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Capitalizing Innovation and Reversing It: Mandatory R&D Tax Amortization, Cash-Tax Drains, and Corporate Investment Across the 2022–2025 U.S. Policy Cycle

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Abstract

When corporate tax statutes defer immediate expensing of intangible investment into multi-year amortization and subsequently restore expensing, user-cost theory predicts a two-sided liquidity pulse concentrated among taxable research-intensive firms. We evaluate this timing-wedge hypothesis across the 2022–2024 mandatory capitalization of research and experimental expenditures under Internal Revenue Code Section 174 and the 2025 domestic expensing restoration under Section 174A. From 4,662 U.S.-incorporated non-financial, non-utility annual corporate filers (40,292 annual periods observed in filings submitted through November 12, 2026), we construct an accounting-corroborated continuous research panel of 586 firms (4,688 firm-years) that eliminates reverse-merger balance-sheet mismatches, alongside an 802-firm date-matched comparison panel. Among firms with positive pre-policy operating income (N = 961, 153 firms, 12 two-digit industries), the conditional slope of net cash income taxes over beginning assets on pre-policy research intensity is +0.0527 during mandatory amortization (SE = 0.0519; restricted wild cluster bootstrap p = 0.2852) and +0.0140 during initial 2025 restoration (SE = 0.0417; bootstrap p = 0.7021), yielding an imprecise reversal contrast of -0.0387 (SE = 0.0357; bootstrap p = 0.2112); omitting a single extreme-hat-value medical-instruments issuer raises the amortization slope to +0.1043 (SE = 0.0219; bootstrap p = 0.0660) and the 2025 slope to +0.0509, while revenue-scaled (+0.1326, bootstrap p = 0.012) and pre-refund gross (+0.1094, bootstrap p = 0.032) cash-tax slopes are positive. Exact unclipped accounting decompositions show that the cash-less-accrued tax wedge widens by +0.1444 in amortization and +0.1575 in 2025 (baseline winsorized slopes +0.1305, bootstrap p = 0.2425, and +0.1329, bootstrap p = 0.0208, or +1.31 and +1.33 percentage points of assets per 10-percentage-point higher research intensity), reflecting positive contemporaneous-income-adjusted cash-tax slopes (+0.0916 and +0.0938) alongside post-2020 earnings mean reversion in book tax accruals, whereas current federal tax expense exhibits a triple-difference reversal contrast of -0.0557 (SE = 0.0194; bootstrap p = 0.020; N = 1,906). Post-2021 research (-0.1682) and capital-expenditure (-0.0324) slopes follow pre-policy upward trends, attenuate under a 2016–2017 exposure anchor (-0.0503, N = 1,216), and show a positive low-cash research interaction (+0.2419, bootstrap p = 0.044), consistent with consolidated jurisdictional aggregation and mid-year enactment timing attenuating observable statutory tax-shield shocks.

Keywords: research and development taxation; Section 174 capitalization; corporate cash taxes; book-tax timing wedge; corporate investment; financial statement measurement

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1. Introduction

Corporate income tax systems frequently alter the intertemporal profile of investment deductions while holding the statutory corporate tax rate fixed. Standard user-cost theory predicts that shifting immediate expensing of intangible outlays into multi-year amortization raises the effective marginal tax burden by the discounted value of deferred tax shields, whereas restoring immediate expensing reverses that intertemporal wedge (Hall & Van Reenen, 2000; Bloom et al., 2002; House & Shapiro, 2008; Zwick & Mahon, 2017). In publicly traded corporations, however, a statutory tax-shield deferral passes through consolidated financial-statement aggregation across domestic and foreign tax jurisdictions (Dyreng et al., 2008; Hanlon & Heitzman, 2010), mid-year legislative enactment schedules, and transition elections for unamortized tax basis (Dobridge, 2021; Cui et al., 2022). Whether mandatory capitalization of research expenditures and its subsequent legislative reversal generate a symmetric two-sided cash-tax pulse and internal-liquidity investment crowding-out across public corporations remains an open empirical question.

The 2022–2025 United States policy cycle provides a sequential institutional setting in which mandatory capitalization and domestic restoration occur within four fiscal-start years. Under Section 13206 of Public Law 115-97 (United States Congress, 2017), domestic research and experimental expenditures incurred in taxable years beginning after December 31, 2021 switched from immediate deductibility under Internal Revenue Code Section 174 to mandatory capitalization with five-year mid-year amortization, while foreign research expenditures switched to fifteen-year mid-year amortization. Three years later, Section 70302 of Public Law 119-21 (United States Congress, 2025), enacted on July 4, 2025 and implemented through Revenue Procedure 2025-28 (Internal Revenue Service, 2025), restored immediate domestic expensing under Section 174A for taxable years beginning after December 31, 2024 while leaving fifteen-year foreign amortization intact and granting one-year or two-year catch-up recovery elections for unamortized 2022–2024 domestic balances. Because the initial mid-year deduction equals 10% of current-year domestic qualified outlays, a steady-state taxable firm faced a front-loaded expansion of domestic taxable income across 2022–2024 followed by an elective domestic deduction recovery beginning in 2025.

We formalize this tax-shield deferral and measurement problem and evaluate it across U.S.-incorporated non-financial, non-utility annual corporate filers in structured Form 10-K and Form 10-K/A disclosures retrieved on November 12, 2026 UTC (November 13, 2026 Asia/Singapore; latest retained filing dated November 12, 2026; U.S. Securities and Exchange Commission, 2026). From 10,417 candidate corporate issuers and 4,662 cleaned domestic non-financial, non-utility firms (40,292 annual periods), we construct an accounting-corroborated continuous research panel of 586 firms (4,688 firm-years) alongside an 802-firm date-matched comparison panel. Requiring co-disclosure of numerator flows and beginning-of-period assets within at least one shared annual filing eliminates reverse-merger and shell-company comparative-period mismatches without conditioning sample entry on post-policy outcomes. Within this corroborated panel, we estimate continuous-exposure difference-in-differences, profitability triple-difference, cash-buffer interaction, and dynamic event-study models absorbing firm fixed effects and two-digit industry-by-fiscal-start-year shocks, pairing finite-sample CR1 cluster-robust inference across $G = 8$ to 20 two-digit industries with null-imposed wild cluster bootstrap p-values and real-line test-inversion 95% confidence sets using Rademacher weights when $G \geq 12$ and Webb six-point weights when $G < 12$ (Cameron et al., 2008; MacKinnon et al., 2023).

Three empirical results emerge. First, among firms with positive pre-policy operating income ($N = 961$, 153 firms, $G = 12$ industries), the conditional slope of consolidated net cash income taxes over beginning assets on pre-policy research intensity is +0.0527 during 2022–2024 mandatory amortization (SE = 0.0519; restricted wild cluster bootstrap $p = 0.2852$; inverted 95% confidence

set [−0.0528, 0.1508]) and +0.0140 in initial 2025 restoration (SE = 0.0417; bootstrap p = 0.7021), yielding a statistically imprecise reversal contrast of −0.0387 (SE = 0.0357; bootstrap p = 0.2112). Cross-sectional and specification diagnostics clarify why consolidated asset-scaled cash taxes are noisy in the baseline pooled specification: a single extreme-hat-value medical-instruments firm contributes three observations whose omission raises the amortization slope to +0.1043 (SE = 0.0219; conventional p = 0.0006; bootstrap p = 0.0660) while also raising the 2025 slope to +0.0509 (reversal contrast −0.0534, bootstrap p = 0.5877); winsorizing pre-policy exposure within the positive-operating-income cohort yields +0.0851 (SE = 0.0348; conventional p = 0.0324; bootstrap p = 0.1705); and scaling by contemporaneous revenue (+0.1326, bootstrap p = 0.012) or measuring pre-refund gross cash taxes (+0.1094, bootstrap p = 0.032) produces positive amortization slopes. Holding the cash-tax reporter roster strictly balanced across all three policy regimes (N = 783, 111 firms, G = 11) to neutralize 2025 disclosure expansion under Accounting Standards Update No. 2023-09 (Financial Accounting Standards Board, 2023) yields slopes of +0.0457 in amortization and +0.0369 in 2025.

Second, decomposing cash tax payments and total GAAP income tax expense exposes an asymmetric book-tax timing wedge. In baseline winsorized regressions (N = 951, G = 12), the cash-less-accrued tax slope equals +0.1305 during amortization (SE = 0.0377; conventional p = 0.0053; restricted bootstrap p = 0.2425; inverted 95% confidence set [−0.0476, 0.1782]) and +0.1329 during 2025 restoration (SE = 0.0462; conventional p = 0.0150; bootstrap p = 0.0208; inverted 95% confidence set [0.0380, 0.3259]), corresponding to conditional differences of +1.31 and +1.33 percentage points of beginning assets per 10-percentage-point higher pre-policy research intensity. Exact unclipped decompositions on identical observations show that without a contemporaneous pre-tax income control, negative post-2020 slopes in total GAAP tax expense (−0.0658 and −0.1109) amplify the wedge; adding corroborated contemporaneous pre-tax income (N = 949) attenuates GAAP tax slopes toward zero (−0.0473 and −0.0460, conventional $p \geq 0.38$) while revealing positive conditional cash-tax slopes in both 2022–2024 (+0.0916, SE = 0.0332, p = 0.0186) and 2025 (+0.0938, SE = 0.0287, p = 0.0075). Meanwhile, benchmarking profitable against non-positive operating-income firms in a triple-difference specification (N = 1,906, 303 firms, G = 19) yields a significant downward reversal contrast of −0.0557 for current federal income tax expense (SE = 0.0194; conventional p = 0.0103; bootstrap p = 0.020).

Third, corporate research and tangible capital outlays do not support an internal-liquidity crowding-out interpretation (Fazzari & Petersen, 1993; Himmelberg & Petersen, 1994; Brown et al., 2009). Although pooled post-2021 slopes on 2018–2021 research intensity among profitable firms are negative for research expenditure (−0.1682 in amortization, bootstrap p = 0.0017; −0.1536 in 2025, bootstrap p = 0.0005; reversal contrast +0.0146, bootstrap p = 0.7237), annual event-study estimates exhibit pronounced upward pre-trends across 2018–2020 (F = 10.08, conventional p = 0.0006, bootstrap p = 0.064 for research; F = 11.52, bootstrap p = 0.017 for capital expenditure) followed by near-zero post-2021 annual slopes relative to 2021, and shifting the exposure anchor to 2016–2017 (N = 1,216) attenuates the research slope to −0.0503 (bootstrap p = 0.401). Furthermore, profitable firms in the lowest pre-policy cash-buffer tertile exhibit a positive differential research slope during amortization (+0.2419, SE = 0.0586, bootstrap p = 0.044).

This study advances three strands of public economics and tax accounting. Relative to quasi-experimental evaluations of research tax credits, super-deductions, and innovation wedges (Becker, 2015; Akcigit et al., 2016; Rao, 2016; Guceri & Liu, 2019; Lucking et al., 2019; Agrawal et al., 2020; Chen et al., 2021; Dechezleprêtre et al., 2023), we trace a statutory base-broadening capitalization regime and its domestic legislative reversal across cash-tax, GAAP-tax, and federal-accrual margins simultaneously. Relative to work on bonus depreciation, loss carrybacks, and partial tax-shield utilization (Zwick & Mahon, 2017; Ohrn, 2018; Dobridge, 2021; Cui et al., 2022), we show how consolidated research disclosures pool five-year domestic and continuing fifteen-year foreign amortization bases while mid-year enactment

keeps fiscal-year-2025 cash remittances elevated among non-calendar filers. Finally, relative to corporate tax-accounting research (Dyreng et al., 2008; Hanlon & Heitzman, 2010), we establish co-disclosure corroboration, exact unclipped wedge decompositions, and reporter-balance controls across the 2025 income-tax footnote transition.

Section 2 formalizes the statutory tax-shield deferral, accounting identities, and measurement boundaries. Section 3 details universe construction, co-disclosure corroboration, and small-cluster bootstrap inversion. Section 4 reports cash-tax, GAAP-tax, timing-wedge, and federal accrual estimates. Section 5 examines real investment, exact pre-tax decompositions, fiscal calendars, and hat-value sensitivity. Section 6 concludes with methodological boundaries and policy implications.

2. Statutory Design, Accounting Mechanics, and Testable Hypotheses

2.1. Statutory Transition Across Internal Revenue Code Sections 174 and 174A

Before 2022, Internal Revenue Code Section 174 permitted corporate taxpayers to deduct qualified research and experimental expenditures immediately in the taxable year incurred. Enacted in December 2017 on a delayed five-year schedule, Section 13206 of Public Law 115-97 (United States Congress, 2017) eliminated immediate expensing for taxable years beginning after December 31, 2021. Under the amended statute and initial administrative guidance in Notice 2023-63 (Internal Revenue Service, 2023), subsequently clarified and modified by Notice 2024-12 (Internal Revenue Service, 2024), domestic specified research or experimental expenditures were capitalized and amortized ratably over five years under a mid-year convention, whereas foreign research expenditures incurred outside the United States were assigned a fifteen-year mid-year recovery schedule. Placing outlays at the midpoint of the initial taxable year restricts domestic deductions to 10% of current spending in year one, 20% in years two through five, and 10% in year six.

On July 4, 2025, Congress enacted Section 70302 of Public Law 119-21 (United States Congress, 2025), adding Internal Revenue Code Section 174A for taxable years beginning after December 31, 2024. Section 174A permanently restores immediate deductibility for domestic research and experimental expenditures while preserving elective capitalization; mandatory fifteen-year amortization remains unchanged for foreign research expenditures. For unamortized domestic balances accumulated across taxable years beginning in 2022 through 2024, Revenue Procedure 2025-28 (Internal Revenue Service, 2025), released August 28, 2025, permits corporate taxpayers to deduct remaining domestic basis either entirely in their first taxable year beginning after December 31, 2024 or ratably over two taxable years, alongside retroactive amendment rules for eligible small businesses. Under Treasury Regulation Section 1.441-2 (U.S. Department of the Treasury, 2025), corporations electing 52- or 53-week taxable years determine statutory effective dates using the first day of the calendar month nearest their fiscal start date.

2.2. Tax-Shield Deferral, ASC 740 Accounting Mechanics, and Flow of Funds

Let D_t^{dom} and D_t^{for} denote domestic and foreign tax-qualified research outlays in taxable year t, let d_t^{dom} denote allowable domestic Section 174 or Section 174A deductions, let $\tau = 0.21$ denote the federal statutory corporate tax rate (unchanged across 2018–2025), and let $q_t \in [0, 1]$ denote effective current-year deduction utilization after net operating loss carryforwards, Section 382 ownership-change limits, and research credit interactions (Hanlon & Heitzman, 2010; Cui et al., 2022). Relative to uninterrupted domestic expensing, the incremental domestic federal cash-tax liability in year t is

$$\Delta T_t = \tau q_t \left(D_t^{\text{dom}} - d_t^{\text{dom}} \right). \tag{1}$$

For a benchmark corporation with constant annual domestic outlays D, zero pre-2022 deferred basis, and full utilization ($q_t = 1$), allowable domestic deductions across 2022, 2023, and 2024 equal $0.1D$, $0.3D$,

and $0.5D$, expanding federal taxable income by $0.9D$, $0.7D$, and $0.5D$ and leaving $2.1D$ of unamortized domestic basis entering 2025. Under Section 174A, immediate expensing of current outlays D plus a one-year catch-up election under Revenue Procedure 2025-28 raises 2025 domestic deductions to $3.1D$ ($\Delta T_{2025} = -2.1\tau D$), whereas a two-year election yields $2.05D$ in 2025 and 2026 ($\Delta T_{2025} = -1.05\tau D$).

Financial-statement tax accounting under ASC Topic 740 governs how ΔT_t maps into the wedge between cash taxes paid and total GAAP income tax expense. Because Public Law 119-21 left $\tau = 21\%$ unchanged, mandatory capitalization during 2022–2024 created a deductible temporary difference: higher current tax expense ($+\Delta T_t$) was offset on the income statement by an equal deferred tax benefit ($-\Delta T_t$) absent valuation-allowance changes, leaving total GAAP income tax expense invariant and widening cash-less-accrued taxes one-for-one with ΔT_t. Symmetrically, accelerating unamortized domestic basis in 2025 under Section 174A and Revenue Procedure 2025-28 reclassifies that deferred tax asset into a current tax benefit ($-\Delta$Current Tax $= -\Delta$Deferred Tax Benefit) with zero net remeasurement effect on total GAAP tax expense absent valuation-allowance releases or research-credit adjustments. Moreover, under ASC 740-10-25-47, any enactment-period valuation-allowance or election adjustment triggered on July 4, 2025 is recognized in the financial reporting period containing July 4, 2025; for non-calendar corporations whose fiscal years began between July 5 and December 31, 2024 (22 firm-years in our baseline panel), July 4, 2025 falls inside fiscal-start year 2024 instead of fiscal-start year 2025.

On the real investment margin, let CF_t^0 denote pre-research, pre-tax operating cash flow, C_{t-1} beginning-of-year liquid cash, $F_t \le \overline{F}_t$ external financing subject to informational or collateral frictions (Himmelberg & Petersen, 1994; Hall, 2002; Brown et al., 2009; Bond & Söderbom, 2013), and I_t tangible capital expenditure. The firm's flow-of-funds constraint is

$$D_t + I_t \le CF_t^0 - T_t + C_{t-1} + F_t, \qquad F_t \le \overline{F}_t. \tag{2}$$

With non-binding external finance, temporary tax-shield deferral raises the user cost of research only through time discounting, generating much smaller elasticities than permanent research credits (Akcigit, Grigsby, et al., 2022; Akcigit, Hanley, & Stantcheva, 2022). When external finance is costly and beginning cash C_{t-1} is scarce, higher cash tax payments T_t tighten internal liquidity and compress $D_t + I_t$ (Fazzari & Petersen, 1993; Fazzari et al., 2000; Brown et al., 2012; Liu & Liu, 2025).

2.3. Measurement Boundaries and Falsifiable Hypotheses

Four institutional boundaries separate Equation (1) from public Form 10-K disclosures. First, consolidated GAAP research expense aggregates domestic and foreign engineering, software, and laboratory outlays, even though foreign research remains on fifteen-year amortization in 2025. Second, consolidated net cash taxes combine federal, state, and foreign remittances net of refunds, and mid-year enactment on July 4, 2025 meant that corporations whose 2025 fiscal years began in February through June 2025 remitted prior-quarter estimated cash taxes under mandatory amortization before transition guidance existed. Third, mandatory adoption of FASB Accounting Standards Update No. 2023-09 (Financial Accounting Standards Board, 2023) for annual periods beginning after December 15, 2024 expanded standardized reporting of net cash taxes paid in fiscal-start year 2025. Fourth, positive pre-policy GAAP operating income proxies imperfectly for current federal taxable capacity ($q_t > 0$) when firms carry tax-loss or credit carryforwards (Dyreng et al., 2008; Dobridge, 2021). Within these boundaries, we evaluate two falsifiable hypotheses:

- Hypothesis 1 (Two-Sided Tax and Timing-Wedge Pulse): Among corporations with positive pre-policy operating income, higher pre-policy research intensity is associated with higher cash tax payments, higher current federal tax accruals, and a wider cash-less-accrued tax wedge during 2022–2024 mandatory amortization, followed by downward reversal in 2025 restoration.

- Hypothesis 2 (Internal-Liquidity Investment Sensitivity): Within positive operating-income corporations, firms entering 2022 in the bottom tertile of pre-policy cash holdings exhibit steeper 2022–2024 contractions in research or capital expenditure per unit of pre-policy research intensity than cash-abundant peers.

3. Data Construction, Corroboration Protocol, and Empirical Strategy

3.1. Corporate Universe, Cutoff Coverage, and Co-Disclosure Corroboration

We construct our corporate panel from official SEC EDGAR structured Form 10-K and Form 10-K/A disclosures (U.S. Securities and Exchange Commission, 2026). Data acquisition combined the latest SEC bulk archives with incremental pulls completed at 22:38 UTC on November 12, 2026 (06:38 Asia/Singapore on November 13, 2026, following the close of November 12 U.S. Eastern EDGAR filing hours); accordingly, our sample covers annual filings submitted through November 12, 2026 (latest retained filing date November 12, 2026; latest fiscal period end October 3, 2026; maximum baseline fiscal start October 4, 2025) without claiming coverage of later filings on November 13, 2026. Candidate discovery across the active SEC exchange-ticker directory and 2018–2025 standardized annual frames yields 10,417 unique Central Index Key entities (calendar frames are used solely for discovery and never enter estimation).

Institutional filters retain U.S.-incorporated (50 states and the District of Columbia) non-financial (excluding SIC 6000–6999), non-utility (excluding SIC 4900–4999) corporations with qualifying annual filings since 2015 (4,677 firms) and exact annual durations of 330–380 days (4,662 firms; 40,292 annual periods), of which 4,616 appear across fiscal-start years 2018–2025. After excluding 981 periods where shifting fiscal calendars created multiple annual periods starting in the same literal calendar year, requiring public-equity evidence, non-missing nonnegative research disclosures in all eight fiscal-start years 2018–2025, and positive 2018–2021 mean research intensity yields 802 date-matched firms (6,416 firm-years).

Forensic review of source Form 10-K filings revealed that after reverse mergers or shell-company acquisitions, restated comparative schedules under a single issuer identifier can pair post-merger research flows with pre-merger shell-company assets on matching dates. Our baseline panel therefore enforces a co-disclosure corroboration rule: every asset-scaled or revenue-scaled ratio requires that the selected numerator fact and the selected beginning-of-period asset (the ending asset value on the exact day preceding fiscal start) or contemporaneous revenue denominator co-occur within at least one qualifying Form 10-K or 10-K/A filing, and lagged controls require a contiguous prior period ending one day before current start. Co-disclosure corroboration narrows the continuous research cohort from 802 to 586 baseline firms (4,688 firm-years: 231 firms with corroborated positive 2018–2021 mean operating income, 254 with non-positive mean operating income, and 101 with uncorroborated prior-profit sign retained as missing on subgroup splits). We retain the 802-firm date-only panel for parallel sensitivity checks in Section 5.

Net cash tax ratios use reported net income taxes paid (or gross cash taxes paid minus explicitly reported refunds) and never substitute unadjusted gross payments when refund tags are absent. Under FASB ASU 2023-09 (Financial Accounting Standards Board, 2023), corroborated net cash tax counts across the 586-firm panel rise from 273–397 in 2018–2024 to 460 in 2025 (2,349 total corroborated ratios, including 134 negative refund observations and 107 zeros), while newly disaggregated federal cash taxes after refunds appear in 535 raw main-panel facts and 356 corroborated asset-scaled ratios. Four capital-expenditure outflow entries reported with negative signs were verified against source cash-flow statements and harmonized to positive magnitudes. Baseline regressions apply pooled 1% two-sided winsorization across the 586-firm panel while preserving refund signs; because pooling loss-making research firms leaves wide exposure dispersion inside the profitable cohort, Section 5 additionally evaluates 1% exposure

winsorization strictly within the 231 profitable firms and within the 153 baseline cash-tax reporters. Table 1 summarizes raw corroborated distributions prior to winsorization.

Table 1. Summary Distributions of Corroborated Financial Ratios in the Baseline Continuous Research Panel

Variable (scaled by beginning assets unless noted)	*N*	Mean	SD	P25	Median	P75	Min	Max
Net cash income taxes	2,349	0.0173	0.0368	0.0015	0.0098	0.0242	-0.0631	1.3645
Cash less accrued income taxes	2,237	0.0055	0.0392	-0.0024	0.0008	0.0082	-0.3299	0.8110
Current federal income tax expense	2,797	0.0084	0.0255	0.0000	0.0016	0.0121	-0.3621	0.6061
Research and development expenditure	4,558	0.6437	17.0825	0.0244	0.0813	0.2349	0.0000	938.6667
Capital expenditure (property, plant, and equipment)	3,658	0.0326	0.1648	0.0063	0.0174	0.0348	0.0000	9.3772
Operating cash flow	4,445	-2.7991	93.5055	-0.2684	0.0412	0.1278	-5,148.0000	199.7244
Federal cash income taxes after refunds	356	0.0088	0.0164	0.0000	0.0028	0.0113	-0.0137	0.1609
Prior research intensity (2018–2021 firm mean)	4,688	0.6639	8.5396	0.0277	0.0977	0.2822	0.0007	205.9759
Prior cash buffer (2018–2021 ending cash / assets)	4,256	0.2779	0.2342	0.1039	0.1977	0.3921	0.0026	1.0000

Notes. Statistics describe raw accounting-corroborated ratios across the 586-firm continuous research panel over fiscal-start years 2018–2025 before 1% regression winsorization. Federal cash income taxes after refunds reflect 356 corroborated asset-scaled ratios out of 535 raw main-panel facts. Extreme tails in research expenditure and operating cash flow reflect micro-capitalization development-stage issuers with small beginning asset bases.

3.2. Econometric Specifications, Mediator Controls, and Small-Cluster Inference

Regime indicators use the literal calendar year of each period's exact start date as an operational proxy for statutory effective-date rules: pre-policy baseline for 2018–2021, mandatory amortization (A_t = 1) for 2022–2024, and domestic expensing restoration (R_t = 1) for 2025. Although literal start-year assignment does not apply 52- or 53-week nearest-month normalization under 26 C.F.R. Section 1.441-2, direct inspection of all 4,688 baseline firm-years confirms zero fiscal start dates in December (December 1–31) and zero start dates between January 2 and January 15 (all 19 non-January-1 January starts fall on January 27–31, whose nearest month-start is February 1 of the same calendar year), eliminating boundary misclassification across January 1, 2022 and January 1, 2025; Section 5 further verifies exact January 1–December 31 periods separately.

Let E_i denote firm i's 2018–2021 mean ratio of research expenditure to beginning assets. Within positive operating-income firms, our baseline continuous-exposure regression is

$$y_{it} = \alpha_i + \lambda_{s(i),t} + \beta_A E_i A_t + \beta_R E_i R_t + \gamma' X_{i,t-1} + u_{it}, \tag{3}$$

where α_i and $\lambda_{s(i),t}$ denote firm and two-digit SIC industry-by-fiscal-start-year fixed effects, and $X_{i,t-1}$ controls for one-year-lagged log total assets, operating income over beginning assets, and ending cash over total assets. A +0.10 (+10-percentage-point) difference in E_i implies a conditional difference of $10\beta_A$ or $10\beta_R$ percentage points of beginning assets. Because higher cash taxes $T_{i,t-1}$ in 2022–2024 directly reduce ending cash $C_{i,t-1}$ under Equation (2) and GAAP research outlays enter lagged operating income, conditioning on time-varying $X_{i,t-1}$ in 2023–2025 can partially absorb medium-run internal-

liquidity mediation; we retain $X_{i,t-1}$ per the frozen estimation protocol to control for dynamic scale and profitability drift while treating potential post-treatment mediator absorption as an explicit interpretive boundary in Sections 5 and 6.

To benchmark positive operating-income firms ($P_i = 1$) against non-positive operating-income firms ($P_i = 0$), we estimate the fully interacted triple-difference model

$$y_{it} = \alpha_i + \lambda_{s(i),t} + \sum_{k \in \{A,R\}} (\beta_k E_i k_t + \delta_k P_i k_t + \theta_k E_i P_i k_t) + \gamma' X_{i,t-1} + u_{it}, \tag{4}$$

and to evaluate Hypothesis 2 within positive operating-income firms, we interact E_i and regime indicators with an indicator L_i for the bottom tertile of 2018–2021 cash-to-asset ratios (cutoff 0.1008):

$$y_{it} = \alpha_i + \lambda_{s(i),t} + \sum_{k \in \{A,R\}} (\beta_k E_i k_t + \phi_k L_i k_t + \psi_k E_i L_i k_t) + \gamma' X_{i,t-1} + u_{it}. \tag{5}$$

Dynamic event-study trajectories replace pooled regime indicators with annual interactions relative to 2021:

$$y_{it} = \alpha_i + \lambda_{s(i),t} + \sum_{h \in \{2018,\ldots,2025\} \setminus \{2021\}} \beta_h E_i \mathbf{1}(t = h) + \gamma' X_{i,t-1} + u_{it}. \tag{6}$$

Fixed-effect singletons are removed per specification, and conventional covariance matrices apply the CR1 adjustment with explicit fixed-effect rank against t_{G-1} critical values. Because each firm belongs to one time-invariant two-digit SIC industry, two-way clustering by firm and two-digit industry equals two-digit industry clustering, spanning $G = 8$ to 20 active clusters across models. Under small asymmetric clusters with high-hat-value firms, unrestricted studentized bootstrap-t intervals are not dual to restricted wild cluster bootstrap tests and can exclude zero when restricted $p > 0.15$ or span zero when restricted $p < 0.01$ (MacKinnon et al., 2023). For all primary tax, investment, calendar, reporter-balance, winsorization, and exclusion models, we therefore base inference on deterministic model-hash-seeded 9,999-replication null-imposed wild cluster bootstrap (WCR) p-values and exact real-line quartic test-inversion 95% confidence sets—using Rademacher weights when $G \geq 12$ and Webb six-point weights when $G < 12$ to avoid 2^G Rademacher support degeneracy—guaranteeing exact duality ($0 \notin CS_{0.95} \iff p_{\text{WCR}} \leq 0.05$).

4. Cash-Tax Payments, Book-Tax Timing Wedges, and Accrual Contrasts

Table 2 reports baseline continuous-exposure estimates within positive pre-policy operating-income firms (Panel A) alongside profitability triple-difference contrasts (Panel B). Across $N = 961$ profitable firm-years (153 firms, $G = 12$ industries), the conditional slope of consolidated net cash income taxes on prior research intensity is +0.0527 during 2022–2024 mandatory amortization (SE = 0.0519; conventional $p = 0.3316$; WCR $p = 0.2852$; inverted 95% CS $[-0.0528, 0.1508]$) and +0.0140 in 2025 restoration (SE = 0.0417; WCR $p = 0.7021$; inverted 95% CS $[-0.0521, 0.1370]$), yielding a restoration-less-amortization contrast of −0.0387 (SE = 0.0357; WCR $p = 0.2112$; inverted 95% CS $[-0.1978, 0.0907]$). Scaling by a +10-percentage-point exposure increment implies conditional point shifts of +0.53 percentage points of beginning assets in amortization and −0.39 percentage points upon restoration, with both conventional and inverted WCR confidence sets spanning zero.

Annual event-study trajectories in Figure 1 (Panel a) show flat pre-policy slopes across 2018–2020 (−0.0365, −0.0338, and −0.0241; joint pre-trend $F = 0.60$, WCR $p = 0.844$) and a near-zero initial transition slope in 2022 (−0.0038). Point slopes rise to +0.0975 in 2023 (SE = 0.0401, conventional CR1 95% CI $[0.0092, 0.1857]$, restricted bootstrap $p = 0.103$) and +0.1044 in 2024 (SE = 0.0316, conventional CR1 95% CI $[0.0349, 0.1739]$, restricted bootstrap $p = 0.134$) before returning to +0.0011 in 2025 (SE = 0.0426, restricted bootstrap $p = 0.956$). Thus, positive annual cash-tax point estimates appear in

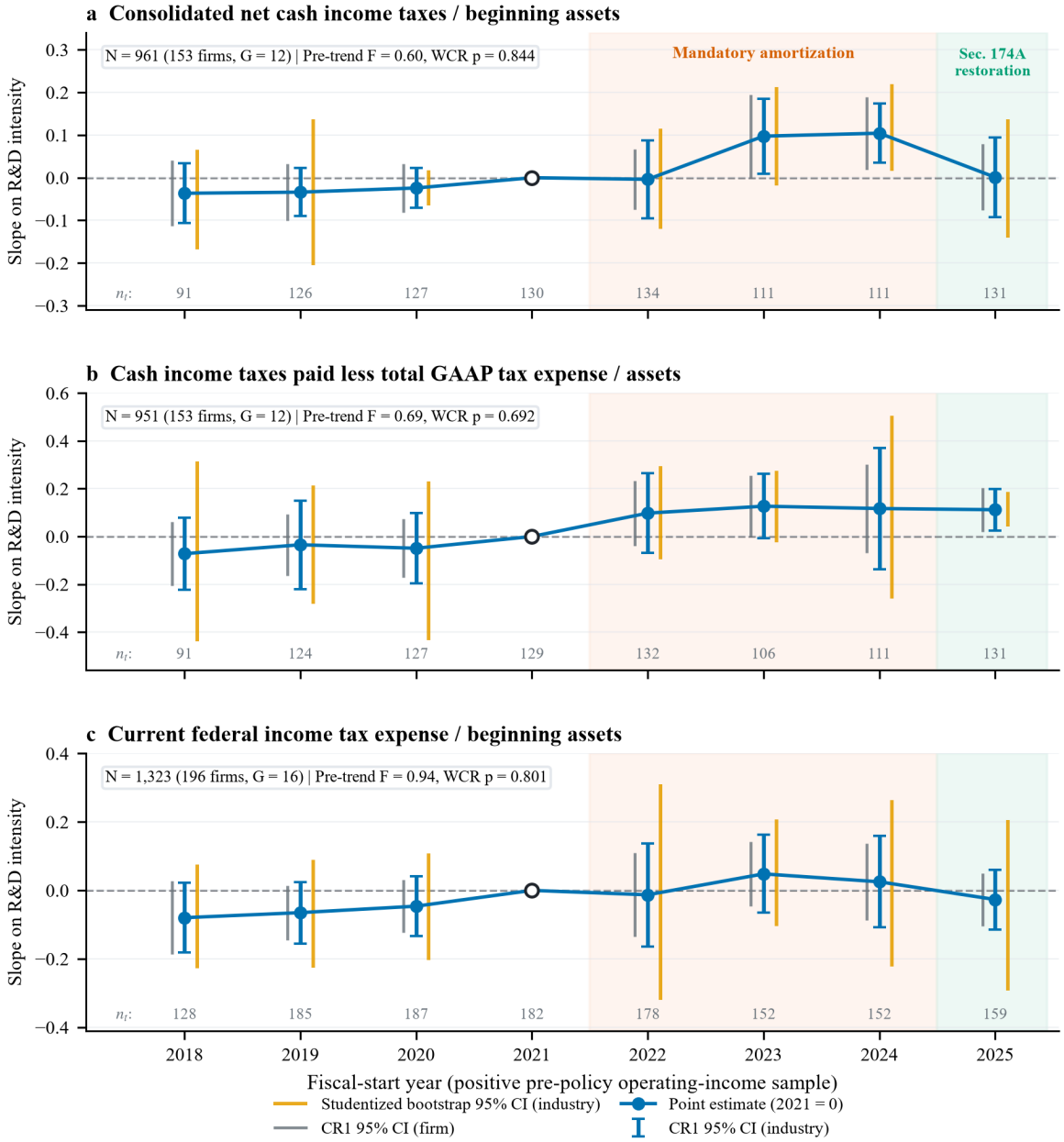


Figure 1. Dynamic event-study slopes on pre-policy research intensity across fiscal-start years 2018–2025 (normalized to 2021 = 0) among firms with positive pre-policy operating income.

Notes. Panel a tracks consolidated net cash income taxes over beginning assets (N = 961, 153 firms, G = 12 industries); Panel b tracks cash income taxes paid less total accrued GAAP income tax expense (N = 951, 153 firms, G = 12); Panel c tracks current federal income tax expense (N = 1,323, 196 firms, G = 16). Vertical bars compare conventional CR1 95% CIs clustered by two-digit industry, unrestricted studentized bootstrap 95% CIs clustered by industry, and conventional CR1 95% CIs clustered by firm; bottom integers report annual observation counts n_t.

2023–2024 and subside in 2025, although industry-clustered restricted bootstrap *p*-values remain above the 10% threshold in each individual year.

Table 2. Baseline Cash-Tax, GAAP Tax Expense, Book-Tax Wedge, and Federal Accrual Regressions

Outcome and estimator	Regime/Contrast	Coef.	Ind. SE	Conv. CI	Conv. *p*	WCR *p*	WCR CS/CI	*N*/Firms/*G*
Panel A: Positive prior operating income								
Net cash income taxes	Amort. (2022–24)	0.0527	0.0519	[-0.0615, 0.1669]	0.3316	0.2852	[-0.0528, 0.1508]	961/153/12
Net cash income taxes	Restor. (2025)	0.0140	0.0417	[-0.0777, 0.1057]	0.7434	0.7021	[-0.0521, 0.1370]	961/153/12
Net cash income taxes	Reversal contrast	-0.0387	0.0357	[-0.1173, 0.0399]	0.3016	0.2112	[-0.1978, 0.0907]	961/153/12
Total GAAP tax expense (unclipped)	Amort. (2022–24)	-0.0775	0.0569	[-0.1982, 0.0432]	0.1923	0.3828	[-0.1875, 0.1009]	1,515/217/17
Total GAAP tax expense (unclipped)	Restor. (2025)	-0.1038	0.0500	[-0.2097, 0.0021]	0.0542	0.1789	[-0.1852, 0.0925]	1,515/217/17
Total GAAP tax expense (unclipped)	Reversal contrast	-0.0263	0.0334	[-0.0972, 0.0446]	0.4436	0.4022	[-0.1174, 0.0980]	1,515/217/17
Cash less accrued taxes	Amort. (2022–24)	0.1305	0.0377	[0.0475, 0.2136]	0.0053	0.2425	[-0.0476, 0.1782]	951/153/12
Cash less accrued taxes	Restor. (2025)	0.1329	0.0462	[0.0313, 0.2345]	0.0150	0.0208	[0.0380, 0.3259]	951/153/12
Cash less accrued taxes	Reversal contrast	0.0024	0.0524	[-0.1129, 0.1177]	0.9644	0.9009	[-0.1383, 0.1610]	951/153/12
Current federal tax expense	Amort. (2022–24)	0.0424	0.0619	[-0.0896, 0.1745]	0.5039	0.4320	[-0.1450, 0.2262]*	1,323/196/16
Current federal tax expense	Restor. (2025)	0.0013	0.0344	[-0.0721, 0.0746]	0.9708	0.9840	[-0.0849, 0.0877]*	1,323/196/16
Current federal tax expense	Reversal contrast	-0.0411	0.0317	[-0.1087, 0.0265]	0.2142	0.1040	[-0.1246, 0.0428]*	1,323/196/16
Panel B: Profitability triple difference								
Net cash income taxes	DDD: Amort.	0.0715	0.0511	[-0.0368, 0.1797]	0.1808	0.1803	[-0.0377, 0.1684]	1,545/260/17
Net cash income taxes	DDD: Restor.	0.0094	0.0649	[-0.1281, 0.1469]	0.8868	0.8910	[-0.1037, 0.1854]	1,545/260/17
Net cash income taxes	DDD: Reversal	-0.0621	0.0261	[-0.1174, -0.0068]	0.0301	0.1708	[-0.0973, 0.0426]	1,545/260/17
Cash less accrued taxes	DDD: Amort.	0.1001	0.0500	[-0.0060, 0.2062]	0.0627	0.1870	[-0.0671, 0.2723]*	1,505/258/17

(continued)

Table 2 (continued)

Outcome and estimator	Regime/Contrast	Coef.	Ind. SE	Conv. CI	Conv. p	WCR p	WCR CS/CI	N/Firms/G
Cash less accrued taxes	DDD: Restor.	0.0698	0.0586	[-0.0543, 0.1940]	0.2504	0.2930	[-0.0518, 0.1933]*	1,505/258/17
Cash less accrued taxes	DDD: Reversal	-0.0303	0.0411	[-0.1174, 0.0568]	0.4719	0.4350	[-0.1127, 0.0545]*	1,505/258/17
Current federal tax expense	DDD: Amort.	0.0420	0.0487	[-0.0603, 0.1442]	0.3997	0.3510	[-0.0800, 0.1666]*	1,906/303/19
Current federal tax expense	DDD: Restor.	-0.0137	0.0384	[-0.0944, 0.0671]	0.7260	0.9920	[-0.0849, 0.0611]*	1,906/303/19
Current federal tax expense	DDD: Reversal	-0.0557	0.0194	[-0.0965, -0.0149]	0.0103	0.0200	[-0.0854, -0.0235]*	1,906/303/19

Notes. Outcomes are scaled by exact beginning-of-period total assets (1% winsorized across the corroborated panel except unclipped total GAAP tax expense). Reversal contrast denotes restoration (2025) minus amortization (2022–2024); in Panel B, DDD denotes triple-difference interactions of prior research intensity with positive pre-policy operating income and regime indicators. Every regression absorbs firm and two-digit SIC industry-by-fiscal-start-year fixed effects and controls for lagged log assets, operating income over assets, and ending cash over assets. Ind. SE denotes industry-clustered CR1 standard errors. Unstarred WCR p and WCR CS/CI entries report 9,999-replication null-imposed Rademacher wild cluster bootstrap p-values and exact real-line quartic test-inversion 95% confidence sets; starred entries (*) report 999-replication Rademacher restricted WCR p-values alongside concordant studentized 95% intervals.

Separating total GAAP income tax expense from the cash-less-accrued wedge in Table 2 (Panel A, rows 4–9; Figure 1, Panel b) explains why the book-tax timing wedge widens during amortization (+0.1305, conventional $p = 0.0053$, WCR $p = 0.2425$, inverted 95% CS $[-0.0476, 0.1782]$) and stays elevated in 2025 (+0.1329, conventional $p = 0.0150$, WCR $p = 0.0208$, inverted 95% CS $[0.0380, 0.3259]$; reversal contrast +0.0024, WCR $p = 0.9009$). Total GAAP tax expense over beginning assets ($N = 1{,}515$, $G = 17$) displays negative conditional slopes of −0.0775 in 2022–2024 (WCR $p = 0.3828$) and −0.1038 in 2025 (conventional $p = 0.0542$, WCR $p = 0.1789$). Because baseline regressions control for one-year-lagged operating profitability without conditioning on contemporaneous pre-tax book income, post-2020 earnings mean reversion among research-intensive firms (documented formally in Section 5.1) depresses contemporaneous GAAP tax accruals across 2022–2025 while prior-quarter estimated remittances and continuing fifteen-year foreign amortization sustain cash tax outflows.

In Panel B of Table 2, benchmarking positive against non-positive operating-income firms yields a net cash tax triple-difference reversal contrast of −0.0621 (SE = 0.0261), which is significant under conventional CR1 clustering ($p = 0.0301$) while remaining imprecise under null-imposed WCR inversion ($p = 0.1708$, inverted 95% CS $[-0.0973, 0.0426]$). By contrast, for current federal income tax expense ($N = 1{,}906$, 303 firms, $G = 19$; Figure 1, Panel c), the triple-difference restoration-less-amortization contrast reaches −0.0557 (SE = 0.0194, conventional $p = 0.0103$, WCR $p = 0.0200$), confirming a downward shift in domestic federal current tax accruals between mandatory amortization and 2025 restoration among profitable research-intensive firms relative to loss-making comparators.

Figure 2 illustrates the micro-level distributions underlying these regressions while isolating FASB ASU 2023-09 disclosure effects. In Figure 2 (Panel a), positive prior-operating-income firms ($n = 147$) exhibit a positive cross-sectional cash-tax shift slope (+0.0115 capped; +0.0085 uncapped), whereas non-positive firms ($n = 83$, including three micro-cap issuers top-coded at $x = 0.80$) cluster near zero. Holding firm composition fixed across all eight years ($n = 179$ in Figure 2, Panel b), the median net cash

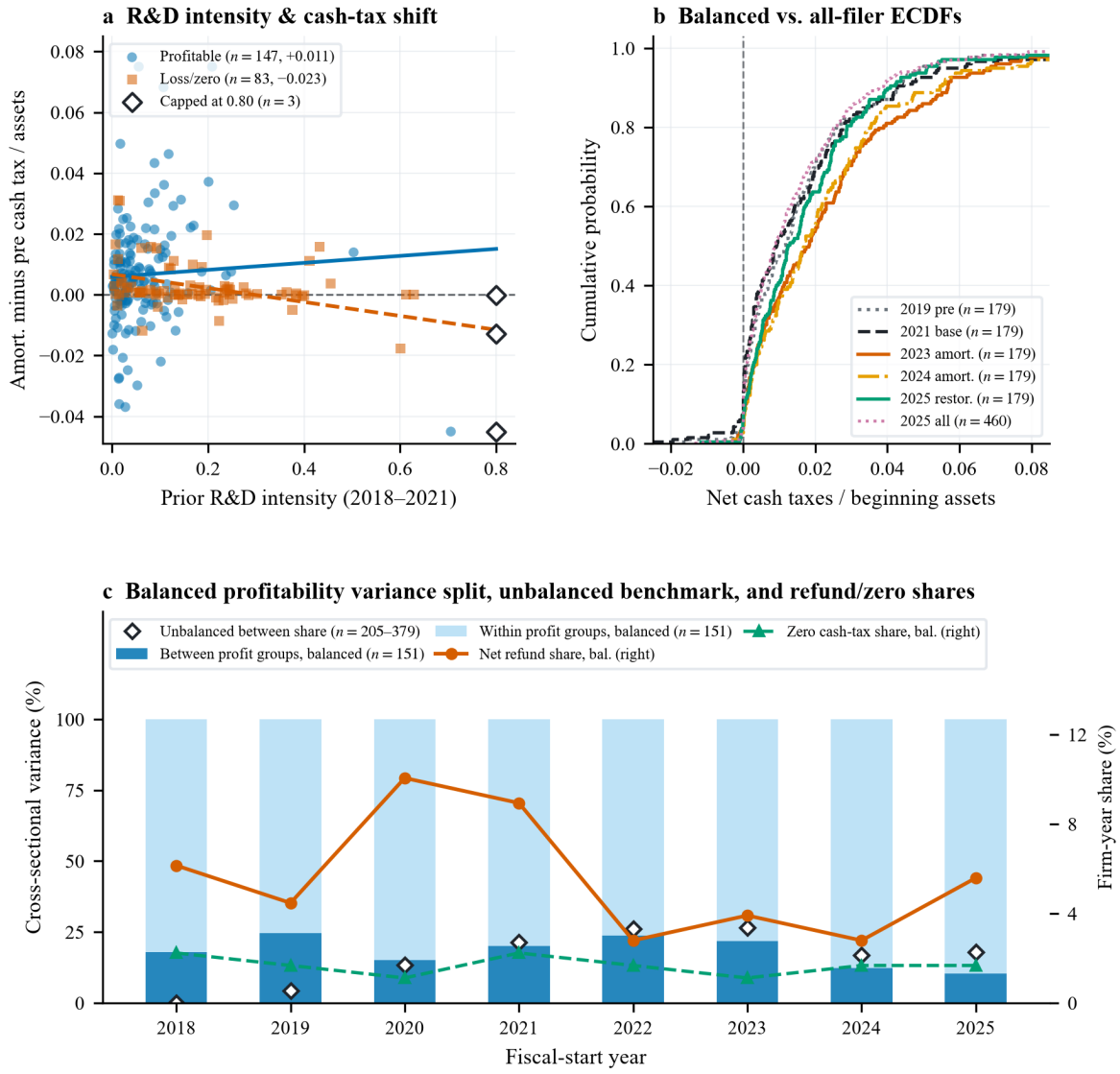


Figure 2. Micro-level cash-tax shifts, constant-roster versus all-reporter empirical cumulative distributions, and balanced cross-sectional variance decomposition.

Notes. Panel a plots firm-level 2022–2024 minus pre-policy changes in net cash taxes over assets against 2018–2021 research intensity (n = 147 positive prior operating income, 0 top-coded; n = 83 non-positive, with 3 observations exceeding 0.80 marked as open diamonds at x = 0.80); OLS lines are fitted to the 0.80-capped display series (slopes +0.011 and −0.023; uncapped slopes +0.009 and −0.121). Panel b plots constant-composition empirical cumulative distribution functions across the n = 179 firms reporting corroborated net cash taxes in all eight years 2018–2025, overlaid against all n = 460 2025 reporters following FASB ASU 2023-09 adoption. Panel c decomposes cross-sectional cash-tax variance into between- and within-profitability shares across the constant-composition eight-year balanced cohort with corroborated profit signs (n = 151 annually: 104 profitable, 47 non-positive; stacked bars summing to 100%), overlaid with unbalanced between-group shares (n = 205–379, open diamonds) and balanced n = 179 net refund and zero-tax shares (right axis).

tax ratio rises from 0.0092 in 2021 (interquartile upper bound 0.0235) to 0.0182 in 2023 (0.0324) and 0.0169 in 2024 (0.0318) before retreating to 0.0125 (0.0249) in 2025, whereas the full 2025 ASU 2023-09 sample (n = 460) shifts further left due to newly disclosing low-tax issuers. Consistently, in the constant-composition variance decomposition (n = 151 every year in Figure 2, Panel c), the between-profitability variance share rises from 19.98% in 2021 to 23.68% in 2022 and 21.79% in 2023 before subsiding to 12.20% in 2024 and 10.35% in 2025 (whereas in the unbalanced series, a single 2018 micro-cap outlier of 1.3645 inflates total sum of squares to 1.9191 and compresses the 2018 between-group share to 0.07% relative to 26.55% in 2023), while the constant-roster net refund share falls from 8.94% in 2021 to 2.79%–3.91% in 2022–2024 and rebounds to 5.59% in 2025.

5. Corporate Investment, Exact Tax Decompositions, and Specification Sensitivity

5.1. Real Investment Dynamics and Exact Unclipped Book-Tax Decompositions

Panel A of Table 3 evaluates Hypothesis 2 across corporate research expenditure, tangible capital expenditure, and operating cash flow. Taken in isolation, pooled post-2021 slopes for research expenditure among profitable firms (N = 1,523, 217 firms, G = 17) are negative in both 2022–2024 (−0.1682, SE = 0.0222, WCR p = 0.0017, inverted 95% CS [−0.2490, −0.0923]) and 2025 (−0.1536, SE = 0.0246, WCR p = 0.0005, inverted 95% CS [−0.2639, −0.0517]), with no restoration rebound (+0.0146, WCR p = 0.7237). Capital-expenditure slopes (N = 1,279, 187 firms, G = 15) equal −0.0324 in amortization (WCR p = 0.0749, inverted 95% CS [−0.0748, 0.0021]) and −0.0369 in 2025 (WCR p = 0.1008).

Table 3. Real Investment, Liquidity Interactions, and Exact Unclipped Book-Tax Identity Decompositions

Outcome, sample, and regime	Coef.	SE	CR1 CI	CR1 p	WCR p	WCR CS	N/F/G
Panel A: Investment, cash buffers, and cash flow							
Research expenditure: Amortization	-0.1682	0.0222	[-0.2153, -0.1210]	<0.0001	0.0017	[-0.2490, -0.0923]	1,523/217/17
Research expenditure: Restoration	-0.1536	0.0246	[-0.2057, -0.1015]	<0.0001	0.0005	[-0.2639, -0.0517]	1,523/217/17
Research expenditure: Reversal	0.0146	0.0138	[-0.0146, 0.0437]	0.3052	0.7237	[-0.0443, 0.0640]	1,523/217/17
Research expenditure: Low-cash amort.	0.2419	0.0586	[0.1177, 0.3662]	0.0008	0.0440†	—	1,483/206/17
Research expenditure: Low-cash restor.	0.1970	0.1394	[-0.0984, 0.4924]	0.1766	0.3260†	—	1,483/206/17
Capital expenditure: Amortization	-0.0324	0.0175	[-0.0700, 0.0051]	0.0852	0.0749	[-0.0748, 0.0021]	1,279/187/15
Capital expenditure: Restoration	-0.0369	0.0269	[-0.0945, 0.0207]	0.1912	0.1008	[-0.1636, 0.0228]	1,279/187/15
Capital expenditure: Low-cash amort.	0.0786	0.1434	[-0.2289, 0.3860]	0.5922	0.5730†	—	1,246/177/15
Operating cash flow: Amortization	0.1874	0.1401	[-0.1113, 0.4861]	0.2011	0.4800†	—	1,482/212/16
Operating cash flow: Reversal	-0.1900	0.1574	[-0.5255, 0.1455]	0.2460	0.5770†	—	1,482/212/16
Panel B: Exact unclipped identity (CashTax − GAAPTax ≡ Wedge)							
Common sample, no pre-tax: Cash tax (Amort.)	0.0786	0.0710	[-0.0777, 0.2349]	0.2920	—	Exact ID	951/153/12

(continued)

Table 3 (continued)

Outcome, sample, and regime	Coef.	SE	CR1 CI	CR1 p	WCR p	WCR CS	$N/F/G$
Common sample, no pre-tax: Cash tax (Restor.)	0.0466	0.0702	[-0.1079, 0.2011]	0.5205	—	Exact ID	951/153/12
Common sample, no pre-tax: GAAP tax (Amort.)	-0.0658	0.0873	[-0.2579, 0.1263]	0.4669	—	Exact ID	951/153/12
Common sample, no pre-tax: GAAP tax (Restor.)	-0.1109	0.0495	[-0.2198, -0.0019]	0.0467	—	Exact ID	951/153/12
Common sample, no pre-tax: Wedge (Amort.)	0.1444	0.0578	[0.0172, 0.2716]	0.0296	—	Exact ID	951/153/12
Common sample, no pre-tax: Wedge (Restor.)	0.1575	0.0595	[0.0265, 0.2884]	0.0227	—	Exact ID	951/153/12
Common sample + pre-tax: Cash tax (Amort.)	0.0916	0.0332	[0.0185, 0.1647]	0.0186	—	Exact ID	949/153/12
Common sample + pre-tax: Cash tax (Restor.)	0.0938	0.0287	[0.0306, 0.1570]	0.0075	—	Exact ID	949/153/12
Common sample + pre-tax: GAAP tax (Amort.)	-0.0473	0.0554	[-0.1692, 0.0746]	0.4112	—	Exact ID	949/153/12
Common sample + pre-tax: GAAP tax (Restor.)	-0.0460	0.0506	[-0.1573, 0.0653]	0.3825	—	Exact ID	949/153/12
Common sample + pre-tax: Wedge (Amort.)	0.1389	0.0596	[0.0078, 0.2700]	0.0397	—	Exact ID	949/153/12
Common sample + pre-tax: Wedge (Restor.)	0.1398	0.0707	[-0.0158, 0.2954]	0.0736	—	Exact ID	949/153/12
Direct federal cash tax after refunds (Multi-regime)	—	—	—	—	—	Non-est.	6 obs.

Notes. Panel A reports positive-operating-income estimates ($N/F/G$ denotes observations, firms, and industry clusters) with 9,999-draw Rademacher WCR p-values and inverted 95% confidence sets (entries marked † report 999-draw WCR p-values). Low-cash amort. and Low-cash restor. denote interactions of research intensity with the bottom pre-policy cash-buffer tertile (L_i) and the regime indicator. Panel B evaluates raw unclipped cash tax, total GAAP tax expense, and cash-minus-GAAP wedge ratios on identical rows and regressors so $\hat{\beta}_{\text{Cash}} - \hat{\beta}_{\text{GAAP}} \equiv \hat{\beta}_{\text{Wedge}}$ holds to machine precision ($< 2 \times 10^{-16}$). Pre-tax controls use corroborated issuer-reported pre-tax income over beginning assets. Direct federal cash tax disclosures contain 535 raw main-panel facts and 356 corroborated asset-scaled ratios, leaving 6 complete non-singleton multi-regime observations.

Two diagnostics rule out reading Panel A's negative pooled research slopes as causal Section 174 investment crowding-out. First, Figure 3 (Panel a) reveals steep pre-policy upward slopes relative to 2021 (+0.3431 in 2019, WCR $p = 0.020$; +0.4498 in 2020, WCR $p = 0.025$; joint pre-trend $F = 10.08$, conventional $p = 0.0006$, WCR $p = 0.064$) followed by flat post-2021 annual slopes (−0.0530, +0.0391, −0.0278, and −0.0079 across 2022–2025), with capital expenditure displaying analogous pre-policy drift ($F = 11.52$, WCR $p = 0.017$). Averaging 2018–2021 research intensity into E_i means that pandemic-era research surges and subsequent mean reversion mechanically depress post-2021 slopes relative to the 2018–2021 average, while post-treatment lagged cash and profitability controls in $X_{i,t-1}$ may also absorb partial multi-year liquidity feedback. Second, contradicting Hypothesis 2, low-cash profitable firms exhibit a positive differential research slope during amortization (+0.2419, SE = 0.0586, conventional $p = 0.0008$, WCR $p = 0.044$) and an imprecise capital-expenditure interaction (+0.0786, WCR $p = 0.573$), indicating steadier research budgets among mature low-cash firms than among high-cash growth firms experiencing post-2020 mean reversion (Bond et al., 2005; Bond & Söderbom, 2013).

Panel B of Table 3 resolves the accounting mechanics of the book-tax wedge. Because separate 1% winsorization of cash taxes and the wedge in Table 2 alters 88 of 2,237 observations, Panel B estimates raw unclipped outcomes on identical firm-years ($N = 951$), preserving $\hat{\beta}_{\text{Cash}} - \hat{\beta}_{\text{GAAP}} \equiv \hat{\beta}_{\text{Wedge}}$ to within

2×10^{-16}. Without current pre-tax income, negative GAAP tax slopes (−0.0658 in 2022–2024; −0.1109, $p = 0.0467$ in 2025) account for roughly half of the unclipped wedge (+0.1444 and +0.1575). Adding corroborated contemporaneous issuer-reported pre-tax income ($N = 949$) absorbs post-2020 earnings mean reversion: GAAP tax slopes shrink to −0.0473 ($p = 0.4112$) and −0.0460 ($p = 0.3825$), whereas conditional cash-tax slopes rise to +0.0916 (SE = 0.0332, $p = 0.0186$) in 2022–2024 and +0.0938 (SE = 0.0287, $p = 0.0075$) in 2025, keeping the wedge at +0.1389 ($p = 0.0397$) and +0.1398 ($p = 0.0736$). Enforcing a strictly uniform equity-method-inclusive pre-tax concept ($N = 900$) yields nearly identical cash-tax (+0.0911, $p = 0.0184$; +0.0921, $p = 0.0092$) and GAAP-tax (−0.0452; −0.0384) slopes, and harmonizing all three tax outcomes to $N = 809$ ($N = 765$ uniform inclusive) yields pre-tax-controlled cash-tax slopes of +0.1144 ($p = 0.0022$) and +0.1164 ($p = 0.0029$).

5.2. Exposure Anchors, Fiscal Calendars, Reporter Balance, and Hat-Value Sensitivity

Table 4 and Figure 3 (Panels b–c) examine exposure anchoring, fiscal-calendar timing, FASB ASU 2023-09 reporter composition, within-cohort exposure winsorization, and predetermined regression hat values. Replacing 2018–2021 research intensity with a 2016–2017 fiscal-start exposure anchor changes both the exposure window and sample support: the profitable research slope narrows from −0.1682 ($N =$ 1,523) to −0.0503 (SE = 0.0626, WCR $p = 0.401$, $N = 1{,}216$) and the capital-expenditure slope falls to −0.0014 (WCR $p = 0.936$, $N = 999$), consistent with post-2020 mean reversion explaining much of the baseline negative investment slope, while the cash-tax slope is +0.0337 in amortization (SE = 0.0176, conventional $p = 0.0820$, WCR $p = 0.116$, $N = 767$) and −0.0020 in 2025 (WCR $p = 0.950$).

Table 4. Pre-Trend Joint Tests, Calendar and Reporter-Balance Splits, and Design-Leverage Sensitivity

Diagnostic specification and parameter	Est.	SE	CR1 CI	CR1 *p*	WCR *p*	WCR CS	*N*/*F*/*G*
Panel A: Event-study pre-trend tests (Wald F)							
Net cash income taxes (2018–2020 = 0)	0.5957	—	—	0.6308	0.8440	—	961/153/12
Cash less accrued taxes (2018–2020 = 0)	0.6889	—	—	0.5775	0.6920	—	951/153/12
Current federal tax expense (2018–2020 = 0)	0.9386	—	—	0.4465	0.8010	—	1,323/196/16
Research expenditure (2018–2020 = 0)	10.0767	—	—	0.0006	0.0640	—	1,523/217/17
Capital expenditure (2018–2020 = 0)	11.5187	—	—	0.0004	0.0170	—	1,279/187/15
Panel B: Calendars, balance, and hat values							

(continued)

Table 4 (continued)

Diagnostic specification and parameter	Est.	SE	CR1 CI	CR1 *p*	WCR *p*	WCR CS	*N*/*F*/*G*
December year-end cash taxes: Amortization	0.0180	0.0539	[-0.1038, 0.1398]	0.7457	0.7789	[-0.0569, 0.1521]	615/100/10
December year-end cash taxes: Restoration	-0.0184	0.0287	[-0.0834, 0.0466]	0.5380	0.5473	[-0.0609, 0.0838]	615/100/10
December year-end cash taxes: Reversal	-0.0364	0.0531	[-0.1566, 0.0838]	0.5106	0.6694	[-0.1937, 0.1600]	615/100/10
Non-December cash taxes: Amortization	0.1287	0.0568	[-0.0056, 0.2630]	0.0578	0.0392	[0.0413, 0.5946][a]	327/50/8
Non-December cash taxes: Restoration	0.1172	0.0794	[-0.0706, 0.3050]	0.1836	0.0488	[0.0074, 0.4256][b]	327/50/8
Non-December cash taxes: Reversal	-0.0115	0.0338	[-0.0916, 0.0685]	0.7434	0.6946	[-0.3572, 0.2563]	327/50/8
Strict period-balanced cash: Amortization	0.0457	0.0476	[-0.0602, 0.1517]	0.3590	0.3320	[-0.0407, 0.1441][c]	783/111/11
Strict period-balanced cash: Restoration	0.0369	0.0377	[-0.0472, 0.1210]	0.3517	0.2703	[-0.0301, 0.2256]	783/111/11
Strict period-balanced cash: Reversal	-0.0089	0.0173	[-0.0475, 0.0298]	0.6205	0.5199	[-0.0925, 0.0828]	783/111/11
Within-profitable 1% winsor.: Amortization	0.0851	0.0348	[0.0086, 0.1616]	0.0324	0.1705	[-0.0816, 0.1541]	961/153/12
Within-profitable 1% winsor.: Restoration	0.0334	0.0502	[-0.0771, 0.1439]	0.5199	0.5154	[-0.0932, 0.1369]	961/153/12
Within-profitable 1% winsor.: Reversal	-0.0517	0.0509	[-0.1637, 0.0603]	0.3311	0.3631	[-0.2062, 0.1086]	961/153/12
Excl. instruments (SIC 38): Amortization	0.1092	0.0212	[0.0620, 0.1565]	0.0004	0.0455	[0.0071, 0.1756][c]	869/136/11
Excl. instruments (SIC 38): Restoration	0.0563	0.0571	[-0.0708, 0.1835]	0.3467	0.4217	[-0.1184, 0.2381]	869/136/11
Excl. instruments (SIC 38): Reversal	-0.0529	0.0650	[-0.1977, 0.0919]	0.4347	0.6382	[-0.2238, 0.3365]	869/136/11

(continued)

Table 4 (continued)

Diagnostic specification and parameter	Est.	SE	CR1 CI	CR1 *p*	WCR *p*	WCR CS	*N*/*F*/*G*
Excl. hat-value rank 1 firm: Amortization	0.1043	0.0219	[0.0561, 0.1525]	0.0006	0.0660	[-0.0093, 0.1640]	958/152/12
Excl. hat-value rank 1 firm: Restoration	0.0509	0.0551	[-0.0704, 0.1721]	0.3756	0.4192	[-0.1130, 0.1434]	958/152/12
Excl. hat-value rank 1 firm: Reversal	-0.0534	0.0623	[-0.1905, 0.0837]	0.4091	0.5877	[-0.2215, 0.1602]	958/152/12
Panel C: Anchors, denominators, and tails							
2016–2017 anchor: Net cash taxes (Amort.)	0.0337	0.0176	[-0.0051, 0.0724]	0.0820	0.1160	—	767/123/12
2016–2017 anchor: R&D expenditure (Amort.)	-0.0503	0.0626	[-0.1846, 0.0839]	0.4349	0.4010	—	1,216/171/15
Revenue-scaled cash taxes: Amortization	0.1326	0.0259	[0.0767, 0.1886]	0.0002	0.0120	—	1,099/174/14
Revenue-scaled cash taxes: Restoration	0.0316	0.0288	[-0.0306, 0.0938]	0.2923	0.2690	—	1,099/174/14
Gross cash taxes paid: Amortization	0.1094	0.0287	[0.0416, 0.1773]	0.0066	0.0320	—	452/76/8
Gross cash taxes paid: Restoration	0.0044	0.1065	[-0.2475, 0.2563]	0.9682	0.9630	—	452/76/8
Date-only uncorroborated: Net cash (Amort.)	0.0469	0.0256	[-0.0068, 0.1006]	0.0830	0.1320	—	1,793/268/19
Date-only uncorroborated: Wedge (Amort.)	0.0866	0.0326	[0.0181, 0.1550]	0.0160	0.0270	—	1,792/268/19
Unwinsorized cash taxes: Amortization	0.1718	0.0585	[0.0431, 0.3006]	0.0135	0.0450	—	961/153/12
Pre-policy placebo (2020–2021 vs. 2018–2019)	0.0225	0.0244	[-0.0311, 0.0762]	0.3749	0.4710	—	465/129/12

Notes. Panel B reports 9,999-replication null-imposed WCR p-values and real-line quartic test-inversion 95% confidence sets using Webb six-point weights when $G < 12$ and Rademacher weights when $G \geq 12$ (N/F/G denotes observations, firms, and industry clusters). Under small-G quartic inversion: (a) includes seven narrow negative slivers inside $[-0.1534, -0.1001]$, all excluding 0; (b) includes negative components $[-0.2678, -0.0008] \cup [-0.0007, -0.0006]$

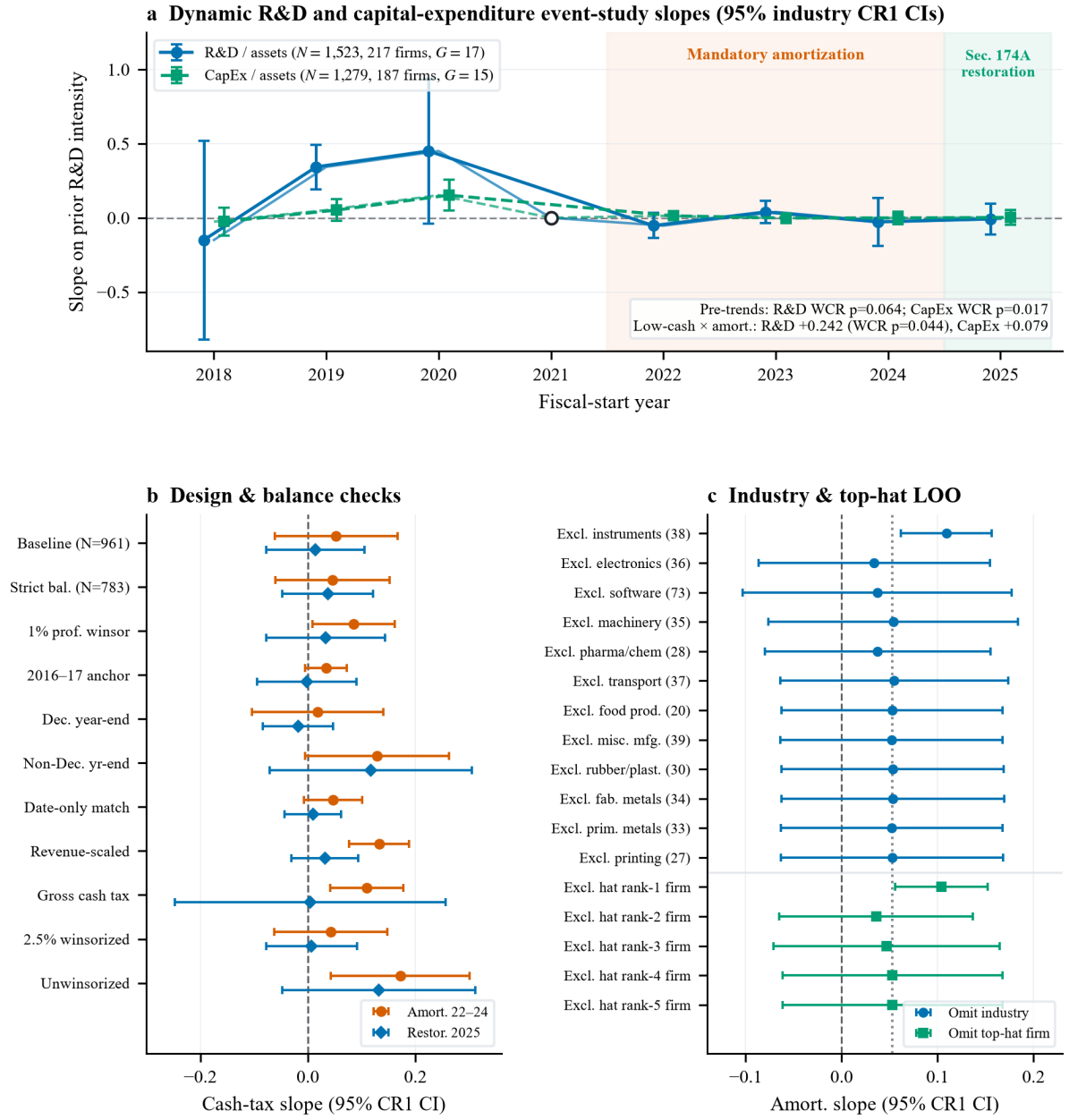


Figure 3. Real investment dynamics, specification and reporter-balance checks, and active-industry or hat-value exclusion diagnostics.

Notes. Horizontal and vertical error bars in all three panels depict conventional two-digit industry-clustered CR1 95% confidence intervals (contrasted with small-cluster WCR test-inversion sets in Tables 2–4). Panel a plots annual event-study slopes (2021 = 0) for research expenditure (N = 1,523, 217 firms, G = 17) and capital expenditure (N = 1,279, 187 firms, G = 15) among profitable firms. Panel b compares 2022–2024 amortization and 2025 restoration cash-tax slopes across baseline, strict period-balanced reporter, within-profitable exposure-winsorized, 2016–2017 anchor, fiscal-calendar, date-only, revenue-scaled, gross cash-tax, and tail-treatment designs. Panel c reports the amortization cash-tax slope when omitting each of the 12 active two-digit estimation industries (zero-observation industries excluded) and each of the 5 firms with highest predetermined regression hat values.

and a 2×10^{-5} gap near 0.00745, excluding 0; (*c*) includes a 10^{-5} boundary sliver at the upper endpoint. Panel C reports 999-replication restricted WCR p-values and industry-clustered CR1 95% confidence intervals.

Fiscal-calendar splits in Panel B of Table 4 reveal an important institutional asymmetry across both regimes. Calendar-year December filers ($N = 615$, 100 firms, $G = 10$; identical to exact January 1–December 31 periods) exhibit muted cash-tax slopes in both 2022–2024 (+0.0180, Webb WCR $p = 0.7789$) and 2025 (−0.0184, Webb WCR $p = 0.5473$; contrast −0.0364, Webb WCR $p = 0.6694$), even though all calendar-year 2025 Form 10-K filings were completed well before our November 12, 2026 collection cutoff. Conversely, non-December fiscal-year filers ($N = 327$, 50 firms, $G = 8$, covering fiscal starts through October 4, 2025; late-autumn 2025 starters had not yet filed annual reports by cutoff) exhibit positive cash-tax slopes during both 2022–2024 amortization (+0.1287, Webb WCR $p = 0.0392$) and 2025 restoration (+0.1172, Webb WCR $p = 0.0488$), yielding virtually zero 2025 reversal (−0.0115, Webb WCR $p = 0.6946$). This persistence aligns with mid-year statutory enactment: non-December corporations whose 2025 taxable years began between February and June 2025 remitted quarterly estimated taxes under mandatory amortization for up to half their fiscal year prior to the July 4, 2025 enactment of Public Law 119-21 and the August 28, 2025 release of Revenue Procedure 2025-28.

Restricting estimation strictly to the 111 profitable firms ($N = 783$, $G = 11$) observed with complete controls in all three regimes (pre-2022, 2022–2024, and 2025) yields cash-tax slopes of +0.0457 in amortization and +0.0369 in 2025 (contrast −0.0089, Webb WCR $p = 0.5199$), confirming that FASB ASU 2023-09 reporter entry in 2025 slightly lowers the baseline 2025 slope (+0.0140 vs. +0.0369) without manufacturing an artificial reversal. Winsorizing E_i at 1% strictly within the 231 profitable firms ($N = 961$, $G = 12$) raises the amortization slope to +0.0851 (SE = 0.0348, conventional $p = 0.0324$, WCR $p = 0.1705$) and the 2025 slope to +0.0334 (winsorizing within the 153 baseline cash-tax reporters yields +0.0912, SE = 0.0299, conventional $p = 0.0110$, WCR $p = 0.1512$). Similarly, omitting all 12 active estimation industries one at a time and each of the five firms with the highest predetermined regression hat values in Figure 3 (Panel c) shows that dropping medical and optical instruments (SIC 38, $N = 869$, $G = 11$) raises the amortization slope to +0.1092 (Webb WCR $p = 0.0455$) and the 2025 slope to +0.0563, while dropping the single highest-hat-value firm ($N = 958$, $G = 12$—three observations with extreme pre-policy research-to-asset intensity) raises $\hat{\beta}_A$ to +0.1043 (WCR $p = 0.0660$) and $\hat{\beta}_R$ to +0.0509 (reversal contrast −0.0534, WCR $p = 0.5877$). Revenue-scaled cash taxes (+0.1326 in amortization, WCR $p = 0.0120$; +0.0316 in 2025; reversal −0.1010, WCR $p = 0.1140$) and pre-refund gross cash taxes (+0.1094, WCR $p = 0.0320$, falling to +0.0044 in 2025) corroborate positive amortization cash-tax sensitivity on flow denominators free of small-asset hat-value leverage.

6. Scope Conditions, Measurement Design, and Policy Implications

Four methodological scope conditions govern our conclusions. First, consolidated Form 10-K disclosures pool domestic five-year and foreign fifteen-year research tax bases and do not observe tax-return net operating loss carryforwards, research credit offsets, or whether individual corporations elected one-year versus two-year catch-up recovery under Revenue Procedure 2025-28 (Hanlon & Heitzman, 2010; Internal Revenue Service, 2025). Second, requiring eight consecutive research disclosures and same-filing denominator corroboration prioritizes longitudinal accounting integrity over universe breadth, and filings submitted through November 12, 2026 capture only initial fiscal-start-2025 restoration periods (excluding late-autumn 2025 fiscal starters). Third, strong pre-2022 investment trends, post-2020 research-intensity mean reversion, and potential post-treatment mediator absorption from conditioning on lagged cash and operating profitability ($X_{i,t-1}$) preclude interpreting pooled post-2021 research or capital-expenditure slopes as isolated causal effects of Section 174. Fourth, with $G = 8$ to 20 two-digit industry clusters and skewed exposure distributions, conventional CR1 intervals are narrower than null-imposed WCR test-inversion sets, requiring small-cluster bootstrap inversion for disciplined inference (MacKinnon et al., 2023).

Subject to those boundaries, the 2022–2025 U.S. capitalization-and-reversal cycle offers two concrete implications for corporate tax design and financial reporting. First, deploying temporary multi-year research amortization as a budget-window revenue raiser expands conditional book-tax timing wedges (+1.31 to +1.33 percentage points of assets per 10-percentage-point higher research intensity) and raises revenue-scaled and pre-tax-controlled cash-tax burdens, whereas mid-year legislative restoration leaves first-year cash-tax relief incomplete—especially among non-calendar fiscal filers remitting prior-quarter estimated taxes—without inducing a symmetric real-investment rebound (House & Shapiro, 2008; Zwick & Mahon, 2017; Akcigit, Grigsby, et al., 2022). Second, evaluating domestic corporate tax reforms in public equity panels requires comparative-period denominator corroboration and multi-year jurisdictional tax footnotes: although FASB ASU 2023-09 expanded net cash-tax reporting in 2025, disaggregated federal cash-tax disclosures (535 raw facts; 356 corroborated asset-scaled ratios; six complete multi-regime observations) remain too sparse in their initial adoption year to identify multi-period reversals without standardized historical comparatives.

Statements

Data availability. Structured annual corporate financial disclosures and statutory or regulatory tax texts examined in this article derive from public filings with the U.S. Securities and Exchange Commission alongside official publications of the U.S. Government Publishing Office, the Internal Revenue Service, and the Financial Accounting Standards Board. The complete firm-year panels, archived source inputs, accounting audit outputs, and replication code are publicly archived on Zenodo under persistent identifier https://doi.org/10.5281/zenodo.24200049.

AI declaration. During the preparation of this study, OpenAI Codex was utilized exclusively to support structured filing-data harmonization and implementation-level auditing of statistical scripts. All assisted procedures were independently verified by each author; the conceptual framing, empirical interpretation, and manuscript text were written by the authors, who assume full responsibility for the work.

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