta_1} < 0.00$). The DD estimate is robust to the inclusion of covariates, firm size trends, growth trends, and marginal tax rate trends in Columns (2), (3), (4), and (5), respectively. The latter specifications yield β_1 estimates between 20% – 23%. I draw quantitatively similar inferences for $RNOA\ Vol_{it}$ in Panel B. Furthermore, the economic magnitude of the binary DD estimate is quantitatively similar to that of the continuous DD estimate (Table 2). In sum, the empirical evidence in Table 4 implies that assumptions about the discount rate do not seem to confound the estimated relation between bonus depreciation incentives and risk-taking.

INSERT TABLE 4 ABOUT HERE

4.3.4 Block Permutation Tests

Sections 4.3.1 – 4.3.3 investigate upward bias in the DD estimator. In this section, I examine potential downward bias in the standard error of the DD estimator, σ_{β_1}. Bertrand et al. (2004) argue that (positive) serial correlation in the dependent variable yields a downward biased σ_{β_1} and leads to overestimation of the treatment effect. Fig. 5 Panels A and B present

[4] Zwick and Mahon (2017) use a 7% rate to discount future depreciation deductions.

autocorrelation coefficients for residuals extracted from OLS regressions of $ROA\ Vol_{it}$ and $RNOA\ Vol_{it}$ on firm and year fixed effects, respectively. The coefficients of first and second order autocovariance for both dependent variables are positive, significant, and identical in magnitude (0.56 and 0.20, respectively). Thus, serial correlation in the within-firm error term might induce Type II error in the DD framework.

I perform a nonparametric block permutation test (e.g., Ohrn, 2018) in an attempt to address this concern. I randomly assign (without replacement) to each industry the z_j^0 value of another industry. Next, I calculate $BONUS_{jt}$ using the randomly assigned placebo z_j^0 values, estimate the fully specified Eq. (1), and extract the placebo treatment effect. I repeat this process another 4,999 times and then plot the empirical cumulative distribution function (CDF) of the 5,000 placebo DD estimators. Assuming that the reduced-form effect of bonus depreciation is unbiased, then the observed DD estimator (see Table 2) should lie at the extreme right tail of the empirical CDF.

Panel C (D) of Fig. 5 presents the empirical CDF of the 5,000 placebo estimates when $ROA\ Vol_{it}$ ($RNOA\ Vol_{it}$) is the outcome of interest. Only 1 out of 5,000 β_1 coefficients is lower than the estimated effect of 23.59 for $ROA\ Vol_{it}$ (non-parametric p-val = 0.00). Similarly, 7 out of 5,000 placebo effects are higher than the 21.49 estimate for $RNOA\ Vol_{it}$ (nonparametric p-val = 0.00). So, Fig. 5 suggests that the DD framework does not underestimate σ_{β_1}. In addition, the block permutations provide an extensive series of placebo treatment tests. Therefore, the evidence presented in Fig. 5 (1) complements the placebo treatment analyses in Section 4.3.2, and (2) further reinforces the conclusion that confounding trends with heterogeneous effects between longer-lived and shorter-lived industries do not appear to explain significant variation in overall corporate risk preferences.

INSERT FIG. 5 ABOUT HERE

4.4 Robustness Tests

I present an extensive series of internal and external validity checks in the Online Appendix. I briefly describe those tests here. Appendix D discusses recent advances in the DD econometrics literature and shows that the the results are robust to DD estimators that account for the negative weights bias in generalized two-way FE DD frameworks. To that extend, I implement three estimators: the de Chaisemartin and D'Haultfœuille (2020), Callaway and Sant'Anna (2021), and Sun and Abraham (2021) estimators. Appendix E then further stresses the internal validity of the identification strategy. More specifically, I address outlier concerns, perform the main analyses using granular quarterly data, implement matching estimators to account for functional form misspecification bias, employ alternative measures of risk-taking, and further stress the parallel trends assumption. In Appendix F, I consider several contemporaneous policies that confound bonus depreciation via their impact on either the bonus depreciation rate (i.e., Section 179) or the federal corporate tax rate (i.e., ETI and DPAD). In the same appendix, I also assess the importance of corporate taxable losses for my identification strategy. Furthermore, empirical tests in Appendix G indicate that the association between risk-taking and bonus depreciation is not mechanical due to industry-level income trends that contaminate the numerator of profitability measures ROA_{itq} and $RNOA_{itq}$. Finally, I investigate the link between bonus depreciation and various corporate outcomes already examined in the relevant literature, such as capital investments (e.g., Zwick and Mahon, 2017), financial structure (Ohrn, 2018), or accounting profitability (Edgerton, 2010) in Appendix H.

5 Underlying Economic Mechanism

What is the economic mechanism underlying the estimated association between risk-taking and bonus depreciation? Theory predicts that tax depreciation schedules distort investment decisions because the effective tax burden varies with accounting instead of economic profits. Hence, capital downside risk — fluctuations in the difference between accounting and economic profits — is not shared efficiently between the firm and the government (Bulow and Summers, 1984; McKenzie and Mintz, 1992). Bulow and Summers (1984) argue that the tax code should offer ex ante tax depreciation at rates faster than ex post economic depreciation. Provided that it does so, risk-sharing increases because (1) the difference between the *actual* tax burden (based on accounting profits) and the *expected* tax burden (based on economic income) is minimized, and consequently (2) tax liability varies with fluctuations in income net of depreciation. Thus, I predict that firms respond to bonus depreciation by investing in assets with higher capital risk.

I employ two measures of capital risk. First, I measure the volatility of future changes in the replacement cost of capital, $RVC\ Uncertainty_{it}$, which captures variation in the price of capital goods (McKenzie, 1994; Eberly et al., 2012). Then, I estimate the unlevered equity beta from a daily Fama-French three-factor model augmented with the momentum factor (Carhart, 1997), $Unlevered\ Beta_{it}$, which reflects the risk premium due to expected variation in the price of capital goods (Bulow and Summers, 1984; McKenzie and Mintz, 1992; McKenzie, 1994).

Table 5 reports results from tests on the proposed economic mechanism. In the first panel, I report results based on $RVC\ Uncertainty_{it}$. Irrespective of the specification choice, the continuous DD estimate, β_1, is positive, and statistically significant at conventional levels (t-stat ≥ 2.30). The progressive addition of the vector of covariates, X_{it}, and the vector of fixed effects, Ψ_{it}, does not affect the magnitude of the DD estimates, which are narrowly specified between 18.03% – 18.42%. These estimates imply an increase in capital risk subsequent to bonus depreciation incentives that ranges between 13.70% ($= 0.76 \times 18.03\%$) and 13.99% ($= 0.76 \times 18.42\%$). Similarly, the second panel reports results on $Unlevered\ Beta_{it}$. Again, the DD estimate, β_1, is specified in a narrow range between 15.93 – 19.53 after controlling for confounding factors and fixed effects. In economic terms, each 1 percentage point increase in the PV of tax shields from new capital investment due to bonus depreciation incentives increases equity beta, $Unlevered\ Beta_{it}$, by 0.16 – 0.20 for firms in longer-lived industries relative to firms in shorter-lived industries.

INSERT TABLE 5 ABOUT HERE

In Fig. 6, I further showcase that unobservable confounding capital risk growth trends that differentially impact firms in longer-lived vs. shorter-lived industries probably do not explain significant variation in capital risk between the two groups. Panels A and B present dynamic DD estimates, $\{\beta_{1995}, \ldots, \beta_{2012}\}$, for model specifications of Eq. (2) with $RVC\ Uncertainty_{it}$ and $Unlevered\ Beta_{it}$ as the main outcomes of interest, respectively. Visual inspection of the dynamic DD estimates suggests the following two key points. First, the treatment anticipation effect is weak and does not indicate an upward pre-treatment trend in capital risk. Second, the dynamic treatment effects are positive and, generally, statistically significant in the post-2001 period. In Panels C and D, I perform block permutation tests on the capital risk proxies using the model specification in Column (5) of Table 5. In Panel C, where $RVC\ Uncertainty_{it}$ is the outcome of interest, 17 out of 5,000 placebo β_1 estimates have a larger magnitude than 18.42%, suggesting a nonparametric p-val < 0.003. In Panel D, where $Unlevered\ Beta_{it}$ is the capital risk proxy, 1 of the 5,000 placebo effects is higher than the estimated effect of 16.21. Overall, the findings presented in Table 5 and Fig. 6 corroborate the notion that firms shift a portion of capital risk to the government due to bonus depreciation incentives.

INSERT FIG. 6 ABOUT HERE

6 Heterogeneous Response to Bonus Depreciation

In this section, I investigate heterogeneous responses to bonus depreciation. Economic theory underpins the selection of the following firm traits: financing costs, productivity, and loss offset provisions. First, firms facing financing frictions apply a higher discount rate on the expected payoffs from current as opposed to future investments (e.g., Lyandres, 2007). So, financially constrained firms postpone investment projects. Furthermore, costly external finance distorts investment decisions. Consequently, firms facing a wedge between the internal and external financing costs substitute risky for safe projects (Almeida et al., 2011). The increase in the PV of tax shields due to bonus depreciation should then be more valuable for small and financially constrained firms. I then predict that the risk-taking response to bonus depreciation should be stronger for firms facing financing frictions. I employ several markers of financial frictions to be consistent with previous studies. The first two, firm size ($Size_{it}$) and sales ($Sales_{it}$), capture financing frictions due to information asymmetries (Zwick and Mahon, 2017). The third marker, the Whited and Wu (2006) index ($F.\ Constraints_{it}$), captures financing frictions due to costly external equity.

Second, firms operating well below the productivity frontier are inclined to invest in riskier projects. The reason is that there is no limit to the upside from risky projects, whereas the downside risk is bounded at zero — firm exits the market. For instance, Imrohoroğlu and Tüzel (2014) find that low productivity firms are risky, presenting evidence supporting the claim that risk-taking should be more attractive for firms further away from the productivity frontier. Furthermore, low productivity firms face increased financing costs (e.g., Levine and Warusawitharana, 2021), and thus, a higher user cost of capital (Auerbach et al., 1983). Hence, I expect that low productivity firms are more responsive to bonus depreciation than high productivity firms. I use firm-level total factor productivity (TFP) to proxy for production efficiency. To that extent, TFP_{it}^{OP}, TFP_{it}^{LP}, and TFP_{it}^{ACF} denote TFP derived from the Olley and Pakes (1996), Levinsohn and Petrin (2003), and Ackerberg, Caves and Frazer (2015) estimation algorithms, respectively.

Third, in the presence of loss offset provisions, the risk-neutral firm finds risky investments attractive because the government shares in the income losses and profits generated from the asset (Domar and Musgrave, 1944). On the one hand, the perceived tax benefits from bonus depreciation could be stronger for firms with taxable income — firms that immediately benefit from the policy (Auerbach and Poterba, 1987; Zwick and Mahon, 2017). That is, loss offsets and bonus depreciation might act as substitutes. On the other hand, loss offset provisions increase the absorptive capacity of bonus depreciation deductions, meaning that the two tax provisions could act as complements. Therefore, I make no prediction on the sign and magnitude of the interplay between bonus depreciation and loss offset provisions, and use the following marker of tax loss carryforwards: changes in tax loss carryforwards ($DNOL_{it}$) and the tax loss carryforwards indicator (NOL_{it}).

For each firm trait, I compute the 33$^{\text{rd}}$ and 67$^{\text{th}}$ percentiles of the distribution, drop firm-years in the middle tercile, and construct an indicator that takes the value 1 if the trait lies in the top tercile of the distribution, and 0 otherwise. I then interact $BONUS_{jt}$ with the trait indicator and estimate the triple differences (DDD) specification:

$$\begin{aligned} Y_{it} = \beta_0 + \beta_1 \times BONUS_{jt} + \beta_2 \times \mathbb{1}(TRAIT) \\ + \beta_3 \times BONUS_{jt} \times \mathbb{1}(TRAIT) + X_{it} \times \Gamma + \Psi_{it} \times \gamma + \varepsilon_{it} \end{aligned} \tag{5}$$

where $\mathbb{1}(TRAIT)$ is the firm trait indicator, and all other specification definitions are described above. Coefficient β_3 reflects the heterogeneous response to bonus depreciation along the firm traits and is the main estimate of interest.

The first three rows of Table 6 report results that correspond to heterogeneous responses due to financing costs. The interaction term is negative and strongly significant in all specifications. This finding indicates that risk-taking responsiveness to bonus depreciation depends on financing frictions. The next three rows show that risk-taking responses to bonus depreciation are stronger for less productive firms. The DDD estimate is large, negative, and statistically significant. Thus, bonus depreciation encourages less productive firms to invest in riskier projects. Turning to tax loss carryforwards, the last two rows further showcase a substitution between the tax shields generated from bonus depreciation and loss offset provisions. Across columns, the DDD estimate is negative and statistically significant at conventional levels. In essence, firms with tax shield alternatives are less responsive to bonus depreciation incentives. Overall, the heterogeneous responses to bonus depreciation reported in Table 6 shed new light on the types of firms that use accelerated depreciation incentives to take more risk.

INSERT TABLE 6 ABOUT HERE

7 Conclusion

A core debate in tax research focuses on the risk-taking consequences of the corporate tax system (Domar and Musgrave, 1944; Ljungqvist et al., 2017; Bethmann et al., 2018; Langenmayr and Lester, 2018). My research question is whether changes in accelerated tax depreciation associate with shifts towards riskier investments. I exploit bonus depreciation, a base-narrowing tax policy, to address this research question. I find that bonus depreciation tax incentives are associated with more firm-level risk. Relative to firms in shorter-lived industries, firms in longer-lived industries increase risk by, on average, 15% in standard deviation units. When bonus depreciation is offered, firms in longer-lived industries invest in corporate capital assets with volatile future prices. Specifically, I find that these firms increase capital risk by, all else equal, 13.7% – 14.0%. The empirical evidence is consistent with theory predicting that rapid tax depreciation schedules mute the effective tax burden on riskier investments (Auerbach et al., 1983; Bulow and Summers, 1984). I further show that the link between risk-taking and bonus depreciation is stronger for smaller and distressed firms, less productive firms, and firms that cannot utilize tax loss carryforwards.

My identification strategy exploits exogenous variation in the PV of tax shields generated from depreciation of new capital equipment using generalized DD and DDD estimators. To address endogeneity concerns, I complement the basic framework with: an extensive number of covariates and fixed effects, dynamic treatment effects, placebo treatment effects, block permutations, and matching estimators. Considering recent advances in DD econometrics, I also control for heterogeneous treatment effects. Nevertheless, I caution the reader to the following limitations.

First, the identification strategy might not recover causal treatment effects even though I employ numerous internal validity checks. Second, the estimates represent average responses to the tax policy only to the extent that the selected variables capture the underlying economic constructs. Third, I cannot implement industry fixed effects because the identifying variable varies at the industry level. Thus, the estimates are open for explanations by unobservable industry trends that are contemporaneous to bonus depreciation. Last but not least, this study does not investigate heterogeneous responses to the tax incentive among industry peers. By the same token, the methodology cannot identify reallocation of risk across firms.

Despite these limitations, my empirical evidence might be informative for academics and policymakers. The study contributes to empirical taxation research by showcasing that accelerated tax depreciation shapes risk attitudes. This finding should also be relevant for policymakers because risk-taking is important for economic development. Overall, my results indicate that making bonus depreciation permanent could shield corporations from inflation effects, might encourage investment in riskier projects, and potentially promote corporate economic growth.

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Figures and Tables

(A) Actual ROA volatility

(B) Simulated ROA volatility

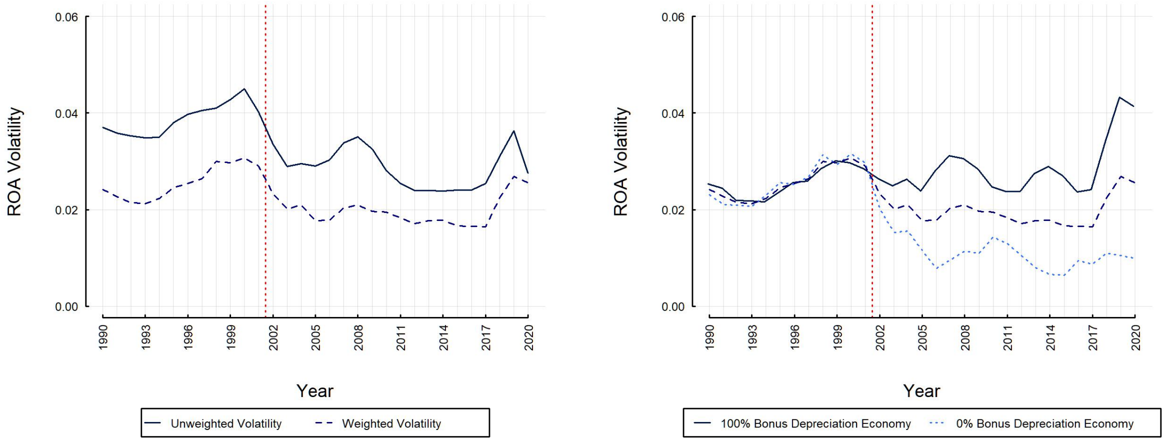


Fig. 1. The evolution of ROA volatility over time.
This figure plots actual and simulated volatilities of ROA for U.S. listed firms in Compustat North America database over the period 1990 – 2020. In Panel A, I plot the annual un-weighted/weighted median ROA volatility across Compustat establishments. I use net sales based on year 2001 real dollars for the weighting. In Panel B, I plot the simulated evolution of ROA volatility for two different states of the U.S. economy: with pure bonus depreciation incentives (100% Bonus Depreciation Economy) and without bonus depreciation incentives (0% Bonus Depreciation Economy). I construct the two states of the U.S. economy as follows. I estimate Eq. (2) and extract the $\{\beta_{1990}, ..., \beta_{2020}\}$ estimates. Next, these β estimates are combined with trends in median weighted ROA volatility in a two-step approach. First, each β estimate is adjusted against $[\sum_{t=1990}^{2000} \beta_t]/11$. Second, 0.5 times the β estimates is added to the annual trends in median weighted ROA volatility to construct the 100% Bonus Depreciation Economy, and 0.5 the annual β estimates is subtracted to construct the 0% Bonus Depreciation Economy. The dashed blue trend is the actual annual weighted median ROA volatility from Panel A. The vertical dashed line indicates year 2001, i.e., first enactment of bonus depreciation. Variable definitions are available in Appendix C.

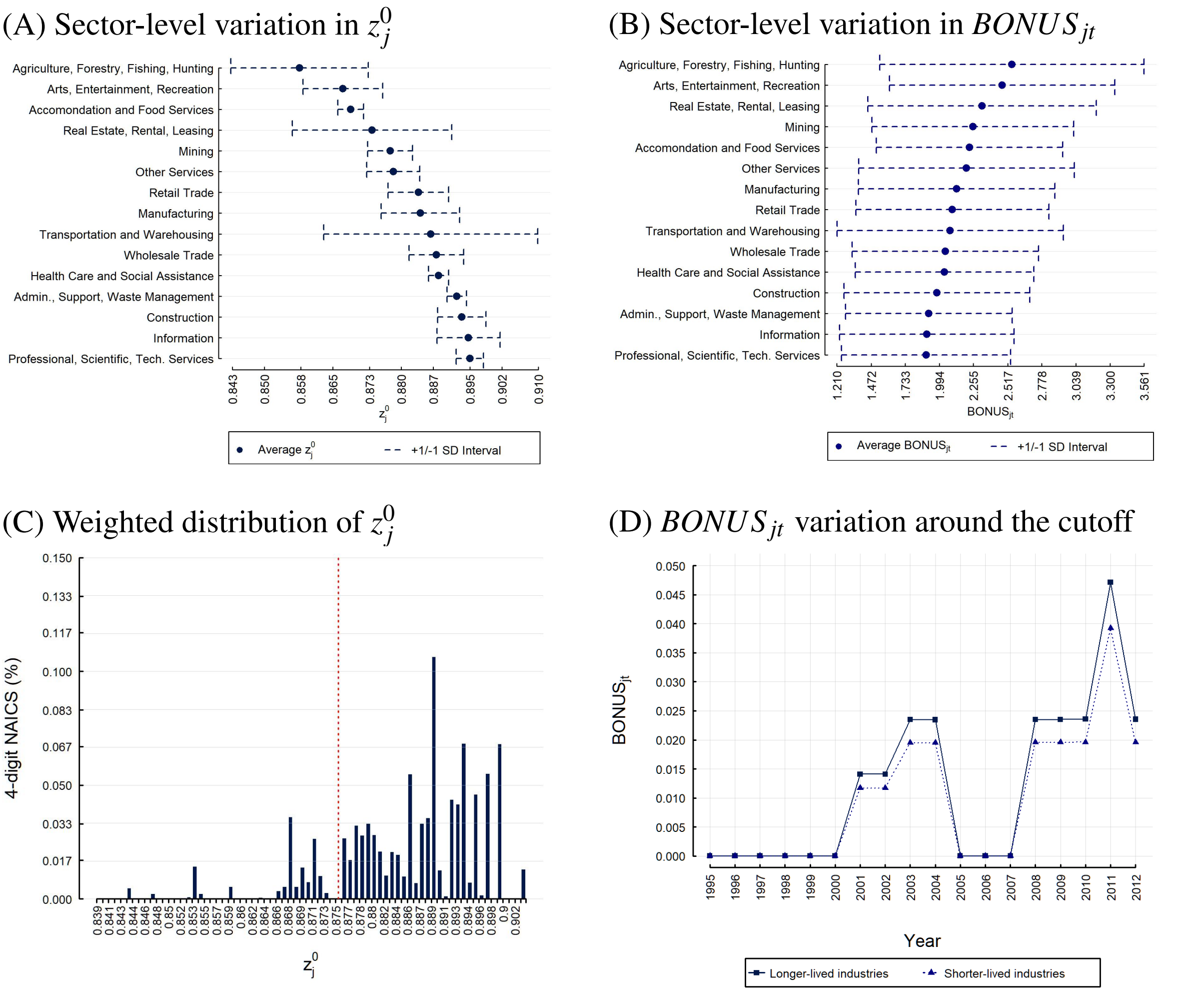


Fig. 2. Bonus depreciation incentives variation.
This figure plots variation in bonus depreciation tax incentives. Panel A plots the average PV of depreciation deductions for each \$1 of new capital investments (z_j^0) across units in NAICS sectors. Panel B plots the average PV increase in tax shields due to bonus depreciation for each \$1 of new capital investments ($BONUS_{jt}$) across units in NAICS sectors. Panel C presents the weighted distribution of z_j^0 using the 4-digit NAICS industries as weights. Panel D plots time-series variation in $BONUS_{jt}$ around the 0.875 structural break. Variable definitions are available in Appendix C.

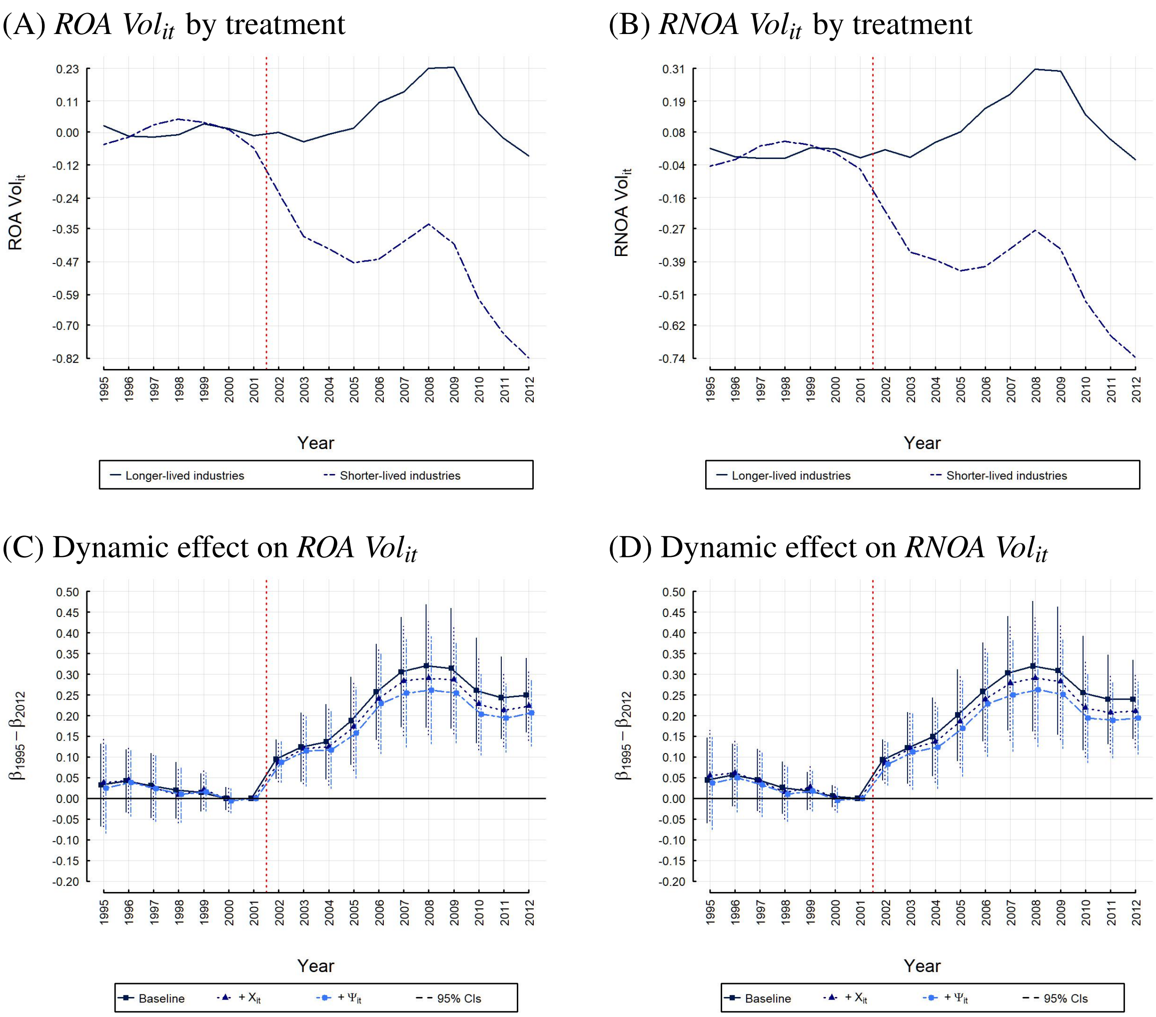


Fig. 3. Dynamic effect of bonus depreciation on corporate risk-taking.
This figure presents visual evidence of the parallel trends assumption. In Panels A and B, I plot the annual mean risk-taking outcomes time series for sample firms in longer-lived and shorter-lived industries. All time series are normalized to have an average value of 0 during 1995 – 2001, and de-trended to remove differential pre-2001 trends in risk-taking outcomes. In Panels C and D, I plot event study DD coefficients $\{\beta_{1995}, ..., \beta_{2012}\}$, using Eq. (2). I scale the coefficients to represent an interquartile increase in $\overline{\theta} \times (1 - z_j^0) \times \tau_f$. I normalize coefficient β_{2001} to 0. The baseline specification reports $\{\beta_{1995}, ..., \beta_{2012}\}$ estimates from estimation of Eq. (2) with firm and year fixed effects, but no covariates. The specification with controls reports $\{\beta_{1995}, ..., \beta_{2012}\}$ estimates from estimation of Eq. (2) with the vector of covariates, X_{it}, and firm and year fixed effects. The specification with additional fixed effects reports $\{\beta_{1995}, ..., \beta_{2012}\}$ estimates from estimation of Eq. (2) with the vector of covariates, X_{it}, and the full vector of fixed effects, Ψ_{it}. The vertical bands represent two-tailed 95% confidence intervals based on standard errors clustered at the 4-digit NAICS industry level. The vertical dashed lines indicate year 2001, i.e., initial implementation of bonus depreciation incentives. In Panels A and C, *ROA Vol*$_{it}$ is the dependent variable. In Panels B and D, *RNOA Vol*$_{it}$ is the dependent variable. Variable definitions are available in Appendix C.

(A) Dynamic placebo effect on *ROA* Vol_{it} (B) Dynamic placebo effect on *RNOA* Vol_{it}

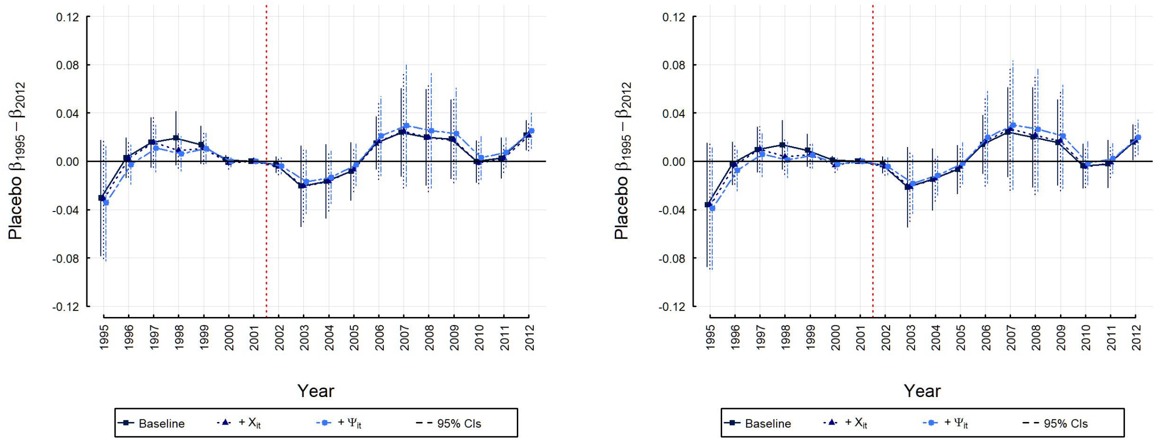


Fig. 4. Dynamic effect of placebo bonus depreciation on corporate risk-taking.
This figure presents placebo event study DD coefficients $\{\beta_{1995}, ..., \beta_{2012}\}$, using a modified Eq. (2) to account for the placebo NAICS industries. I scale the coefficients to represent an interquartile increase in $\overline{\theta} \times (1 - z_j^0) \times \tau_f \times \mathbb{1}(Placebo\ NAICS)$. I normalize coefficient β_{2001} to 0. The baseline specification reports placebo $\{\beta_{1995}, ..., \beta_{2012}\}$ estimates from estimation of Eq. (2) with firm and year fixed effects, but no covariates. The specification with controls reports placebo $\{\beta_{1995}, ..., \beta_{2012}\}$ estimates from estimation of Eq. (2) with the vector of covariates, X_{it}, and firm and year fixed effects. The specification with additional fixed effects reports placebo $\{\beta_{1995}, ..., \beta_{2012}\}$ estimates from estimation of Eq. (2) with the vector of covariates, X_{it}, and the full vector of fixed effects, Ψ_{it}. The vertical bands represent two-tailed 95% confidence intervals based on standard errors clustered at the 4-digit NAICS industry level. The vertical dashed lines indicate year 2001, i.e., initial implementation of bonus depreciation incentives. In Panel A, *ROA* Vol_{it} is the dependent variable. In Panel B, *RNOA* Vol_{it} is the dependent variable. Variable definitions are available in Appendix C.

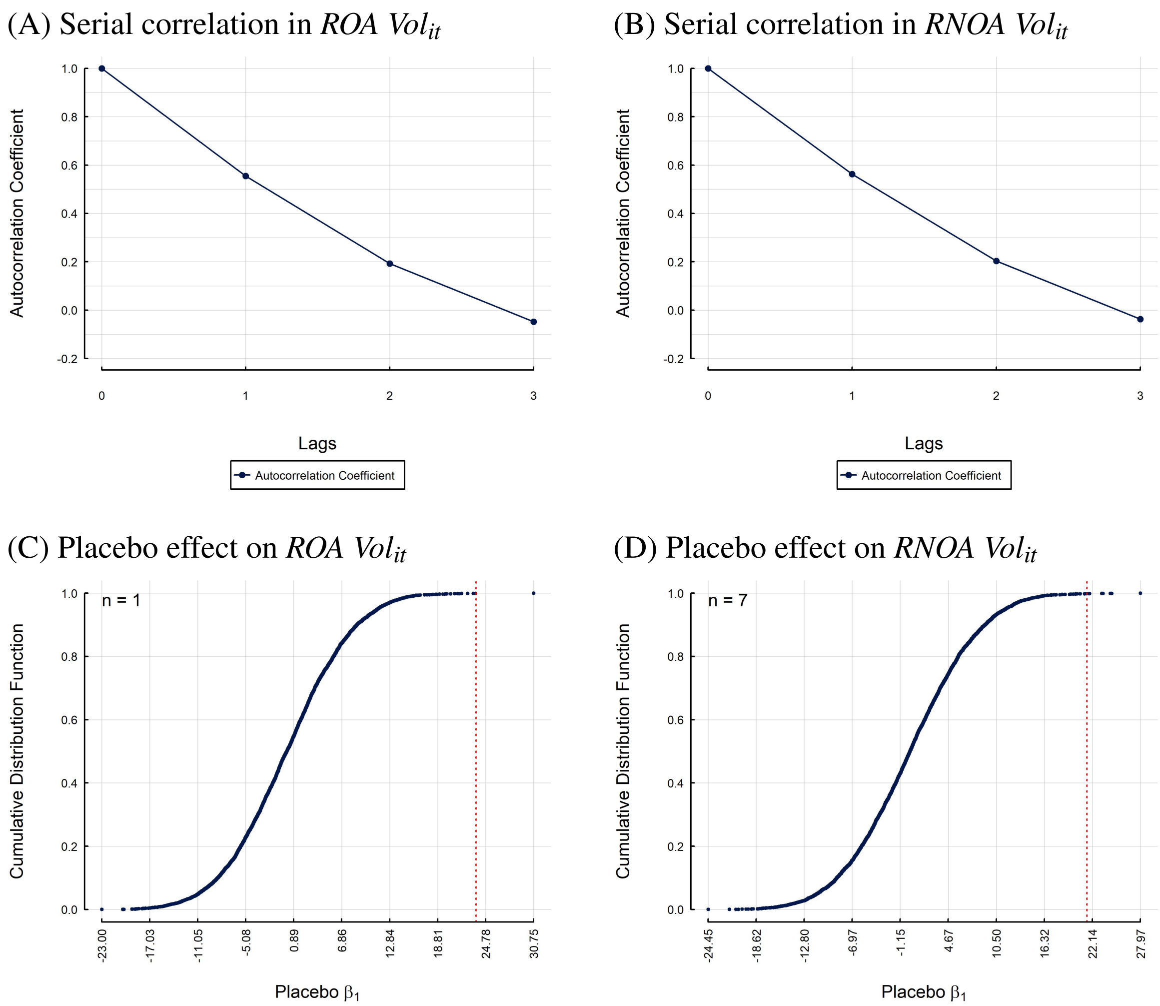


Fig. 5. Addressing serial correlation in the dependent variable.
Panels A and B present autocorrelation coefficients for residuals extracted from OLS regressions of *ROA Vol*$_{it}$ and *RNOA Vol*$_{it}$ on firm and year fixed effects, respectively. Panels C and D present the empirical CDF of placebo effects of bonus depreciation on *ROA Vol*$_{it}$ and *RNOA Vol*$_{it}$, respectively. To obtain the placebo effects, I perform block permutation tests in the spirit of Ohrn (2018). I first randomly assign to each industry j, without replacement, the z_j^0 value of another industry. Next, I recalculate $BONUS_{jt}$ using the randomly assigned placebo z_j^0 values. I then estimate Eq. (1) and extract the DD estimator, β_1. I implement this procedure 5,000 times. Finally, I create the empirical CDF of the 5,000 extracted estimates. The vertical lines indicate the DD estimate corresponding to the specifications in Columns (5) and (10) of Table 2. Variable definitions are available in Appendix C.

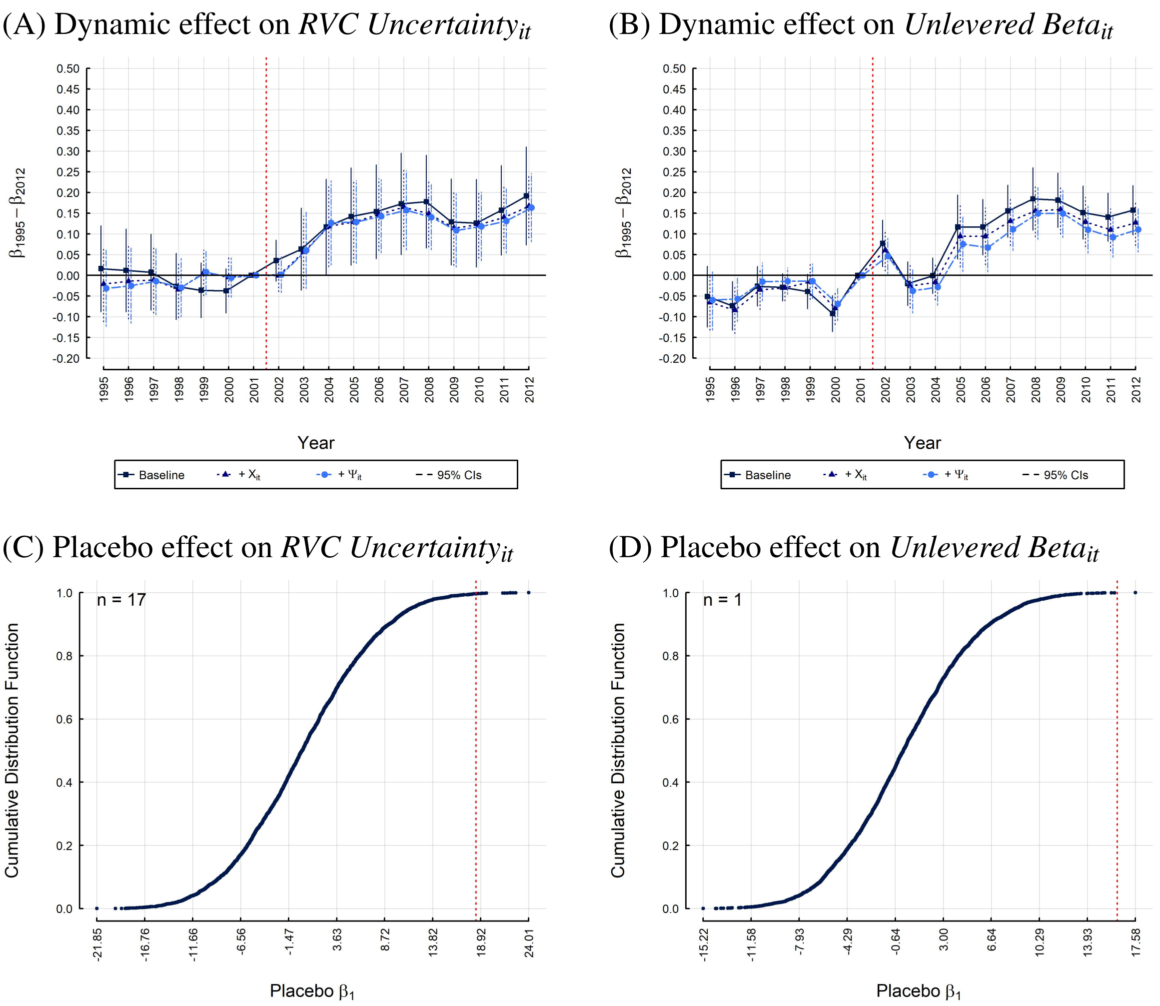


Fig. 6. Addressing unobservable confounding capital risk growth trends.
Panels A and B present event study DD coefficients $\{\beta_{1995}, ..., \beta_{2012}\}$, using Eq. (2), on *RVC Uncertainty*$_{it}$ and *Unlevered Beta*$_{it}$, respectively. I scale the coefficients to represent an interquartile increase in $\overline{\theta} \times (1 - z_j^0) \times \tau_f$. I normalize coefficient β_{2001} to 0. The baseline specification reports $\{\beta_{1995}, ..., \beta_{2012}\}$ estimates from estimation of Eq. (2) with firm and year fixed effects, but no covariates. The specification with controls reports $\{\beta_{1995}, ..., \beta_{2012}\}$ estimates from estimation of Eq. (2) with the vector of covariates, X_{it}, and firm and year fixed effects. The specification with additional fixed effects reports $\{\beta_{1995}, ..., \beta_{2012}\}$ estimates from estimation of Eq. (2) with the vector of covariates, X_{it}, and the full vector of fixed effects, Ψ_{it}. The vertical bands represent two-tailed 95% confidence intervals based on standard errors clustered at the 4-digit NAICS industry level. The vertical dashed lines indicate year 2001, i.e., initial implementation of bonus depreciation incentives. Panels C and D present the empirical CDF of placebo effects of bonus depreciation on *RVC Uncertainty*$_{it}$ and *Unlevered Beta*$_{it}$, respectively. The block permutation test procedure is identical to the one described in Section 4.3.4 and Fig. 5. The vertical lines indicate the DD estimate corresponding to the specification in Column (5) of Table 5. Variable definitions are available in Appendix C.

Table 1
Descriptive statistics.

	N	Mean	S.D.	P1	P25	Median	P75	P99
Risk-Taking								
$ROA\ Vol_{it}$ (%)	34,817	4.55	5.54	0.30	1.50	2.82	5.48	79.59
$RNOA\ Vol_{it}$ (%)	34,817	6.79	8.64	0.38	2.19	4.06	7.91	89.28
$PROA\ Vol_{it}$ (%)	34,817	3.76	4.05	0.29	1.45	2.56	4.58	62.33
$CROA\ Vol_{it}$ (%)	34,817	12.00	11.21	1.05	5.11	8.83	15.00	155.80
$Unlev.\ Stock\ Vol_{it}$	34,779	0.39	0.22	0.02	0.24	0.35	0.51	1.56
$RVC\ Uncertainty_{it}$	34,780	69.88	166.26	0.04	2.59	11.41	49.33	1,447.35
$Unlevered\ Beta_{it}$	32,265	0.78	0.52	-0.87	0.43	0.76	1.08	3.10
Tax Policy								
θ_t (%)	19,719	37.40	27.90	0.00	0.00	50.00	50.00	100.00
z_j^0	34,817	0.89	0.01	0.84	0.88	0.89	0.89	0.90
$BONUS_{jt}$ (%)	16,342	1.97	0.76	1.05	1.38	1.93	2.12	4.47
$BONUS_{jt}$ (30%)	4,407	1.20	0.11	1.04	1.11	1.18	1.27	1.54
$BONUS_{jt}$ (50%)	10,460	2.00	0.18	1.69	1.86	1.97	2.12	2.56
$BONUS_{jt}$ (100%)	1,475	4.02	0.37	3.39	3.74	3.95	4.25	5.13
$DPAD_{jkt}$ (%)	34,759	0.57	1.10	0.00	0.00	0.00	0.50	3.15
ETI_{jt} (%)	34,604	0.16	0.41	0.00	0.00	0.00	0.00	1.56
Covariates								
$Size_{it}$	34,817	5.82	1.96	0.35	4.43	5.79	7.17	11.00
ROA_{it}	34,817	0.08	0.17	-4.90	0.03	0.09	0.15	0.70
$Marg.\ Q_{it}$	34,817	1.92	1.56	0.41	1.10	1.47	2.16	33.70
$Sales\ Growth_{it}$	34,817	0.11	0.42	-0.79	-0.04	0.06	0.18	11.86
$Leverage_{it}$	34,817	0.21	0.21	0.00	0.02	0.17	0.32	1.36
$F.\ Constraints_{it}$	34,817	0.28	0.11	-0.11	0.20	0.27	0.35	0.56
$Marg.\ TR_{it}$	34,817	0.27	0.10	0.00	0.21	0.32	0.34	0.37
$Tax\ Risk_{it}$	34,817	-4.66	0.96	-6.94	-5.34	-4.73	-4.04	-1.82
NOL_{it}	34,817	0.39	0.49	0.00	0.00	0.00	1.00	1.00
$DNOL_{it}$	34,817	0.02	0.22	-1.10	0.00	0.00	0.00	7.04

Notes: This table reports summary statistics for risk-taking, tax policy, and control variables. The sample period spans from 1995 to 2012. Variable definitions are available in Appendix C.

Table 2
The effect of bonus depreciation on corporate risk-taking.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
			$ROA\ Vol_{it}$					$RNOA\ Vol_{it}$		
$BONUS_{jt}$	29.69***	25.11***	24.72***	23.05***	23.59***	27.18***	22.38***	21.89***	20.99***	21.49***
	[7.49]	[6.37]	[6.53]	[6.46]	[6.30]	[7.59]	[6.35]	[6.45]	[6.48]	[6.32]
$Size_{it}$		-0.14***	-0.13***	-0.11***	-0.12***		-0.16***	-0.16***	-0.15***	-0.15***
		[0.02]	[0.02]	[0.02]	[0.02]		[0.02]	[0.02]	[0.02]	[0.02]
ROA_{it}		-0.42***	-0.42***	-0.39***	-0.37***		-0.31***	-0.31***	-0.29***	-0.27***
		[0.06]	[0.06]	[0.06]	[0.06]		[0.06]	[0.06]	[0.06]	[0.06]
$Marg.\ Q_{it}$		0.05***	0.05***	0.05***	0.05***		0.06***	0.06***	0.05***	0.06***
		[0.01]	[0.01]	[0.01]	[0.01]		[0.01]	[0.01]	[0.01]	[0.01]
$Sales\ Growth_{it}$		0.09***	0.09***	0.07***	0.07***		0.09***	0.09***	0.08***	0.08***
		[0.01]	[0.01]	[0.01]	[0.01]		[0.01]	[0.01]	[0.01]	[0.01]
$Leverage_{it}$		0.02	0.01	0.01	0.01		-0.02	-0.03	-0.03	-0.03
		[0.05]	[0.05]	[0.05]	[0.05]		[0.06]	[0.06]	[0.06]	[0.06]
$F.\ Constraints_{it}$		-0.06	-0.09	-0.07	-0.11		-0.38*	-0.42*	-0.41*	-0.44**
		[0.22]	[0.22]	[0.21]	[0.21]		[0.22]	[0.22]	[0.21]	[0.21]
$Marg.\ TR_{it}$		-0.21**	-0.22***	-0.29***	-0.28***		-0.46***	-0.47***	-0.52***	-0.52***
		[0.09]	[0.08]	[0.08]	[0.08]		[0.10]	[0.10]	[0.10]	[0.10]
$Tax\ Risk_{it}$		0.07***	0.07***	0.08***	0.07***		0.08***	0.08***	0.08***	0.08***
		[0.01]	[0.01]	[0.01]	[0.01]		[0.01]	[0.01]	[0.01]	[0.01]
NOL_{it}		-0.02	-0.03*	-0.03*	-0.03**		-0.01	-0.02	-0.02	-0.02
		[0.01]	[0.01]	[0.01]	[0.01]		[0.02]	[0.02]	[0.02]	[0.02]
$DNOL_{it}$		0.07***	0.07***	0.07***	0.07***		0.08***	0.08***	0.08***	0.08***
		[0.01]	[0.01]	[0.01]	[0.01]		[0.02]	[0.02]	[0.02]	[0.02]
Firm-Yrs	34,817	34,817	34,817	34,817	34,817	34,817	34,817	34,817	34,817	34,817
$Adj.\ R^2$	68.69%	70.62%	70.72%	70.98%	71.05%	66.66%	69.27%	69.38%	69.53%	69.57%
Yr FE	X	X				X	X			
Firm FE	X	X	X	X	X	X	X	X	X	X
Size–Yr FE			X	X	X			X	X	X
Sales Growth–Yr FE				X	X				X	X
Marg. TR–Yr FE					X					X
Cluster			4-digit NAICS					4-digit NAICS		

Notes: This table reports estimates of the effect of bonus depreciation on corporate risk-taking using OLS regressions. In Columns (1) – (5), $ROA\ Vol_{it}$ is the dependent variable. In Columns (6) – (10), $RNOA\ Vol_{it}$ is the dependent variable. The sample period spans from 1995 to 2012. In Columns (1) and (6), I regress the dependent variable on the tax policy variable, $BONUS_{jt}$, plus firm and year fixed effects. In Columns (2) and (7), I include the vector of covariates, X_{it}. In Columns (3) and (8), I replace year fixed effects with terciles of average firm size ($Size_{it}$) during 1995 – 2001 interacted with year fixed effects. In Columns (4) and (9), I further include terciles of average growth ($Sales\ Growth_{it}$) during 1995 – 2001 interacted with year fixed effects. In Columns (5) and (10), I further include terciles of average MTR ($Marg.\ TR_{it}$) during 1995 – 2001 interacted with year fixed effects. Standard errors clustered at the industry level (4-digit NAICS) are reported in brackets. Variable definitions are available in Appendix C. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 3
The effect of placebo bonus depreciation on corporate risk-taking.

	(1)	(2)	(3)	(4)	(5)
Panel A:			$ROA\ Vol_{it}$		
$\theta_t \times \tau_f \times \mathbb{1}(Placebo\ NAICS)$	-0.30	-0.26	-0.27	-0.18	-0.12
	[0.25]	[0.21]	[0.21]	[0.19]	[0.19]
$Adj.\ R^2$	69.45%	71.44%	71.52%	71.72%	71.79%
Panel B:			$RNOA\ Vol_{it}$		
$\theta_t \times \tau_f \times \mathbb{1}(Placebo\ NAICS)$	-0.28	-0.21	-0.23	-0.16	-0.09
	[0.25]	[0.19]	[0.19]	[0.17]	[0.18]
$Adj.\ R^2$	67.26%	69.95%	70.03%	70.15%	70.19%
Firm-Yrs	31,105	31,105	31,105	31,105	31,105
Yr FE	X	X			
Firm FE	X	X	X	X	X
Controls		X	X	X	X
Size–Yr FE			X	X	X
Sales Growth–Yr FE				X	X
Marg. TR–Yr FE					X
Cluster			4-digit NAICS		

Notes: This table reports estimates of the effect of placebo bonus depreciation on corporate risk-taking using OLS regressions. In Panel A, $ROA\ Vol_{it}$ is the dependent variable. In Panel B, $RNOA\ Vol_{it}$ is the dependent variable. The sample period spans from 1995 to 2012. In Column (1), I regress the dependent variable on the placebo tax policy variable, $\theta_t \times \tau_f \times \mathbb{1}(Placebo\ NAICS)$, plus firm and year fixed effects. In Column (2), I include the vector of covariates, X_{it}. In Column (3), I replace year fixed effects with terciles of average firm size ($Size_{it}$) during 1995 – 2001 interacted with year fixed effects. In Column (4), I further include terciles of average growth ($Sales\ Growth_{it}$) during 1995 – 2001 interacted with year fixed effects. In Column (5), I further include terciles of average MTR ($Marg.\ TR_{it}$) during 1995 – 2001 interacted with year fixed effects. The coefficient vector of the covariates, Γ, is not displayed for brevity. Standard errors clustered at the industry level (4-digit NAICS) are reported in brackets. Variable definitions are available in Appendix C. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 4
The effect of bonus depreciation on corporate risk-taking: binary treatment.

	(1)	(2)	(3)	(4)	(5)
Panel A:			*ROA* Vol_{it}		
$\mathbb{1}(z_j^0 \leq 0.875) \times \mathbb{1}(t > 2001)$	0.26***	0.23***	0.22***	0.20***	0.21***
	[0.07]	[0.07]	[0.07]	[0.06]	[0.06]
Adj. R^2	68.78%	70.69%	70.78%	71.04%	71.11%
Panel B:			*RNOA* Vol_{it}		
$\mathbb{1}(z_j^0 \leq 0.875) \times \mathbb{1}(t > 2001)$	0.25***	0.21***	0.20***	0.19***	0.19***
	[0.07]	[0.07]	[0.07]	[0.07]	[0.06]
Adj. R^2	66.75%	69.33%	69.43%	69.58%	69.62%
Firm-Yrs	34,817	34,817	34,817	34,817	34,817
Yr FE	X	X			
Firm FE	X	X	X	X	X
Controls		X	X	X	X
Size–Yr FE			X	X	X
Sales Growth–Yr FE				X	X
Marg. TR–Yr FE					X
Cluster			4-digit NAICS		

Notes: This table reports estimates of the effect of bonus depreciation on corporate risk-taking using binary DD OLS regressions. In Panel A, *ROA* Vol_{it} is the dependent variable. In Panel B, *RNOA* Vol_{it} is the dependent variable. The sample period spans from 1995 to 2012. In Column (1), I regress the dependent variable on the binary DD estimator, $\mathbb{1}(z_j^0 \leq 0.875) \times \mathbb{1}(t > 2001)$, plus firm and year fixed effects. In Column (2), I include the vector of covariates, X_{it}. In Column (3), I replace year fixed effects with terciles of average firm size ($Size_{it}$) during 1995 – 2001 interacted with year fixed effects. In Column (4), I further include terciles of average growth (*Sales* $Growth_{it}$) during 1995 – 2001 interacted with year fixed effects. In Column (5), I further include terciles of average MTR (*Marg.* TR_{it}) during 1995 – 2001 interacted with year fixed effects. The coefficient vector of the covariates, Γ, is not displayed for brevity. Standard errors clustered at the industry level (4-digit NAICS) are reported in brackets. Variable definitions are available in Appendix C. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 5
The effect of bonus depreciation on capital risk.

	(1)	(2)	(3)	(4)	(5)
Panel A:			*RVC Uncertainty$_{it}$*		
BONUS$_{jt}$	21.76**	18.03***	18.28***	18.42**	18.42**
	[9.46]	[6.66]	[6.88]	[7.24]	[7.28]
Adj. R^2	92.36%	94.73%	94.75%	94.75%	94.75%
Firm-Yrs	34,780	34,780	34,780	34,780	34,780
Panel B:			*Unlevered Beta$_{it}$*		
BONUS$_{jt}$	24.09***	19.53***	17.60***	15.93***	16.21***
	[4.74]	[3.61]	[3.59]	[3.71]	[3.83]
Adj. R^2	39.22%	43.75%	44.81%	45.38%	45.65%
Firm-Yrs	32,265	32,265	32,265	32,265	32,265
Yr FE	X	X			
Firm FE	X	X	X	X	X
Controls		X	X	X	X
Size–Yr FE			X	X	X
Sales Growth–Yr FE				X	X
Marg. TR–Yr FE					X
Cluster			4-digit NAICS		

Notes: This table reports estimates of the effect of bonus depreciation on capital risk using OLS regressions. In Panel A, *RVC Uncertainty$_{it}$* is the dependent variable. In Panel B, *Unlevered Beta$_{it}$* is the dependent variable. The sample period spans from 1995 to 2012. In Column (1), I regress the dependent variable on the tax policy variable, *BONUS$_{jt}$*, plus firm and year fixed effects. In Column (2), I include the vector of covariates, X_{it}. In Column (3), I replace year fixed effects with terciles of average firm size (*Size$_{it}$*) during 1995 – 2001 interacted with year fixed effects. In Column (4), I further include terciles of average growth (*Sales Growth$_{it}$*) during 1995 – 2001 interacted with year fixed effects. In Column (5), I further include terciles of average MTR (*Marg. TR$_{it}$*) during 1995 – 2001 interacted with year fixed effects. The coefficient vector of the covariates, Γ, is not displayed for brevity. Standard errors clustered at the industry level (4-digit NAICS) are reported in brackets. Variable definitions are available in Appendix C. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 6
Heterogeneous response to bonus depreciation.

	(1)	(2)	(3)	(4)	(5)	(6)
		$ROA\ Vol_{it}$			$RNOA\ Vol_{it}$	
Financing costs:						
$BONUS_{jt} \times \mathbb{1}(Size_{it})$	-5.33***	-5.03***	-5.22***	-5.87***	-5.51***	-5.77***
	[1.84]	[1.93]	[1.90]	[2.03]	[2.07]	[2.02]
$BONUS_{jt} \times \mathbb{1}(Sales_{it})$	-5.69***	-5.83***	-6.49***	-6.30***	-6.35***	-7.19***
	[2.05]	[1.97]	[2.02]	[2.21]	[2.15]	[2.22]
$BONUS_{jt} \times \mathbb{1}(F.\ Constraints_{it})$	-4.50**	-4.84***	-5.44***	-5.05***	-5.15***	-5.66***
	[1.73]	[1.73]	[1.85]	[1.74]	[1.74]	[1.88]
Productivity:						
$BONUS_{jt} \times \mathbb{1}(TFP^{OP}_{it})$	-3.39***	-3.01***	-3.84***	-3.81***	-3.45***	-4.15***
	[1.29]	[1.11]	[1.16]	[1.36]	[1.17]	[1.22]
$BONUS_{jt} \times \mathbb{1}(TFP^{LP}_{it})$	-4.14***	-3.59***	-4.08***	-4.43***	-4.07***	-4.52***
	[1.51]	[1.34]	[1.34]	[1.52]	[1.35]	[1.34]
$BONUS_{jt} \times \mathbb{1}(TFP^{ACF}_{it})$	-3.86***	-3.26***	-3.79***	-4.17***	-3.73***	-4.27***
	[1.37]	[1.19]	[1.18]	[1.36]	[1.19]	[1.16]
Loss offset provisions:						
$BONUS_{jt} \times \mathbb{1}(DNOL_{it})$	-2.05***	-1.87***	-1.72**	-2.35***	-2.22***	-2.11***
	[0.67]	[0.67]	[0.67]	[0.72]	[0.73]	[0.71]
$BONUS_{jt} \times NOL_{it}$	-1.70**	-1.53**	-1.37*	-1.64**	-1.52**	-1.38*
	[0.70]	[0.70]	[0.70]	[0.75]	[0.77]	[0.75]
Controls	X	X	X	X	X	X
Firm FE	X	X	X	X	X	X
Size–Yr FE	X	X	X	X	X	X
Sales Growth–Yr FE		X	X		X	X
Marg. TR–Yr FE			X			X
Cluster			4-digit NAICS			

Notes: This table reports estimates of the heterogeneous effect of bonus depreciation on corporate risk-taking using OLS regressions. Each row presents the interaction coefficient, $BONUS_{jt} \times \mathbb{1}(TRAIT)$, from Eq. (5). $\mathbb{1}(TRAIT)$ varies across rows, and row headings indicate the trait used in each separate regression. The construction of the variable is consistent throughout. Consider $\mathbb{1}(Size_{it})$ as an example of the variable construction process. $\mathbb{1}(Size_{it})$ takes the value 1 (0) if the firm is in the top (bottom) tercile of $Size_{it}$ distribution. In Columns (1) – (3), $ROA\ Vol_{it}$ is the dependent variable. In Columns (4) – (6), $RNOA\ Vol_{it}$ is the dependent variable. The sample period spans from 1995 to 2012. Specifications in Columns (1) – (3) and Columns (4) – (6) progressively incorporate the vector of fixed effects, Ψ_{it}. The coefficients on $BONUS_{jt}$, $\mathbb{1}(TRAIT)$, and vector of the covariates, Γ, are not displayed for brevity. Standard errors clustered at the industry level (4-digit NAICS) are reported in brackets. Variable definitions are available in Appendix C. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Online Appendices (Not For Publication)

The Online Appendix provides supplemental information to reinforce the theoretical and empirical arguments developed in the main body of the study. This information is briefly mentioned in the main body of the study. Below is the list of contents.

- Appendix A illustrates the impact of bonus depreciation on the i) PV of depreciation deductions, ii) PV of tax shields, and ii) PV cost of $1 of qualifying capital investment.
- Appendix B models the effect of bonus depreciation on the marginal tax rates faced by safe and risky assets.
- Appendix C provides a detailed explanation of all variables used in the study.
- Appendix D addresses potential biases in generalized two-way fixed effects DD models due to treatment effect heterogeneity.
- Appendix E presents robustness tests that assess the internal validity of empirical identification strategy.
- Appendix F shows that the risk-taking effect of bonus depreciation is orthogonal to Section 179, corporate taxable losses, and two contemporaneous tax policies.
- Appendix G shows that aggregate income trends do not appear to explain the estimated effect of the tax incentive on risk-taking.
- Appendix H reports robustness tests that assess the external validity of the empirical identification strategy.

Appendix A – MACRS and Bonus Depreciation Schedules

Table A.1 illustrates the effect of tax depreciation on the present value cost of new capital investments. I assume that firm X, which operates in economy Y, has to invest in an $10,000 depreciable asset. Economy Y offers a federal statutory tax rate (τ_f) equal to 35% (i.e., the corporate tax rate offered during the sample period), and a bonus depreciation rate (θ_t) equal to 50%. Firm X uses a 7% rate (ρ_δ) to discount the future stream of depreciation deductions. The useful life of the depreciable asset is 3 years in Panel A and 7 years in Panel B.

I start the discussion with the numerical exercise in Panel A. In the absence of bonus depreciation, firm X depreciates $3,333 of the 3-year asset on the year of the purchase, $4,445 on the second year, and so on so forth until the asset is fully depreciated. The tax savings for each year equal the depreciation deductions times the federal corporate tax rate, and amount to $1,167 on the year of the purchase, $1,556 on the second year, $518 on the third year, and $259 on the final year. The nominal value cost of the investment is $6,500; the initial cost of $10,000 minus the nominal aggregate tax shields of $3,500. The tax shields are generated over a period of 4 years, resulting in a $3,285 present value of aggregate tax shields. Hence, the present value cost of the investment is $6,715; $10,000 minus the present value of aggregate tax shields. Finally, the present value of depreciation deductions is $9,386, implying that each $1 of depreciation deductions is worth $0.9386 for firm X.

In the presence of bonus depreciation, firm X depreciates an additional 50% of the asset's value on the year of the purchase, and the outstanding 50% is depreciated based on the MACRS schedule. The depreciation rate of the first year becomes 66.67% ($= 50\% + 50\% \times 33.33\%$), the second year depreciation rate is 22.23% ($= 50\% \times 44.45\%$), and so forth. The tax savings then amount to $2,333.3 on the purchase year, $777.9 on the second year, $259.1 on the third year, and $129.7 on the final year. The nominal investment cost is still $6,500. However, the present value of the tax shields increases by $108 or 1.08 percentage points, from $3,285 to $3,393. Hence, the present value cost of the investment decreases by $108 or 1.08 percentage points, from $6,715 to $6,607. Finally, the present value of depreciation deductions increases by 3.07 percentage points ($\approx \frac{1.08}{\tau_f}$); with bonus depreciation, each $1 of depreciation deductions is worth 3.07 cents more ($= \$0.9693 - \$0.9386$) for firm X.

I then continue with the numerical exercise in Panel B. Firm X depreciates $1,429 of the asset on the purchase year, $2,449 on the second year, $1,749 on the third year, ..., and $446 on the final year. The nominal tax savings from the depreciation deductions, again, equal $3,500, but their present value equals $2,959 due to discounting. So, the present value cost of the investment is $7,041, which is $541 higher than the nominal cost. Firm X values each $1 of depreciation deductions for the 7-year asset at $0.8455.

When economy Y offers bonus depreciation incentives, the depreciation rate on the year of the purchase increases from 14.29% to 57.145%, and the depreciation rates for the remainder of the asset's life are half of those based on MACRS depreciation; 12.245%, 8.745%, ..., 2.23%, respectively. The depreciation deduction for the first year raises to \$5,714.5, and the depreciation deductions for the next periods are half of those based on MACRS depreciation.; \$1,224.5, \$874.5, ..., \$223, respectively. Now, the present value of tax shields generated over the asset's life increase by \$271 or 2.71 percentage points, from \$2,959 to \$3,230. This traslates into a \$271 or 2.71 percentage points decrease in the present value cost of the asset, from \$7,041 to \$6,770. Similarly, the present value of depreciation deductions increases by 7.73 percentage points ($\approx \frac{2.71}{\tau_f}$). Under bonus depreciation incentives, each \$1 of new capital depreciation deductions is worth 7.73 cents (= \$0.9228 – \$0.8455) more for firm X.

A comparison between the two numerical exercises also illustrates the identification strategy in the study, which is discussed in Section 3.3. The effect of bonus depreciation on the present values of investment costs, tax shields, and depreciation deductions is larger for long-duration assets as opposed to short-duration assets. For the same \$1 investment, the present value differential due to bonus depreciation is 1.63 percentage points (= 2.71 – 1.08) between a 7-year and a 3-year asset. Hence, the firms that actually benefit from the incentive reside in industries that, typically, invest in long-duration assets (e.g., mining, crop production, food manufacturing) (House and Shapiro, 2008; Zwick and Mahon, 2017). Still, the present value benefit due to bonus depreciation might not be economically meaningful for the average U.S. public firm. In the case of a 7-year asset and a 50% bonus depreciation, the present value benefit is just 2.71% of the nominal investment cost. With immediate expensing, the present value benefit rises to 5.41%. Considering that the average bonus depreciation rate over the 2002 – 2012 period is 37.4% (see Table 1), then the economic benefit from bonus depreciation seems marginal (see Desai and Goolsbee, 2004).

INSERT TABLE A.1 ABOUT HERE

Table A.1
Numerical example of MACRS versus bonus depreciation schedules.

Panel A: 3-year asset									
Years relative to purchase (t):	0	1	2	3	4	5	6	7	Total
MACRS Depreciation									
δ_t^{MACRS} (%)	33.33	44.45	14.81	7.41	0.00	0.00	0.00	0.00	100
D_t ($)	3,333	4,445	1,481	741	0	0	0	0	10,000
z^0 ($)	**9,386**[1]								
$\tau_f \times D_t$ ($)	1,167	1,556	518	259	0	0	0	0	3,500
$z^0 * \tau_f$	**3,285**								
Bonus Depreciation (50%)									
δ_t^{BONUS} (%)	66.665	22.225	7.405	3.705	0.00	0.00	0.00	0.00	100
D_t ($)	6,666.5	2,222.5	740.5	370.5	0	0	0	0	10,000
z^{BONUS} ($)	**9,693**[2]								
$\tau_f \times D_t$ ($)	2,333.3	777.9	259.1	129.7	0	0	0	0	3,500
$z^{BONUS} * \tau_f$ ($)	**3,393**								
BONUS ($)	**108**[3]								

Panel b: 7-year asset									
Years relative to purchase (t):	0	1	2	3	4	5	6	7	Total
MACRS Depreciation									
δ_t^{MACRS} (%)	14.29	24.49	17.49	12.49	8.93	8.92	8.93	4.46	100
D_t ($)	1,429	2,449	1,749	1,249	893	892	893	446	10,000
z^0 ($)	**8,455**[4]								
$\tau_f \times D_t$ ($)	500	857	612	437	313	312	313	156	3,500
$z^0 * \tau_f$ ($)	**2,959**								
Bonus Depreciation (50%)									
δ_t^{BONUS} (%)	57.145	12.245	8.745	6.245	4.465	4.46	4.465	2.23	100
D_t ($)	5,714.5	1,224.5	874.5	624.5	446.5	446	446.5	223	10,000
z^{BONUS} ($)	**9,228**[5]								
$\tau_f \times D_t$ ($)	2,000	429	306	219	156	156	156	78	3,500
$z^{BONUS} * \tau_f$ ($)	**3,230**								
BONUS ($)	**271**[6]								

This table illustrates the tax depreciation of 3-year and 7-year MACRS assets based on the MACRS and bonus depreciation schedules. In Panel A, the depreciable asset has a useful life of 3 years. In Panel B, the depreciable asset has a useful life of years. δ_t^{MACRS} denotes the MACRS depreciation rate in year t as stated in the IRS Publication 946. δ_t^{BONUS} denotes the bonus depreciation rate in year t. D_t is the depreciation deduction in year t. τ_f denotes the federal corporate tax rate that is assumed to be 35%. The discount rate is assumed to be 7% (see Zwick and Mahon, 2017).

[1] $\$9,386 = \sum_{t=0}^{4} \frac{1}{(1.07)^t} \times \delta_t^{MACRS} \times 10,000$

[2] $\$9,693 = \sum_{t=0}^{4} \frac{1}{(1.07)^t} \times \delta_t^{BONUS} \times 10,000$

[3] $\$108 = 3,393 - 3,285$

[4] $\$8,455 = \sum_{t=0}^{7} \frac{1}{(1.07)^t} \times \delta_t^{MACRS} \times 10,000$

[5] $\$9,228 = \sum_{t=0}^{7} \frac{1}{(1.07)^t} \times \delta_t^{BONUS} \times 10,000$

[6] $\$271 = 3,230 - 2,959$

Appendix B – The Marginal Effective Tax Rate on Risky Assets

The Hall and Jorgenson (1967) theoretical framework lies at the core of my main prediction (i.e., *substitution hypothesis*). Based on this framework, the firm invests until the rate of return to the marginal \$1 capital investment equals the user cost of capital. I model the marginal effective tax rate within a user cost of capital framework (Hall and Jorgenson, 1967; Auerbach et al., 1983). The tax-inclusive effective tax rate on the marginal \$1 investment is expressed as:

$$METR = 1 - \frac{r \times (1-\tau_f)}{(r+\delta) \times [1-(\kappa+z) \times \tau_f] - \delta \times (1-\tau_f)} \quad \text{(B.1)}$$

where r is the required rate to discount investment cash flows (which is a function of the risk-free rate plus a risk premium), δ is the asset's economic depreciation rate, κ is the proportion of the investment eligible for tax credit, z is the PV of depreciation deductions, and τ_f is the federal corporate tax rate. For simplicity, I assume that tax depreciation equals economic depreciation in the estimation of z:

$$z = \frac{\delta}{\delta + \rho_\delta + \pi}$$

where ρ_δ is the required rate to discount depreciation deductions and π is the inflation rate. Eq. (B.1) showcases how $METR$ varies from τ_f:

$$METR = \begin{cases} 1 \text{ for } r = 0 \\ \tau_f \text{ for } \delta = 0 \;\&\; \kappa = 0 \\ 0 \text{ for } \tau_f = 0 \\ 0 \text{ for } r = -\delta \\ 0 \text{ for } \kappa + z = 1 \end{cases}$$

Ceteris paribus, Eq. (B.1) implicitly assumes that an exogenous increase in z will lead to a greater reduction in the $METR$ of risky investments via the interaction between r and z (see Auerbach et al., 1983; McKenzie, 1994). By extension, bonus depreciation should reduce the marginal tax burden on riskier investments. I calculate $METRs$ for various risk profiles to illustrate the interplay between risk and the PV of depreciation deductions. I implement the exercise in three steps. Holding everything else constant, I start by calculating the percentage change in the $METR$ of a benchmark asset between two states of the economy: with and without bonus depreciation incentives. Consider the benchmark asset with $r = 0.04$ (benchmark risk), $\delta = 0.15$, $\kappa = 0$, $\tau_f = 0.35$, $\rho_\delta = 0.01$, and $\pi = 0.02$. The $METR$ on this asset is 29.89%. With a 50% bonus depreciation rate, the $METR$ drops to 17.57%, which represents a 41.21% drop relative to the initial state. I then sequentially raise r by increments of 0.02 and perform step one again. For instance, the asset with $r = 0.06$ has a $METR$ of 23.90%. When bonus depreciation is offered at 50%, the $METR$ drops by 43.21% to 13.57%. Finally, I measure the differential impact — similar to a DD estimate — of bonus depreciation on the $METR$ of the risky and benchmark assets. Continuing the example, the riskier asset sees a 2 percentage points (= 43.21% − 41.21%) differential effect on its $METR$ due to bonus depreciation relative to the benchmark asset.

Table B.1 simulates the exercise for risk profiles ranging from $r = 0.04$ to $r = 0.24$ and bonus depreciation rates ranging from $\theta = 0.00\%$ to $\theta = 100\%$. With $\theta = 10\%$, the differential drop in $METR$ equals 0.57% (1.34%) [1.61%] when the risk difference between the risky and benchmark assets is 0.02 (0.10) [0.20]. With $\theta = 50\%$, the differential drop in $METR$ equals 2.00% (4.53%) [5.39%] when the risk difference between the risky and benchmark assets is 0.02 (0.10) [0.20]. With immediate expensing ($\theta = 100\%$), the differential impact of bonus depreciation equals 0.00% because the $METR$ on all assets is 0; the government refunds to the firm portion τ_f of the investment cost and receives portion τ_f of investment cash flows. Hence, all assets are taxed uniformly and investment decisions are not distorted.

Table B.1
Taxation and risk: impact of bonus depreciation on $METR$.

$\Delta r =$	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18	0.20
θ										
10.0%	0.57%	0.89%	1.09%	1.23%	1.34%	1.42%	1.48%	1.53%	1.58%	1.61%
20.0%	1.07%	1.66%	2.04%	2.30%	2.50%	2.64%	2.76%	2.85%	2.93%	3.00%
30.0%	1.49%	2.31%	2.82%	3.18%	3.44%	3.64%	3.80%	3.92%	4.03%	4.12%
40.0%	1.80%	2.78%	3.40%	3.82%	4.13%	4.37%	4.55%	4.70%	4.83%	4.93%
50.0%	2.00%	3.07%	3.74%	4.20%	4.53%	4.79%	4.98%	5.14%	5.28%	5.39%
60.0%	2.04%	3.13%	3.80%	4.26%	4.59%	4.84%	5.04%	5.19%	5.32%	5.43%
70.0%	1.91%	2.91%	3.52%	3.94%	4.24%	4.47%	4.64%	4.79%	4.90%	5.00%
80.0%	1.56%	2.36%	2.85%	3.18%	3.42%	3.60%	3.74%	3.85%	3.94%	4.02%
90.0%	0.94%	1.42%	1.70%	1.90%	2.04%	2.14%	2.22%	2.29%	2.34%	2.39%
100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Notes: Values derived using Eq. (B.1) with $\delta = 0.15$, $\kappa = 0$, $\tau_f = 0.35$, $\rho_\delta = 0.01$, and $\pi = 0.02$, respectively.

Appendix C – Variables Definitions

Risk-Taking:

$ROA\ Vol_{it}$	Seasonally adjusted return on assets volatility. I compute $ROA\ Vol_{it}$ as $\log_e[\sigma(\Delta ROA_{itq}) \times \sqrt{4}]$, where ROA_{itq} is $\frac{oiadpq_{itq}}{atq_{itq-1}}$, and ΔROA_{itq} is $ROA_{itq} - ROA_{it-1,q}$. I estimate $\sigma(\Delta ROA_{itq})$, the standard deviation of ΔROA_{itq}, over a twelve-quarter period q to q + *11* (min. 4 observations). Next, I annualize $\sigma(\Delta ROA_{itq})$ by multiplying by $\sqrt{4}$. I then log-transform $\sigma(\Delta ROA_{itq})$.
$RNOA\ Vol_{it}$	Seasonally adjusted return on net operating assets volatility. I compute $RNOA\ Vol_{it}$ as $\log_e[\sigma(\Delta RNOA_{itq}) \times \sqrt{4}]$, where $RNOA_{itq}$ is $\frac{oiadpq_{itq}}{ceqq_{itq-1}+pstkq_{itq-1}+dlttq_{itq-1}+dlcq_{itq-1}+mibtq_{itq-1}}$, and $\Delta RNOA_{itq}$ is $RNOA_{itq} - RNOA_{it-1,q}$. I estimate $\sigma(\Delta RNOA_{itq})$, the standard deviation of $\Delta RNOA_{itq}$, over a twelve-quarter period q to q + *11* (min. 4 observations). Next, I annualize $\sigma(\Delta RNOA_{itq})$ by multiplying by $\sqrt{4}$. I then log-transform $\sigma(\Delta RNOA_{itq})$.
$PROA\ Vol_{it}$	Return on assets volatility. I compute $PROA\ Vol_{it}$ as $\log_e[\sigma(ROA_{itq}) \times \sqrt{4}]$, where ROA_{itq} is $\frac{oiadpq_{itq}}{atq_{itq-1}}$. I estimate $\sigma(ROA_{itq})$, the standard deviation of ROA_{itq}, over a twelve-quarter period q to q + *11* (min. 4 observations). Next, I annualize $\sigma(ROA_{itq})$ by multiplying by $\sqrt{4}$. I then log-transform $\sigma(ROA_{itq})$.
$CROA\ Vol_{it}$	Seasonally adjusted cash return on assets volatility. I compute $CROA\ Vol_{it}$ as $\log_e[\sigma(\Delta CROA_{itq}) \times \sqrt{4}]$, where $CROA_{itq}$ is $\frac{oancfy_{itq}}{atq_{itq-1}}$, and $\Delta CROA_{itq}$ is $CROA_{itq} - CROA_{it-1,q}$. I estimate $\sigma(\Delta CROA_{itq})$, the standard deviation of $\Delta CROA_{itq}$, over a twelve-quarter period q to q + *11* (min. 4 observations). Next, I annualize $\sigma(\Delta CROA_{itq})$ by multiplying by $\sqrt{4}$. I then log-transform $\sigma(\Delta CROA_{itq})$.
$Stock\ Vol_{it}$	Stock return volatility. I compute $Stock\ Vol_{it}$ as $\sigma(RET_{itm})$, where RET_{itm} is $\log_e(\frac{prccm_{itm}+dvpsxm_{itm}}{ajexm_{itm}}) - \log_e(\frac{prccm_{itm-1}}{ajexm_{itm-1}})$. I estimate $\sigma(RET_{itm})$, the standard deviation of RET_{itm}, over a thirty-six-month period m to m + *35* (min. 12 observations). I then annualize $Stock\ Vol_{it}$ by multiplying by $\sqrt{12}$.
$Unlev.\ Stock\ Vol_{it}$	Unlevered stock return volatility. I define $Unlev.\ Stock\ Vol_{it}$ as $Stock\ Vol_{it} \times \frac{prcc\_f_{it} \times csho_{it}}{prcc\_f_{it} \times csho_{it} + dltt_{it} + dlc_{it}}$.
$RVC\ Uncertainty_{it}$	Replacement cost of capital stock volatility. I define $RVC\ Uncertainty_{it}$ as $\log_e[\sigma(\Delta K_{itq}) \times \sqrt{4}]$, where K_{itq} is the replacement value of capital stock, and ΔK_{itq} is $K_{itq} - K_{itq-1}$. I construct K_{itq} using the recursion: $K_{itq} = (K_{itq-1} \times \frac{GDPDEF_t}{GDPDEF_{t-1}} + capxy_{itq}) \times (1-\delta_j)$, where $\delta_j = \frac{2}{L_j}$ is the implied economic depreciation rate for industry j using the double-declining balance method, and $L_j = \frac{1}{N_j} \times \sum_{i \in j} \frac{ppentq_{itq-1}+dpq_{itq-1}+capxy_{itq}}{dpq_{itq}}$ is the useful life of capital goods in industry j. I estimate $\sigma(\Delta K_{itq})$, the standard deviation of ΔK_{itq}, over a twelve-quarter period q to q + *11* (min. 4 observations). Next, I annualize $\sigma(\Delta K_{itq})$ by multiplying by $\sqrt{4}$. I then log-transform $\sigma(\Delta K_{itq})$. *Sources:* Eberly et al. (2012), and St. Louis FRED.

$Unlevered\ Beta_{it}$	Unlevered market beta from a daily four-factor Fama-French asset pricing model. I define $Unlevered\ Beta_{it}$ as $\frac{\beta_{it}^{FF-4F}}{1+(1-MTR_{it})\times\frac{dltt_{it}+dlc_{it}}{prcc\_f_{it}\times csho_{it}}}$.

Tax Policy:

$BONUS_{jt}$	PV increase in tax shields for every \$1 of new capital investment due to bonus depreciation incentives. I define $BONUS_{jt}$ as $\theta_t \times (1-z_j^0)\times\tau_f$, where θ_t is the bonus depreciation rate in year t, z_j^0 is the PV of depreciation deductions for every \$1 of new capital investment under MACRS in industry j, and τ_f is the U.S. federal corporate tax rate. *Source:* Zwick and Mahon (2017).
$BONUS''_{jkt}$	PV increase in tax shields for every \$1 of new capital investment due to bonus depreciation incentives, orthogonalized against DPAD and ETI. I define $BONUS''_{jkt}$ as $\theta_t \times (1-z_j^0)\times(\tau_f - \frac{DPAD_{jkt}}{100} - \frac{ETI_{jt}}{100})$, where θ_t is the bonus depreciation rate in year t, z_j^0 is the PV of depreciation deductions for every \$1 of new capital investment under MACRS in industry j, τ_f is the U.S. federal corporate tax rate, $DPAD_{jkt}$ is the percentage point reduction in τ_f for firms in industry j, size bin k, and year t due to DPAD incentives, and ETI_{jt} is the percentage point reduction in τ_f for firms in industry j, and year t due to ETI incentives. *Sources:* Ohrn (2018) and Zwick and Mahon (2017).
$\mathbb{1}(z_j^0 \leq 0.875)$	Longer-lived industries indicator. Indicator that takes the value 1 for firms that operate in industries with z_j^0 values below 0.875, and 0 otherwise. *Source:* Zwick and Mahon (2017).
$\mathbb{1}(Placebo\ NAICS)$	Placebo longer-lived industries indicator. Indicator that takes the value 1 for firms that operate in longer-lived industries that invest in new capital that does not qualify for bonus depreciation, and 0 otherwise. *Source:* Garrett et al. (2020).
$\mathbb{1}(t > 2001)$	Post-2001 indicator. Indicator that takes the value 1 for years after 2001, and 0 otherwise.
$DPAD_{jkt}$	$DPAD_{jkt}$ is defined as the percentage point reduction in τ_f for firms in industry j, size bin k, and year t due to DPAD incentives. *Source:* Ohrn (2018).
$QPAI\%_{jk}$	Average percentage of domestic production activities that qualifies for deduction from taxable income by industry-size bin. *Source:* Ohrn (2018).
ETI_{jt}	ETI_{jt} is defined as the percentage point reduction in τ_f for firms in industry j, and year t due to ETI incentives. *Source:* Ohrn (2018).

Covariates:

$Size_{it}$	Book value of total assets in year 2001 constant dollars. I define $Size_{it}$ as $\log_e(\frac{at_{it}}{GDPDEF_t})$. *Source:* St. Louis FRED.
ROA_{it}	Return on assets. I define ROA_{it} as $\frac{oiadp_{it}}{at_{it-1}}$.
$Marg.\ Q_{it}$	Tobin's marginal q. I define $Marg.\ Q_{it}$ as $\frac{prcc\_f_{it}\times csho_{it}+at_{it}-ceq_{it}-txdb_{it}}{at_{it}}$.

Sales Growth$_{it}$	Net sales growth in year 2001 constant dollars. I define *Sales Growth*$_{it}$ as $\frac{\frac{sale_{it}}{GDPDEF_t}}{\frac{sale_{it-1}}{GDPDEF_{t-1}}} - 1$. *Source:* St. Louis FRED.
Leverage$_{it}$	Book leverage. I define *Leverage*$_{it}$ as $\frac{dltt_{it}+dlc_{it}}{at_{it}}$.
F. Constraints$_{it}$	Whited and Wu financial constraints index. I define *F. Constraints*$_{it}$ as $(-1) \times (-0.091 \times A_{it} - 0.062 \times B_{it} + 0.021 \times C_{it} - 0.044 \times D_{it} + 0.102 \times E_{it} - 0.035 \times F_{it})$, where A_{it} is $\frac{ib_{it}+dp_{it}}{at_{it-1}}$, B_{it} is an indicator that takes the value 1 for firms that pay dividends ($dvc_{it} > 0 \mid dv_{it} > 0$), C_{it} is $\frac{dltt_{it}}{at_{it}}$, D_{it} is $\log_e(at_{it})$, E_{it} is net sales growth at the 3-digit SIC level, F_{it} is $\frac{sale_{it}}{sale_{it-1}} - 1$.
Marg. TR$_{it}$	Simulated post-financing marginal corporate tax rate. *Source:* Blouin et al. (2010).
Tax Risk$_{it}$	Standard deviation of Henry & Sansing's (2018) delta (*HS Delta*$_{it}$). I define *HS Delta*$_{it}$ as $\frac{txpd_{it} - 0.35 \times (pi_{it} - spi_{it})}{prcc\_f_{it} \times csho_{it} + at_{it} - ceq_{it} - txdb_{it}}$. I then estimate *Tax Risk*$_{it}$ as the standard deviation of *HS Delta*$_{it}$ over a five-year period *t-4* to *t* (min. 3 observations). I log-transform *Tax Risk*$_{it}$.
NOL_{it}	Net operating loss carryforwards indicator. Indicator that takes the value 1 for firms that report net operating loss carryforwards ($tlcf_{it} > 0$), and 0 otherwise.
$DNOL_{it}$	Change in net operating loss carryforwards. I define $DNOL_{it}$ as $\frac{tlcf_{it} - tlcf_{it-1}}{at_{it-1}}$.
Other variables:	
$CAPEX_{it}$	Real capital investment rate. I define $CAPEX_{it}$ as $\frac{\frac{capx_{it}}{GDPDEF_t}}{\frac{ppent_{it-1}}{GDPDEF_{t-1}}}$. *Source:* St. Louis FRED.
RD_{it}	Real R&D investment rate. I define RD_{it} as $\frac{\frac{xrd_{it}}{GDPDEF_t}}{\frac{sale_{it-1}}{GDPDEF_{t-1}}}$. *Source:* St. Louis FRED.
Sales$_{it}$	Net sales in year 2001 constant dollars. I define *Sales*$_{it}$ as $\log_e(\frac{sale_{it}}{GDPDEF_t})$. *Source:* St. Louis FRED.
TFP_{it}	Total factor productivity. I define TFP_{it} as the residuals from a log-transformed Cobb-Douglas production function. I employ three semi-parametric estimation algorithms. TFP_{it}^{OP} refers to TFP derived from the Olley and Pakes (1996) algorithm. TFP_{it}^{LP} refers to TFP derived from the Levinsohn and Petrin (2003) algorithm. TFP_{it}^{ACF} refers to TFP derived from the Ackerberg et al. (2015) algorithm.
Vega$_{it}$	CEO wealth volatility to stock return volatility. I define *Vega*$_{it}$ as $\log_e(vega_{it})$. *Source:* Coles et al. (2006).
Delta$_{it}$	CEO wealth volatility to stock price. I define *Delta*$_{it}$ as $\log_e(delta_{it})$. *Source:* Coles et al. (2006).

Notes: Subscripts *i*, *t*, *q*, *m*, *j*, and *k* are the firm, year, quarter, month, industry, and size-bin indices, respectively. All continuous variables are winsorized yearly at the 1% and 99% levels.

Appendix D – Controlling for Heterogeneous Treatment Effects

My identification strategy exploits cross-industry intertemporal variation in bonus depreciation rates combined with two-way fixed effects (TWFE). A series of papers have recently highlighted that heterogeneous treatment effects bias the "static" and "dynamic" TWFE DD estimands (see de Chaisemartin and D'Haultfœuille, 2020; Callaway and Sant'Anna, 2021; Sun and Abraham, 2021). The bias relates to the negative or non-convex weights that several units receive when the outcome of interest is aggregated to estimate average treatment effects on the treated (ATOT). Hence, the identification strategy could fail to produce sensible ATOTs due to time-series and cross-sectional treatment effect heterogeneity. Here, I implement several estimators that are proposed in the DD econometrics literature to show that the DD framework is robust to negative/non-convex weights. I briefly discuss those estimators as follows.

de Chaisemartin and D'Haultfœuille (2020) derive an estimator that not only addresses the negative weights bias, but can also be implemented when the treatment is reversed and reinstated during the sample period. Considering that bonus depreciation was turned off during 2005 – 2007 and on from 2008 onwards, I first implement the de Chaisemartin and D'Haultfœuille (2020) estimator. Next, I implement the Callaway and Sant'Anna (2021) estimator. This estimator allows the researcher to i) avoid the negative weighting of treatment units, ii) control for arbitrary treatment effect heterogeneity, iii) address serial correlation in the outcome of interest (see Fig. 5), and iv) flexibly select the control group (i.e., never-treated, last-treated, or not-yet treated units). I then implement the Sun and Abraham (2021) estimator as a final robustness test. This estimator also accounts for points i) – iii) discussed above, but restricts the control group to either never-treated or last-treated units.[5] So, the Sun and Abraham (2021) estimator provides a stricter identification of the ATOT.

Fig. D.1 presents dynamic DD estimates $\{\beta_{1995}, ..., \beta_{2012}\}$ for each estimator. The dynamic TWFE DD specification is also displayed as the benchmark for comparison. These alternative estimators provide dynamic estimates that are highly consistent with DD estimates reported throughout the study (see Figs. 3 and E.2). Estimates $\{\beta_{1995}, ..., \beta_{2000}\}$ are statistically insignificant and reject the assumption of pre-existing differences in trends. Estimates $\{\beta_{2002}, ..., \beta_{2012}\}$ indicate a quick and significant response to bonus depreciation. Based on these tests, I conclude that treatment effect heterogeneity does not seem to bias the DD estimands reported elsewhere in the study.

INSERT FIG. D.1 ABOUT HERE

[5] I assume that the never-treated group consists of firm in industries that invested in assets that did not qualify for the incentive. During 2002 – 2012, these firms invested in structured investment products and intellectual property that do not qualify for bonus depreciation. For a more extensive discussion refer to Section 4.3.2.

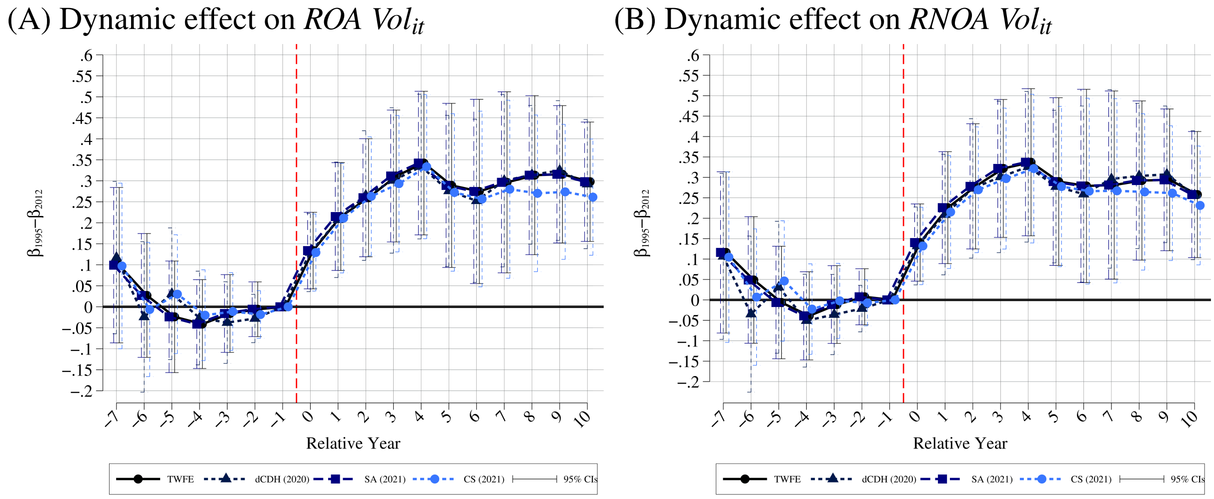


Fig. D.1. Parallel trends using heterogeneous treatment effect estimators.
This figure presents visual evidence of the parallel trends assumption while controlling for heterogeneous treatment responses. In both panels, I plot event study DD coefficients $\{\beta_{1995}, ..., \beta_{2012}\}$ using the correction methods in de Chaisemartin and D'Haultfœuille (2020), Sun and Abraham (2021), and Callaway and Sant'Anna (2021). I normalize coefficient β_{2001} to 0. Specification TWFE implements a two-way fixed effects event study using Eq. (4). Specification dCDH (2020) implements the de Chaisemartin and D'Haultfœuille (2020) correction method. Specification SA (2021) implements the Sun and Abraham (2021) correction method. Specification CS (2021) implements the Callaway and Sant'Anna (2021) correction method. The vertical bands represent two-tailed 95% confidence intervals based on standard errors clustered at the 4-digit NAICS industry level. The vertical dashed lines indicate year 2001, i.e., initial implementation of bonus depreciation incentives. *ROA Vol*$_{it}$ is the dependent variable in Panel A, and *RNOA Vol*$_{it}$ is the dependent variable in Panel B. Variable definitions are available in Appendix C.

Appendix E – Internal Validity Robustness Tests

In this Appendix, I implement a set of substantive tests that intend to support the internal validity of the study's identification framework. I start with an investigation of whether outliers in the distribution of z_j^0, i.e., industries that invest in very long-duration (or short-duration) assets, bias the DD estimate. I construct binned scatter plots of bonus depreciation to visually assess outliers. Panels A and B of Fig. E.1 report binned scatter plots of $ROA\ Vol_{it}$ and $RNOA\ Vol_{it}$ against $BONUS_{jt}$, along with best linear fits that correspond to the model specifications in Columns (2) and (7) of Table 2, respectively. The majority of the binned points are close to the best-fit line and indicate a strong positive association between the tax incentive and the primary outcomes. Furthermore, binned points at the right tail of the distribution of residualized $BONUS_{jt}$ exhibit downward deviation from the conditional expectation function. If anything, outliers bias against finding a positive effect of bonus depreciation on corporate risk-taking.

Second, I plot dynamic DD estimates using quarterly data. The more granular quarterly data allow for a more thorough investigation of the pre-2001 trends in risk-taking for firms in longer-lived vs. shorter-lived industries. The visual evidence in Fig. E.2 is consistent with the event study evidence presented in Fig. 3: dynamic betas $\in \{\beta_{1995:I}, ..., \beta_{2001:II}\}$ corresponding to the period 1995:I – 2001:II are indistinguishable from zero and suggest that the parallel-trends assumption is not violated.

Third, Table E.1 reports results from placebo bonus depreciation tests using a binary DD framework similar to Eq. (4). In particular, I replace the binary treatment indicator, $\mathbb{1}(z_j^0 \leq 0.875)$, with the placebo industries indicator, $\mathbb{1}(Placebo\ NAICS)$. $ROA\ Vol_{it}$ and $RNOA\ Vol_{it}$ are the risk-taking proxies in Panels A and B, respectively. The risk-taking proxies in Panels C and D are annualized volatilities based on return on assets, $PROA\ Vol_{it}$, and seasonally adjusted cash return on assets, $CROA\ Vol_{it}$, respectively. In all four panels, the placebo DD estimates range between -5% and 8%, are not statistically different from zero, and indicate that bonus depreciation is not associated with incremental risk-taking behavior for firms in placebo NAICS industries. Overall, the placebo estimates from the binary DD framework are quantitatively in line with those from the generalized DD framework reported in Table 3.

Fourth, Table E.2 provides evidence that the relation between bonus depreciation and earnings volatility measures is insensitive to discretizing the treatment variable at various percentiles of the z_j^0 distribution. In Columns (1), (2), (3), (4), and (5), I split the z_j^0 distribution at the 20^{th}, 25^{th}, 30^{th}, 35^{th}, and 40^{th} percentile, respectively. Across Panels, the β_1 coefficients have a consistent and stable magnitude ranging from 18% to 20%. Thus, the DD estimand is orthogonal to the initial decision to cut the z_j^0 distribution at 0.875 (Curtis et al., 2023). In Fig. E.3, I also plot event study DD estimates extracted from Eq. (4), where the treatment indicator takes the value 1 (0) if industry j's z_j^0 value lies below (above) the 25^{th}, 30^{th}, 35^{th}, and 40^{th} percentiles of the variable's distribution, respectively. Fig. E.3 provides similar inference to Fig. 3 and Fig. E.2.

Fifth, I complement the DD framework with matching estimators to mitigate concerns that unobservable systematic differences between firms in longer-lived industries and firms in shorter-lived industries contaminate the DD estimator. So, I employ entropy balance and propensity score matching algorithms.[6] Table E.3 presents the results.[7] Across columns in the three panels, the matching estimator (β_1) remains significant at conventional levels ($p_{\beta_1} < 0.04$). I conclude that systematic unobservable differences between firms that are more affected relative to firms that are less affected by the policy probably do not confound the DD estimator.

Sixth, Table E.4 provides evidence that the selection of risk-taking proxies does not drive the results. To this extent, I estimate Eq. (1) (results reported in Panel A) and Eq. (4) (results reported in Panel B) using four alternative risk-taking measures as the dependent variables. In Columns (1) and (2), the risk measures are $PROA\ Vol_{it}$ and $CROA\ Vol_{it}$, respectively (Langenmayr and Lester, 2018). In Column (3), the risk-taking proxy is the levered volatility of monthly stock returns, $Stock\ Vol_{it}$ (Ljungqvist et al., 2017). Similarly, in Column (4), the risk-taking proxy is the unlevered volatility of monthly stock returns, $Unlev.\ Stock\ Vol_{it}$. Using these alternative risk-taking measures, I continue to find a statistically positive and economically meaningful effect of bonus depreciation.

Seventh, I perform nonparametric block permutations (described in Section 4.3.4) on these alternative risk-taking measures. Fig. E.4 presents the empirical CDF of the 5,000 placebo DD estimands. For $PROA\ Vol_{it}$, 5 out of 5,000 placebo coefficients are larger than the estimated effect of 21.68 (Column (1) Table E.4 Panel A). For $CROA\ Vol_{it}$, 35 out of 5,000 placebo coefficients are larger that the estimate of 14.54 (Column (2) Table E.4 Panel A). Finally, none of the placebo coefficients are larger than the estimated effects of 11.20 and 11.80 (Columns (3) and (4) of Table E.4 Panel A) for $Stock\ Vol_{it}$ and $Unlev.\ Stock\ Vol_{it}$, respectively.

Eighth, I replace the vector of covariates with its five-piece splines counterpart and re-estimate Eqs. (1), (2), and (3). The results are quantitatively unchanged.[8] Finally, I perform the Oster (2019) test to mitigate concerns that selection on unobservable confounding factors has a larger magnitude on the DD estimate than selection on observable vector, X_{it}. The model specification employed for the test corresponds to Column (5) of Table 4. I follow Oster (2019) and assume that (1) $R^2_{max} = 1.3 \times R^2$, and that DD estimates $\{\mathbb{1}(z^0 j \leq 0.875), \mathbb{1}(t > 2001), \mathbb{1}(z^0_j \leq 0.875) \times \mathbb{1}(t > 2001)\}$ are fully observed. The Oster (2019) δ estimate equals 7.25 (7.69) when $ROA\ Vol_{it}$ ($RNOA\ Vol_{it}$) is the outcome variable of interest. The δ estimate is well above the critical value of 1 and implies that selection on unobservable confounding factors

[6] I implement the matching estimators in 2001 to ensure that the tax policy does not confound the matching covariates (Roberts and Whited, 2013). I entropy balance on a third order polynomial expansion of the vector of covariates with a 0.5% tolerance level. I propensity score match without replacement on the vector of covariates and impose common support and a 0.5% caliper.

[7] For brevity, I report results only for $ROA\ Vol_{it}$ as the outcome of interest. The results for other proxies for risk-taking are quantitatively unchanged.

[8] In untabulated analyses, I further investigate a balanced panel of firm-years during 1995 – 2012. The results are quantitatively unchanged, indicating that sample composition does not confound the DD estimate.

must be 7.25 – 7.69 times the selection on observable vector of covariates. The test also yields a bias-corrected DD estimate of 17.41% (16.19%) when $ROA\ Vol_{it}$ ($RNOA\ Vol_{it}$) is the outcome variable of interest. The statistically significant δ estimates, along with the bias-corrected DD estimates that are close to those reported in Table 4, further suggest that unobservable factors do not seem to explain the observed association between risk-taking and bonus depreciation incentives. Overall, the litany of robustness checks reinforces the empirical validity of the research framework and reduces concerns that confounding ex ante risk-taking trends with heterogeneous effects across industries explain the observed ex post variation in risk-taking.

(A) *ROA* Vol_{it} vs. $BONUS_{jt}$ (B) *RNOA* Vol_{it} vs. $BONUS_{jt}$

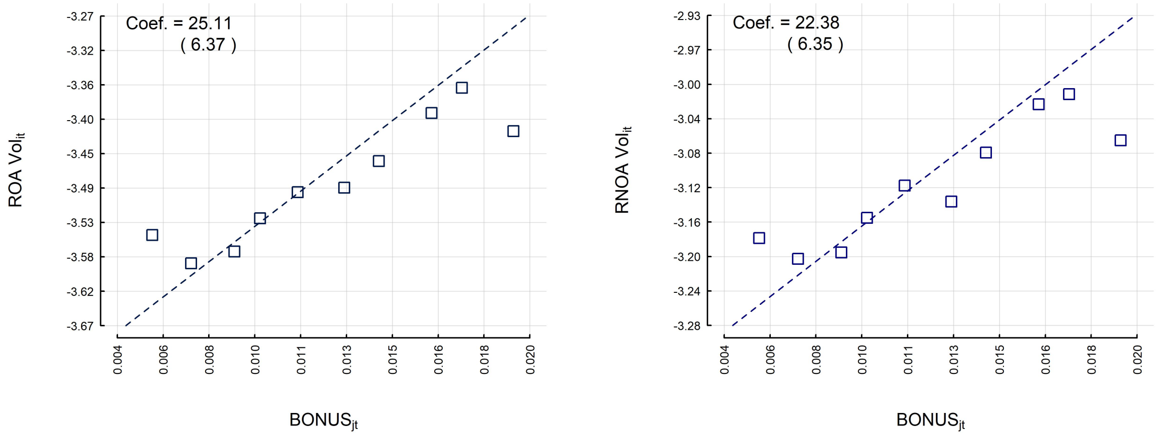


Fig. E.1. Binned scatter plots: bonus depreciation and risk-taking.
This figure presents binned scatter plots of corporate risk-taking (*ROA* Vol_{it}/*RNOA* Vol_{it}) vs. bonus depreciation ($BONUS_{jt}$). I first residualize the dependent variables (*ROA* Vol_{it}/*RNOA* Vol_{it}), and the tax policy variable, ($BONUS_{jt}$), against the vector of covariates, X_{it}, and the vector of fixed effects, Ψ_{it}. Next, I split residualized $BONUS_{jt}$ into 10 equal-sized groups. I then plot the average residualized dependent variable in each group against the average residualized $BONUS_{jt}$ in each group. The fitted lines are conditional expectation functions based on the model specifications reported in Columns (2) and (7) of Table 2. In Panels A, *ROA* Vol_{it} is the dependent variable. In Panels B, *RNOA* Vol_{it} is the dependent variable. Variable definitions are available in Appendix C.

(A) Dynamic effect on *ROA* Vol_{itq} (B) Dynamic effect on *RNOA* Vol_{itq}

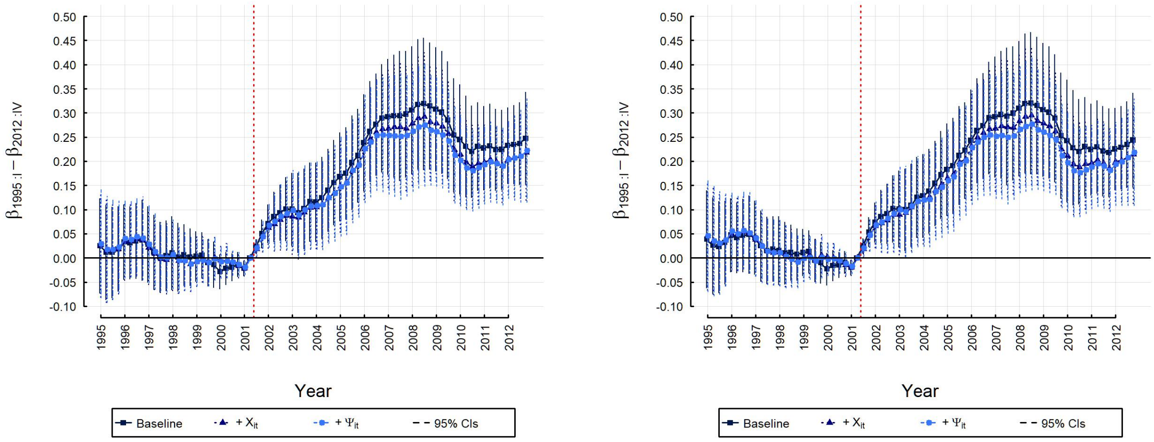
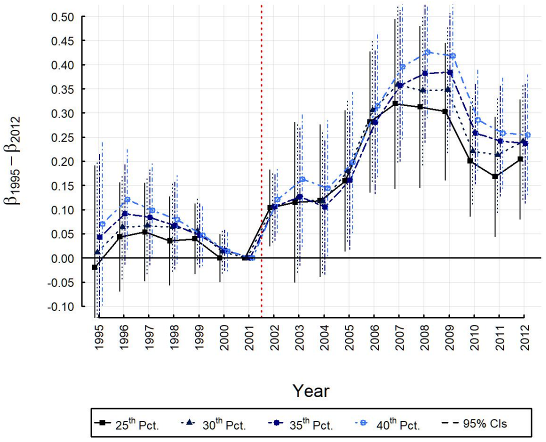


Fig. E.2. Dynamic quarterly effect of bonus depreciation on corporate risk-taking.
This figure presents quarterly event study DD coefficients $\{\beta_{1995:I}, ..., \beta_{2012:IV}\}$, using a modified Eq. (2). I normalize coefficient $\beta_{2001:II}$ to 0. The vertical dashed lines indicate 2001:II, i.e., fiscal quarter immediately before the implementation of bonus depreciation incentives. All other estimation parameters mimic the estimation parameters described in Fig. 3. In Panel A, quarterly *ROA* Vol_{itq} is the dependent variable. In Panel B, quarterly *RNOA* Vol_{itq} is the dependent variable. Variable definitions are available in Appendix C.

(A) Dynamic effect on *ROA* Vol_{it}



(B) Dynamic effect on *RNOA* Vol_{it}

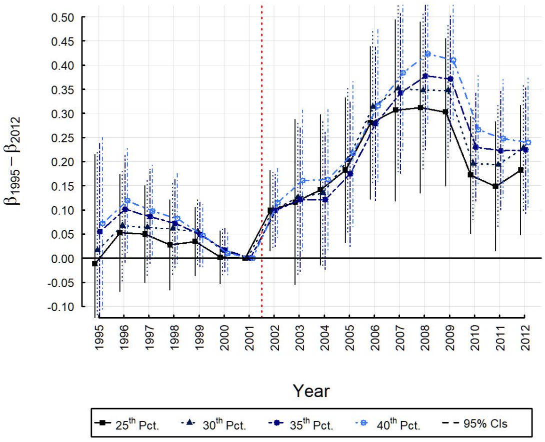


Fig. E.3. Dynamic effect of bonus depreciation conditional on the distribution of z_j^0.
This figure presents event study DD coefficients $\{\beta_{1995}, ..., \beta_{2012}\}$ from a binary DD framework based on a modified Eq. (4). I normalize coefficient β_{2001} to 0. Across specifications, the treatment indicator takes the value 1 if industry j has a z_j^0 value below the 25^{th}, 30^{th}, 35^{th}, and 40^{th} percentile of the variable's distribution, and 0 otherwise, respectively. All other estimation parameters correspond to the specification in Column (5) of Table 4. The vertical dashed lines indicate year 2001, i.e., initial implementation of bonus depreciation incentives. In Panel A, *ROA* Vol_{it} is the dependent variable. In Panel B, *RNOA* Vol_{it} is the dependent variable. Variable definitions are available in Appendix C.

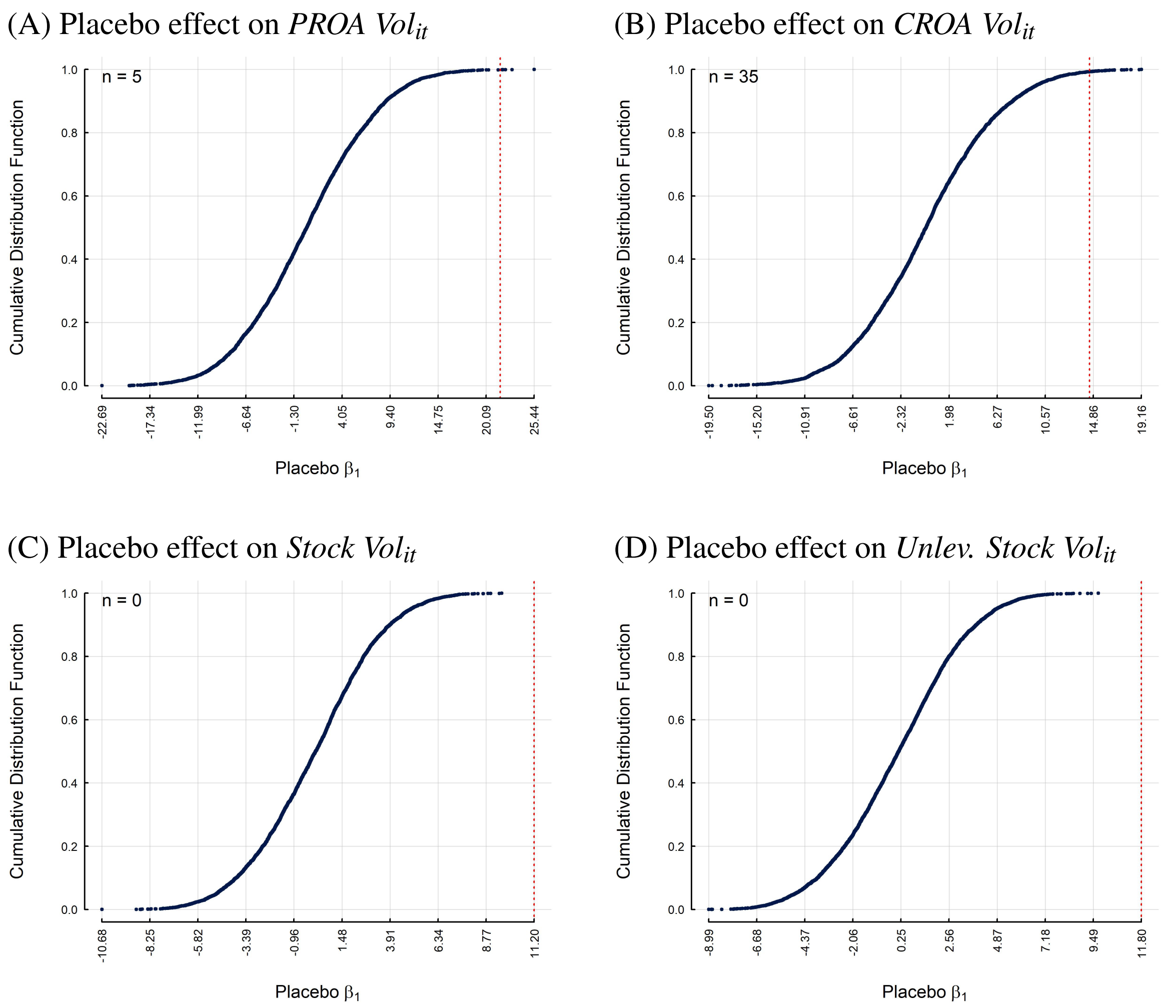


Fig. E.4. Addressing serial correlation: Alternative dependent variables.
This figure presents the empirical CDF of placebo effects of bonus depreciation on *PROA* Vol_{it} (Panel A), *CROA* Vol_{it} (Panel B), *Stock* Vol_{it} (Panel C), and *Unlev. Stock* Vol_{it} (Panel D), respectively. The block permutation test procedure is identical to the one described in Section 4.3.4 and Fig. 5. The vertical lines indicate the DD estimate corresponding to the respective specifications in Table E.4 Panel A. In Panel A, 5 out of 5,000 placebo effects are larger than the treatment effect. In Panel B, 35 out of 5,000 placebo effects are larger than the treatment effect. In Panels C and D, 0 out of 5,000 placebo effects are larger than the treatment effect. Variable definitions are available in Appendix C.

Table E.1
The effect of placebo bonus depreciation on corporate risk-taking (binary treatment).

	(1)	(2)	(3)	(4)	(5)
Panel A:			*ROA* Vol_{it}		
$\mathbb{1}(Placebo\ NAICS) \times \mathbb{1}(t > 2001)$	-0.02	0.00	0.00	0.03	0.05
	[0.05]	[0.05]	[0.05]	[0.06]	[0.06]
Adj. R^2	69.45%	71.44%	71.51%	71.72%	71.80%
Panel B:			*RNOA* Vol_{it}		
$\mathbb{1}(Placebo\ NAICS) \times \mathbb{1}(t > 2001)$	0.00	0.04	0.03	0.05	0.08
	[0.05]	[0.07]	[0.07]	[0.08]	[0.08]
Adj. R^2	67.26%	69.95%	70.03%	70.15%	70.20%
Panel C:			*PROA* Vol_{it}		
$\mathbb{1}(Placebo\ NAICS) \times \mathbb{1}(t > 2001)$	0.00	0.03	0.02	0.04	0.06
	[0.06]	[0.04]	[0.04]	[0.04]	[0.04]
Adj. R^2	69.32%	71.38%	71.44%	71.55%	71.63%
Panel D:			*CROA* Vol_{it}		
$\mathbb{1}(Placebo\ NAICS) \times \mathbb{1}(t > 2001)$	-0.05	0.00	0.01	0.01	0.02
	[0.06]	[0.03]	[0.03]	[0.03]	[0.03]
Adj. R^2	61.81%	64.24%	64.29%	64.26%	64.31%
Firm-Yrs	31,105	31,105	31,105	31,105	31,105
Yr FE	X	X			
Firm FE	X	X	X	X	X
Controls		X	X	X	X
Size–Yr FE			X	X	X
Sales Growth–Yr FE				X	X
Marg. TR–Yr FE					X
Cluster			4-digit NAICS		

Notes: This table reports estimates of the placebo effect of bonus depreciation on corporate risk-taking using binary DD OLS regressions. In Panel A, *ROA* Vol_{it} is the dependent variable. In Panel B, *RNOA* Vol_{it} is the dependent variable. In Panel C, *PROA* Vol_{it} is the dependent variable. In Panel D, *CROA* Vol_{it} is the dependent variable. The sample period spans from 1995 to 2012. In Column (1), I regress the dependent variable on the placebo binary DD estimator, $\mathbb{1}(Placebo\ NAICS) \times \mathbb{1}(t > 2001)$, plus firm and year fixed effects. In Column (2), I include the vector of covariates, X_{it}. In Column (3), I replace year fixed effects with terciles of average firm size ($Size_{it}$) during 1995 – 2001 interacted with year fixed effects. In Column (4), I further include terciles of average growth ($Sales\ Growth_{it}$) during 1995 – 2001 interacted with year fixed effects. In Column (5), I further include terciles of average MTR ($Marg.\ TR_{it}$) during 1995 – 2001 interacted with year fixed effects. The coefficient vector of the covariates, Γ, is not displayed for brevity. Standard errors clustered at the industry level (4-digit NAICS) are reported in brackets. Variable definitions are available in Appendix C. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table E.2
Bonus depreciation binary treatment: Alternative cutoffs.

	(1)	(2)	(3)	(4)	(5)
Percentile cutoff (p):	P20	P25	P30	P35	P40
Panel A:			*ROA* Vol_{it}		
$\mathbb{1}(z_j^0 \leq z_p^0) \times \mathbb{1}(t > 2001)$	0.19***	0.18***	0.18***	0.18***	0.20***
	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]
Adj. R^2	71.12%	71.12%	71.20%	71.21%	71.27%
Panel B:			*RNOA* Vol_{it}		
$\mathbb{1}(z_j^0 \leq z_p^0) \times \mathbb{1}(t > 2001)$	0.19***	0.18***	0.18***	0.18***	0.19***
	[0.05]	[0.05]	[0.05]	[0.05]	[0.05]
Adj. R^2	69.65%	69.65%	69.74%	69.72%	69.79%
Firm-Yrs	34,817	34,445	34,390	34,536	34,475
Controls	X	X	X	X	X
Firm FE	X	X	X	X	X
Size–Yr FE	X	X	X	X	X
Sales Growth–Yr FE	X	X	X	X	X
Marg. TR–Yr FE	X	X	X	X	X
Cluster			4-digit NAICS		

Notes: This table reports estimates of the effect of bonus depreciation on corporate risk-taking using binary DD OLS regressions. In Panel A, *ROA* Vol_{it} is the dependent variable. In Panel B, *RNOA* Vol_{it} is the dependent variable. Across Columns, all specification correspond to specification in Column (5) of Table 4. The sample period spans from 1995 to 2012. In Columns (1), (2), (3), (4), and (5), the treatment indicator cutoff depends on the 20^{th}, 25^{th}, 30^{th}, 35^{th}, and 40^{th} percentile of the z_j^0 distribution, respectively. The coefficient vector of the covariates, Γ, is not displayed for brevity. Standard errors clustered at the industry level (4-digit NAICS) are reported in brackets. Variable definitions are available in Appendix C. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table E.3
Matching estimators.

	(1)	(2)	(3)	(4)	(5)
			ROA Vol_{it}		
Panel A:			**Continuous entropy balance sample**		
$BONUS_{jt}$	27.88***	28.89***	28.68***	28.04***	28.20***
	[9.23]	[8.58]	[8.64]	[8.15]	[8.17]
Adj. R^2	67.09%	68.75%	68.90%	69.09%	69.14%
Firm-Yrs	27,598	27,598	27,598	27,598	27,598
Panel B:			**Binary entropy balance sample**		
$\mathbb{1}(z_j^0 \leq 0.875) \times \mathbb{1}(t > 2001)$	0.16**	0.15**	0.13**	0.13**	0.13**
	[0.07]	[0.07]	[0.06]	[0.06]	[0.06]
Adj. R^2	63.99%	66.11%	66.68%	67.94%	68.17%
Firm-Yrs	27,598	27,598	27,598	27,598	27,598
Panel C:			**Nearest-neighbor PSM sample**		
$\mathbb{1}(z_j^0 \leq 0.875) \times \mathbb{1}(t > 2001)$	0.19**	0.18**	0.17**	0.16**	0.17***
	[0.08]	[0.07]	[0.07]	[0.06]	[0.06]
Adj. R^2	61.97%	63.80%	64.02%	64.49%	64.47%
Firm-Yrs	6,312	6,312	6,312	6,312	6,312
Yr FE	X	X			
Firm FE	X	X	X	X	X
Controls		X	X	X	X
Size–Yr FE			X	X	X
Sales Growth–Yr FE				X	X
Marg. TR–Yr FE					X
Cluster			4-digit NAICS		

Notes: This table reports estimates of the effect of bonus depreciation on corporate risk-taking using continuous and binary DD matching estimators. In all Panels, *ROA* Vol_{it} is the dependent variable. I do not report results for *RNOA* Vol_{it} for brevity. In Panel A, I report results for an entropy balanced sample obtained from a continuous entropy balance algorithm. In Panel B, I report results for an entropy balanced sample obtained from a binary entropy balance algorithm. In Panel C, I report results for a matched sample obtained from a nearest-neighbor prospensity score matching algorithm. The sample period spans from 1995 to 2012. In Column (1), I regress the dependent variable on the tax policy variable, $BONUS_{jt}/\mathbb{1}(z_j^0 \leq 0.875) \times \mathbb{1}(t > 2001)$, plus firm and year fixed effects. In Column (2), I include the vector of covariates, X_{it}. In Column (3), I replace year fixed effects with terciles of average firm size ($Size_{it}$) during 1995 – 2001 interacted with year fixed effects. In Column (4), I further include terciles of average growth (*Sales* $Growth_{it}$) during 1995 – 2001 interacted with year fixed effects. In Column (5), I further include terciles of average MTR (*Marg.* TR_{it}) during 1995 – 2001 interacted with year fixed effects. The coefficient vector of the covariates, Γ, is not displayed for brevity. Standard errors clustered at the industry level (4-digit NAICS) are reported in brackets. Variable definitions are available in Appendix C. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table E.4
The effect of bonus depreciation on corporate risk-taking: Alternative dependent variables.

	(1) *PROA Vol*$_{it}$	(2) *CROA Vol*$_{it}$	(3) *Stock Vol*$_{it}$	(4) *Unlev. Stock Vol*$_{it}$
Panel A:	Continuous DD estimator			
$BONUS_{jt}$	21.68***	14.54**	11.20***	11.80***
	[6.11]	[5.86]	[2.18]	[2.08]
Adj. R^2	71.50%	63.74%	63.38%	70.09%
Panel B:	Binary DD estimator			
$\mathbb{1}(z_j^0 \leq 0.875) \times \mathbb{1}(t > 2001)$	0.20***	0.17***	0.08***	0.08***
	[0.05]	[0.04]	[0.02]	[0.01]
Adj. R^2	71.57%	63.81%	63.45%	70.16%
Firm-Yrs	34,817	34,817	34,784	34,779
Controls	X	X	X	X
Firm FE	X	X	X	X
Size–Yr FE	X	X	X	X
Sales Growth–Yr FE	X	X	X	X
Marg. TR–Yr FE	X	X	X	X
Cluster	4-digit NAICS			

Notes: This table reports estimates of the effect of bonus depreciation on corporate risk-taking using continuous (Panel A) and binary (Panel B) DD OLS regressions. Across Columns, all specification correspond to specification in Column (5) of Table 2. In Columns (1), (2), (3), and (4), *PROA Vol*$_{it}$, *CROA Vol*$_{it}$, *Stock Vol*$_{it}$, and *Unlev. Stock Vol*$_{it}$ are the dependent variables, respectively. The coefficient vector of the covariates, Γ, is not displayed for brevity. Standard errors clustered at the industry level (4-digit NAICS) are reported in brackets. Variable definitions are available in Appendix C. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Appendix F – Controlling for Confounding Tax Policies

As already discussed in Section 3.3, $BONUS_{jt}$ varies in the cross-section due to variation in z_j^0, and (2) in the time-series due to variation in θ_t. Nevertheless, bonus depreciation was implemented concurrently with three other tax policies: Section 179, ETI, and DPAD. In addition, firms can take advantage of bonus depreciation to the extend that they report tax profits. Each of these factors introduces a third source of variation in $BONUS_{jt}$. Section 179 confounds $BONUS_{jt}$ through variation in θ_t. Corporate taxable losses confound $BONUS_{jt}$ because bonus depreciation incentives are contingent on corporate taxable profits. ETI and DPAD confound $BONUS_{jt}$ through variation in τ_f. Hence, the purpose of this Appendix is to address those issues. I consider Section 179 in Section F.1. I take into account tax losses in Section F.2. Finally, I control for ETI and DPAD in Section F.3.

F.1 – Controlling for Section 179

Section 179 amplifies the magnitude of θ_t on the PV of depreciation deduction (Curtis et al., 2023). Effectively, the incentive offers immediate expensing for qualifying capital investments up to a specified threshold.[9] For a given Section 179 threshold ($\bar{I}_t$) in time t, then the PV of depreciation deductions for a \$1 eligible capital investment in industry j (I_{jt}) is equal to:

$$z_{jt}^{0'} = \begin{cases} 1 \text{ for } I_{jt} \leq \bar{I}_t \\ z_j^0 \times (1 - \mathbb{I}[I_{jt} \leq \bar{I}_t]) + 1 \times \mathbb{I}[I_{jt} \leq \bar{I}_t] \text{ for } I_{jt} > \bar{I}_t \end{cases}$$

When firms can claim both Section 179 allowances and bonus depreciation incentives, assuming that the \$1 investment exceeds the Section 179 threshold, then the PV of depreciation deductions becomes:

$$\begin{aligned} z_{jt}^{BONUS'} &= (\theta_t + (1-\theta_t) \times z_j^0) \times (1 - \mathbb{I}[I_{jt} \leq \bar{I}_t]) + 1 \times \mathbb{I}[I_{jt} \leq \bar{I}_t] \\ &= (\theta_t + (1-\theta_t) \times z_j^0) + \mathbb{I}[I_{jt} \leq \bar{I}_t] \times [(1 - \theta_t - (1-\theta_t) \times z_j^0)] \\ &= (\theta_t + (1-\theta_t) \times z_j^0) + \mathbb{I}[I_{jt} \leq \bar{I}_t] \times [(1-\theta_t) \times (1 - z_j^0)] \end{aligned} \tag{F.1}$$

Note that Eq. (F.1) gives:

[9] The threshold varies over the sample period. In particular, the threshold was equal to \$17,500 in 1995 – 1996, \$18,000 in 1997, \$18,500 in 1998, \$19,000 in 1999, \$20,000 in 2000, \$24,000 in 2001 – 2002, \$100,000 in 2003, \$102,000 in 2004, \$105,000 in 2005, \$108,000 in 2006, \$125,000 in 2007, \$250,000 in 2008 – 2009, and \$500,000 in 2010 – 2012.

$$z_{jt}^{BONUS'} = \begin{cases} z_j^0 \text{ for } \theta_t = 0 \text{ \& } \mathbb{I}[I_{jt} \leq \bar{I}_t] = 0 \\ z_{jt}^{0'} \text{ for } \theta_t = 0 \\ z_{jt}^{BONUS} \text{ for } \mathbb{I}[I_{jt} \leq \bar{I}_t] = 0 \end{cases}$$

The increase in the PV of depreciation deductions from the marginal \$1 investment due to bonus depreciation and Section 179 then equals the difference between $z_{jt}^{BONUS'}$ and z_j^0:

$$z_{jt}^{BONUS'} - z_j^0 = (1 - z_j^0) \times \{\theta_t + (1 - \theta_t) \times \mathbb{I}[I_{jt} \leq \bar{I}_t]\} \tag{F.2}$$

Multiplying Eq. (F.2) by τ_f one derives:

$$BONUS'_{jt} = (z_{jt}^{BONUS'} - z_j^0) \times \tau_f \tag{F.3}$$

Eq. (F.3) provides the expected response of industry j to bonus depreciation and Section 179 in a given year t. One can immediately notice that $E[BONUS']_{jt}$ is increasing in $E[\mathbb{I}[I_{jt} \leq \bar{I}_t]]_t \in [0, 1]$. In essence, Section 179 amplifies the average response to bonus depreciation. The DD estimate (β_1) in Eq. (1) captures $E[BONUS]_{jt} = E[\theta_t \times (1 - z_j^0) \times \tau_f]_{jt}$, which does not account for Section 179. I then use Eq. (F.3) to get a better understanding of the interplay between bonus depreciation and Section 179 in my study. I further assume that $\theta_t = 37.40\%$ (taken from Table 1) and $E[\mathbb{I}[I_{jt} \leq \bar{I}_t]]_t = 12\%$ (taken from Garrett et al. (2020)). Based on these assumptions, the expected response to bonus depreciation absent Section 179 equals $\frac{\theta_t \times (1 - z_j^0) \times \tau_f}{(1 - z_j^0) \times \{\theta_t + (1 - \theta_t) \times E[\mathbb{I}[I_{jt} \leq \bar{I}_t]]_t\} \times \tau_f} = \frac{0.374}{[0.374 + (1 - 0.374) \times 0.12]} \approx 0.83 \approx 83\%$ of the estimated response. In Column (5) of Table 2, the estimated increase in risk-taking for a percentage point increase in $BONUS_{jt}$ is 23.59%. So, the structural response to bonus depreciation in the absence of Section 179 would be 19.58% ($\approx 23.59\% \times 0.83$). In untabulated analyses, I exclude firms that primarily take advantage of Section 179 — firms with less than \$0.5m capital investment in any year — to compare structural and reduced-form responses. The estimated risk-taking response to bonus depreciation equals 19.32% and is close to the structural target. Overall, Section 179 does not seem to bias substantially the identification framework.

F.2 – Controlling for Taxable Losses

Firms with taxable losses cannot take advantage of the tax policy because there is no profit available to offset the bonus deduction. For a given level of taxable profits in time t (p_{it}), then the increase in the PV of tax shields for each \$1 of qualifying investment due to bonus depreciation equals to:

$$BONUS_{jt} = [\theta_t \times (1-z_j^0) \times \tau_f] - \{\theta_t \times (1-z_j^0) \times \tau_f \times \mathbb{I}[p_{it} \leq 0]\}$$
$$= [\theta_t \times (1-z_j^0) \times \tau_f] \times \{1-\mathbb{I}[p_{it} \leq 0]\} \tag{F.4}$$

Note that Eq. (F.4) gives:

$$BONUS_{jt} = \begin{cases} BONUS_{jt} \text{ for } \mathbb{I}[p_{it} \leq 0] = 0 \\ 0 \text{ for } \mathbb{I}[p_{it} \leq 0] = 1 \end{cases}$$

Eq. (F.4) provides the expected risk-taking response of industry j to bonus depreciation in the presence of profit and loss domains in a given year t. It also becomes apparent that $E[BONUS]_{jt}$ is decreasing in $E[\mathbb{I}[p_{it} \leq 0]]_t \in [0,1]$. That is, taxable losses reduce the expected response to bonus depreciation. I then use Eq. (F.4) to derive structural responses to bonus depreciation absent taxable losses in my study. The average sample firm-year experiences taxable losses in 21.1% of the years in the sample. So, I assume that $E[\mathbb{I}[p_{it} \leq 0]]_t = 21.1\%$. Using this calibration assumption, the structural response to bonus depreciation absent taxable losses equals $\frac{\theta_t \times (1-z_j^0) \times \tau_f}{[\theta_t \times (1-z_j^0) \times \tau_f] \times \{1-E[\mathbb{I}[p_{it} \leq 0]]_t\}} = \frac{1}{0.789} \approx 1.27 \approx 127\%$ of the estimated response. Based on the DD estimate in Column (5) of Table 2, the structural response to bonus depreciation net of taxable losses is 29.96% ($\approx 23.59\% \times 1.27$). I further assess reduced-form estimates using a sample of firms-years with taxable profits (untabulated). The DD estimate is 32.34% and almost identical to the structural estimate. I conclude that corporate losses do not seem to affect the evidence in the main body of the study.

F.3 – Controlling for ETI and DPAD

ETI and DPAD tax incentives introduce a third source of variation due to reductions in τ_f (Ohrn, 2018). In principle, the incentives reduced the effective tax rate on domestic manufacturing activities and export activities, respectively. Considering that $\tau_f = 35\%$ during the sample period, DPAD and ETI give:

$$\tau_f' = 0.35 - \frac{DPAD_{jkt}}{100} - \frac{ETI_{jt}}{100} \tag{F.5}$$

where $DPAD_{jkt}$ denotes the percentage point reduction in τ_f for firms in industry j, size bin k, and year t due to DPAD deductions, and ETI_{jt} denotes the percentage point reduction in τ_f for firms in industry j and year t due to ETI deductions. Using Eq. (F.5) one derives:

$$BONUS''_{jkt} = (z_{jt}^{BONUS} - z_j^0) \times \tau_f'$$
$$= \theta_t \times (1-z_j^0) \times (0.35 - \frac{DPAD_{jkt}}{100} - \frac{ETI_{jt}}{100}) \tag{F.6}$$

$BONUS''_{jkt}$ captures variation in bonus depreciation between longer-lived and shorter-lived industries over and above variation induced due to ETI and DPAD incentives. Eq. (F.6) then provides the expected response of industry j to bonus depreciation orthogonal to DPAD or ETI incentives in a given year t. $E[BONUS'']_{jkt}$ is decreasing in $E[DPAD_{jkt}]]_t$ and $E[ETI_{jt}]]_t$. I then use Eq. (F.6) to derive structural effects of bonus depreciation net of ETI and DPAD. I assume that $E[DPAD_{jkt}]]_t = 1.02$ and $E[ETI_{jt}]]_t = 0.516$ (sample averages in my study). Based on these assumptions, the expected response to bonus depreciation absent ETI and DPAD equals $\frac{\tau_f}{\tau_f - \frac{DPAD_{jkt}}{100} - \frac{ETI_{jt}}{100}} \approx 1.046 \approx 104.6\%$ of the estimated response. Therefore, the structural response to bonus depreciation net of ETI and DPAD is 24.67% ($\approx 23.59\% \times 1.046$). I also estimate Eq. (1) using $BONUS''_{jkt}$ as the identification variable to derive reduced-form estimates. I also include $DPAD_{jkt}$ and ETI_{jt} in the vector of covariates to control for their potential association with corporate risk-taking.

The results are reported in Table F.1. Columns (1) – (3) report results for $ROA\ Vol_{it}$ and Columns (4) – (6) report results for $RNOA\ Vol_{it}$. The main takeaways from the table are as follows. First, the DD estimate on $BONUS''_{jkt}$ remains positive and significant at the 1% level. $BONUS''_{jkt}$ exhibits a 0.72 standard deviation during the post-2001 period. Hence, the estimate is also quantitatively consistent with the estimate from the empirical specification in Table 2; each 0.72 percentage point increase in the PV of tax shields generated from \$1 of new capital investment increases ROA (RNOA) volatility by 16.49% – 17.78% (14.71% – 15.46%). Second, the reduced-form estimates on $ROA\ Vol_{it}$ are in the 22.90 – 24.70 range and closely approximate the structural estimate. Finally, the coefficients on $DPAD_{jkt}$ and ETI_{jt} are only marginally different from zero and statistically insignificant, indicating that DPAD and ETI incentives do not affect corporate risk-taking attitudes.

INSERT TABLE F.1 ABOUT HERE

However, I take the analysis one step further and explore any potential dynamic effects of DPAD on earnings volatility. I borrow the Ohrn (2018) empirical framework that conducts the dynamic DD analysis for DPAD:

$$Y_{it} = \beta_0 + \sum_{\substack{\xi=1995 \\ \xi \neq 2004}}^{2012} \{\beta_\xi \times [QPAI\%_{jk} \times \mathbb{1}(t=\xi)]\} + X_{it} \times \Gamma + \Psi_{it} \times \gamma + \varepsilon_{it} \tag{F.7}$$

where $QPAI\%_{jk}$ is the average percentage of qualified production activities income deductible from taxable income by industry-size bins, $\mathbb{1}(t=\xi)$ are yearly indicators, $BONUS''_{jkt}$ and ETI_{jt} are included in the vector of covariates, and all other model specification choices are identical to those in Eq. (1). Coefficients $\{\beta_{1995}, ..., \beta_{2003}\}$ capture treatment anticipation effects, $t = 2004$ is the omitted baseline period, and coefficients $\{\beta_{2005}, ..., \beta_{2012}\}$ identify dynamic treatment effects. Thus, coefficients $\{\beta_{1995}, ..., \beta_{2012}\}$ capture risk-taking differences at time $t = \xi$ between firms in industry-size bins with 100% QPAI and firms in industry-size bins with 0% QPAI relative to risk-taking differences between the two types of firms at time $t = 2004$.

I plot these dynamic DD estimates in Fig. F.1. Not surprisingly, coefficients $\{\beta_{2005}$, ..., $\beta_{2012}\}$ are weak and statistically indistinguishable from zero, indicating that firms did not respond to DPAD by increasing risk. In sum, the empirical evidence supports the notion — discussed elsewhere in this study — that contemporaneous tax policies do not appear to confound the estimated relation between bonus depreciation and firm risk-taking.

INSERT FIG. F.1 ABOUT HERE

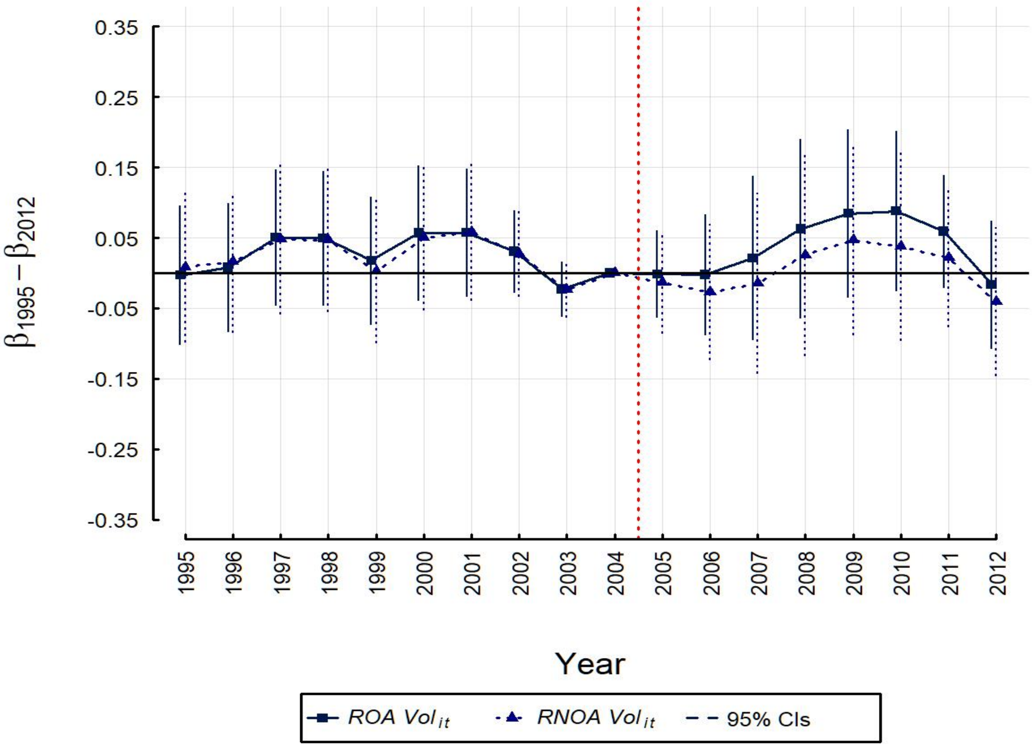


Fig. F.1. Dynamic effect of DPAD on corporate risk-taking.
This figure presents event study DD coefficients $\{\beta_{1995}, ..., \beta_{2012}\}$ using Eq. (F.7). I scale the coefficients to represent an interquartile increase in $QPAI\%_{jk}$. I normalize coefficient β_{2004} to 0. All other estimation parameters correspond to the specification in Column (5) of Table 2. The vertical dashed line indicates year 2004, i.e., initial implementation of DPAD. Variable definitions are available in Appendix C.

Table F.1
Controlling for confounding events.

	(1)	(2)	(3)	(4)	(5)	(6)
		ROA Vol$_{it}$			*RNOA Vol$_{it}$*	
$BONUS''_{jkt}$	24.70***	22.90***	23.43***	21.47***	20.43***	20.90***
	[6.41]	[6.30]	[6.18]	[6.55]	[6.52]	[6.39]
$DPAD_{jkt}$	0.03	0.02	0.02	0.01	0.00	0.00
	[0.04]	[0.03]	[0.03]	[0.04]	[0.04]	[0.04]
ETI_{jt}	-0.02	-0.01	-0.02	-0.03	-0.03	-0.03
	[0.04]	[0.03]	[0.03]	[0.04]	[0.04]	[0.04]
Firm-Yrs	34,604	34,604	34,604	34,604	34,604	34,604
Adj. R^2	70.67%	70.93%	71.00%	69.34%	69.49%	69.54%
Controls	X	X	X	X	X	X
Firm FE	X	X	X	X	X	X
Size–Yr FE	X	X	X	X	X	X
Sales Growth–Yr FE		X	X		X	X
Marg. TR–Yr FE			X			X
Cluster		4-digit NAICS			4-digit NAICS	

Notes: This table reports estimates of the effect of bonus depreciation on corporate risk-taking using OLS regressions, after controlling for the effects of confounding tax policies. In Columns (1) – (3), *ROA Vol$_{it}$* is the dependent variable. In Columns (4) – (6), *RNOA Vol$_{it}$* is the dependent variable. The sample period spans from 1995 to 2012. The tax policy variable, $BONUS''_{jkt}$, is a variation of $BONUS_{jt}$ that controls for the effects of DPAD and ETI on τ_f. DPAD$_{jkt}$ is the percentage point reduction in τ_f due to DPAD incentives. ETI$_{jt}$ is the percentage ponts reduction in τ_f due to ETI incentives. The coefficient vector of the covariates, Γ, is not displayed for brevity. Standard errors clustered at the industry level (4-digit NAICS) are reported in brackets. Variable definitions are available in Appendix C. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Appendix G – Controlling for Income Trends

It is important to note that the empirical analysis is vulnerable to explanations from industry-specific responses to volatile income trends. Volatile income streams contaminate the numerator of profitability measures and, by extension, the earnings volatility measures employed in this study. I alleviate this concern in two steps. First, I orthogonalize the risk-taking variables, Y_{it}, with respect to those trends. To do so, I estimate the following model for each NAICS industry for the period 1989 – 2001:

$$Y_{it} = \alpha_0 + \alpha_1 \times \%\Delta PI_t + \varepsilon_{it} \tag{G.1}$$

where $\%\Delta PI_t$ is the percentage change in aggregate corporate pre-tax income (available here). I then estimate expected risk-taking levels using industry-specific coefficients $\hat{\alpha}_0$ and $\hat{\alpha}_1$ from Eq. (G.1). Second, I estimate Eq. (1) using the residual risk-taking, *Residual* Y_{it}, calculated as follows:

$$Residual\ Y_{it} = Y_{it} - \hat{\alpha}_0 - \hat{\alpha}_1 \times \%\Delta PI_t \tag{G.2}$$

The DD estimates from those regressions are reported in Table G.1. The estimates on $BONUS_{jt}$ are fairly consistent with those reported in the main body of the study. Hence, aggregate income trends do not seem to drive the estimated risk-taking responses to bonus depreciation.

Table G.1
Controlling for income trends.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Residual Y_{it}:	*ROA* Vol_{it}	*RNOA* Vol_{it}	*PROA* Vol_{it}	*CROA* Vol_{it}	*Stock* Vol_{it}	*Unlev. Stock* Vol_{it}	*RVC* $Uncertainty_{it}$	*Unlevered* $Beta_{it}$
$BONUS_{jt}$	20.33***	18.29***	20.59***	13.01**	10.60***	10.47***	18.72**	16.03***
	[6.04]	[6.03]	[5.90]	[5.66]	[2.11]	[1.84]	[8.57]	[4.06]
Firm-Yrs	34,794	34,794	34,794	34,794	34,762	34,757	34,757	32,249
Adj. R^2	62.13%	60.97%	63.95%	56.46%	58.64%	61.62%	91.02%	41.78%
Controls	X	X	X	X	X	X	X	X
FEs	X	X	X	X	X	X	X	X
Cluster	4-digit NAICS							

Notes: This table reports estimates of the effect of bonus depreciation on corporate risk-taking using OLS regressions. The dependent variables have been orthogonalized with respect to industry-specific income trends. All estimation parameters correspond to the specification in Column (5) of Table 2. The coefficient vector of the covariates, Γ, is not displayed for brevity. Standard errors clustered at the industry level (4-digit NAICS) are reported in brackets. Variable definitions are available in Appendix C. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Appendix H – External Validity Tests

In this Appendix, I investigate the interplay between bonus depreciation and various corporate outcomes. To do so, I regress those outcomes on $BONUS_{jt}$, X_{it}, and Ψ_{it}. The results are reported in Table H.1. For brevity, I report the DD estimates on $BONUS_{jt}$. Consistent with House and Shapiro (2008), Zwick and Mahon (2017) and Curtis et al. (2023), firms increase capital investments in response to bonus depreciation incentives. Furthermore, bonus depreciation does not induce a significant substitution effect with respect to R&D investments. Consistent with Ohrn (2018), firms do not respond to bonus depreciation by altering their financial structure or tax planning strategies. Furthermore, bonus depreciation is not related to accounting-based rates of return (Edgerton, 2010). Last but not least, bonus depreciation is not associated with larger managerial equity risk incentives. This finding is important as it implies that the estimated — throughout the study — risk-taking effect is not mechanical due to convex CEO payoffs in response to the tax policy (e.g., Coles et al., 2006).

Table H.1
The effect of bonus depreciation on other corporate outcomes.

	(1) $CAPEX_{it}$	(2) RD_{it}	(3) $Leverage_{it}$	(4) $HS\ Delta_{it}$	(5) ROA_{it}	(6) $Marg.\ Q_{it}$	(7) $Tax\ Risk_{it}$	(8) $Vega_{it}$
$BONUS_{jt}$	6.24***	-13.14	-0.37	-0.09	-1.24	65.27***	11.74	5.43
	[2.35]	[10.74]	[1.34]	[0.17]	[1.07]	[14.67]	[12.44]	[19.60]
Firm-Yrs	34,738	34,817	34,817	33,927	34,817	34,817	34,817	15,045
Adj. R^2	30.54%	53.75%	71.29%	46.28%	62.72%	54.05%	64.46%	52.87%
Controls	X	X	X	X	X	X	X	X
Firm FE	X	X	X	X	X	X	X	X
Size–Yr FE	X	X	X	X	X	X	X	X
Sales Growth–Yr FE	X	X	X	X	X	X	X	X
Marg. TR–Yr FE	X	X	X	X	X	X	X	X
Cluster	4-digit NAICS							

Notes: This table reports estimates of the effect of bonus depreciation on corporate outcomes using OLS regressions. In Column (1), $CAPEX_{it}$ is the dependent variable. In Column (2), RD_{it} is the dependent variable. In Column (3), $Leverage_{it}$ is the dependent variable. In Column (4), $HS\ Delta_{it}$ is the dependent variable. In Column (5), ROA_{it} is the dependent variable. In Column (6), $Marg.\ Q_{it}$ is the dependent variable. In Column (7), $Tax\ Risk_{it}$ is the dependent variable. In Column (8), $Vega_{it}$ is the dependent variable, and $Delta_{it}$ is also included in the vector of covariates. All other estimation parameters correspond to the specification in Column (5) of Table 2. The coefficient vector of the covariates, Γ, is not displayed for brevity. Standard errors clustered at the industry level (4-digit NAICS) are reported in brackets. Variable definitions are available in Appendix C. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.