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## Amortization of R and E Expenditures under the TCJA: Unintended Consequences and Policy Lessons for Innovation Incentives

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### Abstract

This article examines the mandatory capitalization and amortization of research and experimental (R&E) expenditures under amended Internal Revenue Code §174, as a retrospective case study in unintended tax policy consequences. Before the Tax Cuts and Jobs Act (TCJA) of 2017, firms could immediately deduct R&E expenditures in the year incurred, preserving liquidity and maximizing the present value of associated tax shields. The TCJA eliminated this option, requiring domestic R&E costs to be amortized over five years and foreign R&E costs over fifteen, generating immediate and material distortions for innovation-intensive firms. Drawing on statutory analysis, corporate finance theory, firm-level case studies, and industry advocacy evidence, this article makes three principal contributions. First, it reframes the amortization mandate as an intertemporal tax policy intervention, quantifying how deduction deferral reduces the present value of tax shields and raises effective hurdle rates, particularly under risk-adjusted discount rates reflective of innovation uncertainty. Second, it extends R&E incentive research by analyzing the consequences of withdrawing a longstanding preference rather than introducing new benefits. Third, it situates the episode within broader debates on tax stability, liquidity constraints, and cross-provision interactions, especially with qualified small business stock under §1202 and deferred tax accounting under ASC 740, and offers evidence-based lessons for innovation-oriented tax design. The 2025 reversal through the One Big Beautiful Bill Act, while substantially corrective, left legacy harms that illustrate the durable costs of budget-driven policy misalignment with the distinctive economics of R&E investment.

**Keywords:** Research and experimental expenditures; Section 174 amortization; Tax Cuts and Jobs Act; Innovation tax policy; R&E tax incentives; Corporate liquidity

### 1. Introduction

Research and Experimental (R&E) investment plays a central role in economic growth, productivity, and technological innovation. Because private firms often underinvest in research due to uncertainty, long development cycles, and knowledge spillovers, governments frequently rely on tax policy to encourage innovation [2]. In the United States (U.S.), federal tax incentives supporting research investment historically rested on two pillars: the ability to immediately deduct research expenditures under Internal Revenue Code §174, and the availability of the research tax credit under Internal Revenue Code §41, originally introduced by the Economic Recovery Tax Act of 1981. While the research credit allows firms to offset a portion of qualifying research expenditures directly against tax liability, the deductibility of R&E expenses under §174 has long reduced the effective cost of innovation by allowing firms to expense research costs in the year incurred.

This longstanding framework was significantly altered by the Tax Cuts and Jobs Act (TCJA). In the realm of tax policy, few provisions have generated as much sustained debate and scrutiny in recent years as the changes to the treatment

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of R&E expenditures introduced by the TCJA. Enacted in 2017 as the most sweeping overhaul of the U.S. corporate tax system in decades, the TCJA was designed to enhance domestic competitiveness, stimulate investment, and encourage the repatriation of capital [12]. However, embedded within this broader pro-growth framework was a provision that, while fiscally motivated, produced significant and unintended consequences for innovation-driven enterprises: the amendment to Internal Revenue Code (IRC) Section 174 mandating the capitalization and amortization of R&E expenditures. Specifically, the TCJA required taxpayers to capitalize and amortize R&E expenditures over 5 years for domestic research activities and over 15 years for foreign research activities, beginning at the midpoint of the taxable year in which such costs were incurred, for tax years beginning after December 31, 2021 [58],[64]. This change marked a sharp departure from decades of U.S. tax policy, under which taxpayers were permitted to immediately expense R&E costs in the year incurred. The prior regime reflected a recognition that R&E expenditures are fundamentally different from capital investments in tangible assets: they are highly uncertain, often fail to generate commercially viable results, and are essential recurring costs of remaining competitive in innovation-intensive industries [16].

Although included in the TCJA as a revenue-raising base-broadening measure intended to help offset the costs of reducing the corporate tax rate from 35% to 21% and other tax incentives, the mandatory amortization of R&E expenditures represented a substantive shift in the after-tax economics of innovation [12]. The policy change generated substantial concern among industry groups, policymakers, and tax professionals. Critics argued that mandatory amortization increased the effective cost of innovation and imposed liquidity constraints on firms with significant research expenditures. By deferring deductions, the provision increased the near-term tax burden on R&E-intensive firms, reduced liquidity precisely when cash outflows were most acute, and effectively raised the cost of capital for high-risk, long-horizon investments. These concerns were particularly acute for technology and biotechnology firms, whose business models often depend on sustained R&E investment and whose profitability horizons may extend years into the future. After several years of intense debate and bipartisan advocacy from industry groups and policymakers, Congress addressed these concerns through the One Big Beautiful Bill Act (OBBBA), Pub. L. No. 119-21, of 2025, which restored immediate expensing for domestic R&E expenditures under new Internal Revenue Code Section 174A for tax years beginning after December 31, 2024, while providing transition relief (including acceleration options) for previously capitalized amounts from 2022–2024 [61],[35]. Foreign R&E expenditures continue to be amortized over 15 years.

This article examines the Section 174 amortization episode as a retrospective case study in unintended tax policy consequences. While prior literature has extensively analyzed the effects of introducing or expanding R&E incentives (particularly the §41 credit) on investment, patenting, and firm behavior [26],[27], comparatively less attention has been devoted to the economic impacts of temporarily withdrawing a longstanding preference for immediate expensing; a gap this study addresses by exploiting the rare natural experiment afforded by the 2022–2024 regime and its 2025 reversal.

The paper makes three principal contributions. First, it reframes the amortization mandate as an intertemporal tax policy intervention, demonstrating how deduction timing affects the present value of tax shields, corporate liquidity, and hurdle rates for high-risk R&E investments. Second, it extends existing research on R&E incentives by focusing on the consequences of removal rather than addition of favorable treatment, integrating qualitative evidence from industry advocacy, firm-level case studies, and post-reversal dynamics. Third, it situates the episode within broader debates on tax stability, liquidity constraints, cross-provision interactions (e.g., with §1202 QSBS and ASC 740), and international competitiveness, offering lessons for designing innovation-oriented tax provisions that better account for R&E's distinctive economics like uncertainty, spillovers, and dependence on sustained private investment.

The analysis proceeds as follows. The subsequent sections examine the historical treatment under §174 and the complementary §41 credit, the statutory mechanics and rationale of the TCJA amendment, cash-flow and investment distortions in innovation-intensive sectors, financial reporting and cross-provision interactions, the political economy of reversal, and broader implications for tax code design and innovation policy.

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## 2. Historical Foundations of U.S. R&E Tax Policy

The U.S. maintains the largest R&E ecosystem in the world [43]. Total R&E expenditure in the U.S. reached approximately \$937 billion in 2023, with projections suggesting an increase to \$993 billion in 2024 [43]. Private firms account for the majority of this investment, reflecting the central role of corporate innovation in the U.S. economy. Given the scale of these investments, the tax treatment of R&E expenditures has long been considered a critical instrument of U.S. innovation policy. The federal tax system has historically encouraged corporate innovation through two primary mechanisms: (1) immediate deductibility of research expenditures under Section 174 of the Internal Revenue Code, and (2) the Research and Experimentation Tax Credit introduced in 1981 [34],[27].

### 2.1.1. Section 174 and the Traditional Treatment of R&E Expenditures

Prior to the amendments enacted by the TCJA, IRC §174 afforded taxpayers considerable flexibility in the treatment of R&E expenditures, a framework originally established in 1954 to resolve longstanding uncertainty surrounding the tax characterization of research investments and to foster corporate innovation [57],[39]. The dominant and overwhelmingly preferred option under former §174(a) permitted immediate expensing: taxpayers could deduct qualifying R&E costs in full in the taxable year incurred, treating them as ordinary business expenses rather than capital outlays (26 U.S.C. §174(a) (2012) [54]: "A taxpayer may treat research or experimental expenditures... as expenses which are not chargeable to capital account"). This immediate deductibility reflected a deliberate policy judgment that R&E expenditures differ fundamentally from conventional capital investments in tangible assets [5],[6]. Unlike depreciable machinery or structures which produce discrete, durable outputs with predictable useful lives, R&E activities are inherently speculative, characterized by elevated failure rates, intangible outputs, and highly uneven or uncertain realization of economic benefits, if any [30]. Immediate expensing therefore aligned tax timing with economic substance, enabling firms to offset current R&E outlays against contemporaneous income, thereby preserving liquidity and smoothing cash flows in a manner supportive of sustained, high-risk innovation [27].

From a corporate finance standpoint, this treatment maximized the present value of the associated tax shield [27],[11]. For instance, a firm incurring \$10 million in qualifying R&E expenditures under a 21% corporate tax rate could realize an immediate tax savings of approximately \$2.1 million in the year of expenditure, reducing the after-tax cost of investment and enhancing internal cash generation, an especially critical consideration for firms reliant on retained earnings to fund innovation. This mechanism proved particularly advantageous for early-stage, growth-oriented, and pre-revenue enterprises, which frequently incur prolonged accounting losses while committing substantial resources to product development, clinical trials, or platform technologies. By permitting full current deductions, §174 facilitated the creation or augmentation of net operating losses (NOLs) that could be carried forward to offset future taxable income, thereby increasing the present value of tax attributes and bolstering access to external capital markets [33].

Alternative treatments existed but were seldom elected. Under former §174(b), taxpayers could opt to capitalize R&E expenditures (excluding those otherwise chargeable to depreciable property under §167 or depletable under §611) and amortize them ratably over a period of not less than 60 months, commencing with the month in which benefits from the research were first realized in the taxpayer's trade or business [54]. In limited circumstances, an additional election under §59(e), enacted as part of the Tax Reform Act of 1986 [65], permitted a 10-year ratable amortization of certain qualified expenditures, including those otherwise deductible under §174(a), primarily to manage alternative minimum tax exposure or other timing preferences [60].

In practice, however, immediate expensing under §174(a) remained the norm, as the slower amortization options under §174(b) and §59(e) offered little advantage given the economic profile of R&E: uncertain payoffs, non-linear benefit accrual, and the absence of a reliable "useful life" metric akin to that for tangible assets [34],[27]. The preference for current deductibility thus constituted a structural incentive embedded in the tax code, lowering the effective cost of capital for innovation and complementing other provisions such as the incremental R&E tax credit under §41 in promoting private-sector research activity.

### 2.1.2. The Research and Experimentation Tax Credit (1981)

Complementing the flexibility afforded by pre-TCJA §174, Congress introduced the Credit for Increasing Research Activities commonly known as the R&E tax credit, through the Economic Recovery Tax Act of 1981 (Pub. L. No. 97-34). Originally codified as §44F, the provision was redesignated as §30 in 1984 (Deficit Reduction Act of 1984, Pub. L. No. 98-369) and permanently relocated to its current position in §41 by the Tax Reform Act of 1986 (Pub. L. No. 99-514). Unlike §174, which governs the timing and deductibility of R&E expenditures, §41 operates as a nonrefundable credit that directly reduces tax liability for incremental qualified research expenses (QREs) exceeding a calculated base amount [23],[15]. The credit is generally computed as 20% of QREs above the base under the regular method (with an alternative simplified credit available), subject to the general business credit limitations under §38. To qualify as "qualified research," activities must satisfy a stringent four-part statutory test [55],[34]:

- Section 174 test: The expenditures must qualify as deductible R&E under §174, entailing technological uncertainty and a process of experimentation.
- Technological in nature: The research must fundamentally rely on principles of the physical or biological sciences, engineering, or computer science.
- Process of experimentation: The taxpayer must evaluate one or more alternatives through systematic testing, modeling, simulation, or trial-and-error to eliminate uncertainty.

- Business component test: The research must be intended to discover information useful in developing or improving a new or enhanced business component (product, process, technique, formula, invention, software, or software component).

Qualified research expenses primarily encompass wages for qualified services, supplies consumed in the research, and 65% of amounts paid for contract research [55],[63]. By targeting incremental spending, §41 sought to overcome market failures associated with underinvestment in R&E positive externalities such as knowledge spillovers and non-appropriable benefits thereby lowering the marginal private cost of additional research.

When paired with immediate expensing under §174, this dual mechanism constituted a robust, layered subsidy for innovation: §174 preserved short-term liquidity by synchronizing deductions with cash outflows and facilitating NOL carryforwards, while §41 provided a dollar-for-dollar offset against tax liability for qualifying incremental efforts. This combination was especially salient for startups and growth-stage firms, where R&E often dominates operating expenses (frequently 40–70% in technology, biotechnology, and clean technology sectors; [52],[14]). The framework effectively reduced effective hurdle rates for high-risk, long-horizon projects, smoothing cash flows and enhancing the present value of tax attributes in capital-constrained environments.

Although initially enacted as a temporary measure, the credit underwent repeated short-term extensions amid periodic policy debates over its efficacy, cost, and compliance burden. It was made permanent in 2015 by the Protecting Americans from Tax Hikes (PATH) Act (Division Q of the Consolidated Appropriations Act, 2016, Pub. L. No. 114-113) [62]. The PATH Act further broadened accessibility, permitting eligible small businesses (generally those with average gross receipts ≤\$50 million over the prior three years) to apply the credit against alternative minimum tax (AMT) liability and, for qualified startups (gross receipts <\$5 million in the current year with no gross receipts more than five years prior), to offset up to \$250,000 annually against employer payroll tax obligations [55],[59] and subsequent guidance. This payroll offset cap was subsequently increased to \$500,000 for tax years beginning after December 31, 2022, per the Inflation Reduction Act of 2022 [56]. These reforms reflected explicit congressional intent to extend meaningful benefits to pre-revenue and loss-making innovators, mitigating the credit's historical bias toward profitable, established corporations. Critically, however, the TCJA's subsequent mandate of capitalization and amortization under amended §174 disrupted the long-settled equilibrium of the U.S. innovation tax architecture effectively imposing a deferral "penalty" that eroded liquidity, diminished the present value of tax shields, and raised the after-tax cost of research [11].

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### 3. The TCJA Amendment to Section 174

Section 13206 of the TCJA effected a profound and abrupt shift in the treatment of R&E expenditures under IRC §174. For amounts paid or incurred in tax years beginning after December 31, 2021, the amendment eliminated the long-standing option of immediate expensing, mandating instead that taxpayers capitalize specified research or experimental expenditures and amortize them ratably over:

- Five years (60 months) for expenditures attributable to domestic research activities, and
- Fifteen years (180 months) for expenditures attributable to foreign research activities.

Compounding the deferral, the statute imposed a midpoint convention under amended §174(a)(2)(B): amortization commences at the midpoint of the taxable year in which the expenditures are paid or incurred [58]. For domestic activities, this results in only 10% of the expenditure deductible in the first taxable year (one-half of one-fifth), followed by 20% in each of the next four years, and the remaining 10% in the sixth year, yielding an effective six-year recovery period. Foreign activities similarly extend over sixteen years under the same convention. The midpoint rule, while mechanically consistent with half-year conventions in other depreciation contexts, front-loads the tax burden precisely when cash outflows for R&E are most acute, exacerbating liquidity strains in innovation-intensive sectors.

The scope of capitalization was broad. Amended §174(c)(3) expressly includes software development costs as specified research or experimental expenditures, encompassing activities such as planning, design, coding, testing, and modifications prior to readiness for use or sale irrespective of whether the software is for internal use or commercial disposition [58]. Notice 2023-63 provided critical interim clarification, confirming that pre-readiness software development phases constitute amortizable expenditures while excluding post-readiness activities such as routine maintenance, data conversion (absent new software facilitation), and customer support [58]. This expansive inclusion swept in substantial portions of engineering and software labor costs for technology firms, even where such activities bore scant resemblance to traditional capital asset formation.

For affected firms, the mechanical consequences were immediate and severe. Consider a firm incurring \$50 million in qualifying domestic R&E expenditures in 2022: pre-TCJA, the full amount would have been deductible currently. Post-TCJA, the deduction schedule driven by the midpoint convention, limits the 2022 deduction to \$5 million (10%), followed by \$10 million annually from 2023 to 2026, and \$5 million in 2027 [58]. At the prevailing 21% corporate tax rate, this deferral inflates 2022 taxable income by \$45 million, imposing an approximate \$9.45 million incremental tax liability in the year of heaviest outlay. The deferral materially elevates the effective after-tax cost of R&E, altering cash-flow forecasts, financing requirements, and internal capital allocation priorities.

The inclusion of mandatory amortization was not the outgrowth of a deliberate reevaluation of innovation policy but rather a fiscal expedient embedded in the TCJA's budgetary architecture. The Act's core reform, which was a permanent reduction in the corporate income tax rate from 35% to 21%, was projected to forgo trillions in revenue over a ten-year horizon [36]. Enacted via budget reconciliation, the legislation demanded offsetting revenue measures to satisfy procedural deficit constraints [8]. Amortization of R&E expenditures emerged as a politically viable, high-scoring offset: the Joint Committee on Taxation estimated it would generate approximately \$120 billion over fiscal years 2018–2027, primarily through accelerated collections from deferred deductions rather than permanent base broadening [36]. The provision thus functioned as a timing shift, advancing revenue into the budget window at the expense of future-year deductions, a design choice that conventional static scoring favored but dynamic behavioral responses undermined.

Proponents, including the House Committee on Ways and Means, advanced a secondary conceptual defense: amortization purportedly better matched deductions to the multi-period benefits of successful R&E such as patents, proprietary processes, or software platforms, aligning tax recovery with capital recovery principles [51],[50]. Immediate expensing, in this view, constituted an unwarranted subsidy that distorted incentives and narrowed the corporate tax base. Yet this rationale rests on a strained analogy to depreciable tangible assets. R&E exhibits profound uncertainty, non-linear and asymmetric payoffs, and elevated rates of total loss, with many projects yielding no commercially viable output whatsoever [30]. Imposing fixed, rigid amortization schedules on such inherently unpredictable activity therefore substitutes an artificial accounting construct for economic reality, effectively penalizing experimentation and failure; the very mechanisms that drive breakthrough innovation in technology and biotechnology.

Critics, including economists and policy scholars, have identified several fundamental flaws in the mandatory amortization regime. Foremost among these is its failure to account for the time value of money: deferring deductions systematically reduces their present value, thereby increasing the after-tax cost of R&E investment [42]. Under baseline assumptions (a 5% discount rate and 21% corporate tax rate), the present value of a \$100 deduction amortized over five years approximates \$82. As Cowx et al., [13] demonstrate, at higher risk-adjusted discount rates of 10–15% reflective of the uncertainty and capital constraints, typical in innovation projects, the erosion becomes far more pronounced, often exceeding 30–50%. This intertemporal distortion materially elevates hurdle rates for marginal projects, rendering those with positive expected social value but lower private returns more likely to be abandoned, delayed, or relocated to jurisdictions with more favorable tax treatment [42].

Cumulatively, such effects risk broader macroeconomic consequences: diminished aggregate innovation output, slowed productivity growth, and weakened U.S. competitiveness in strategic, high-value sectors [13]. The regime's rigidity further exacerbates these issues by failing to distinguish projects that generate no recoverable value. In cases of total failure common in R&E-driven fields, capitalization merely postpones deductions without any corresponding future income offsets. As Haskel and Westlake [30] contend, this effectively imposes a de facto penalty on experimentation and risk-taking, standing in direct tension with longstanding tax policy objectives that have sought to minimize barriers to innovation precisely by lowering the cost of trial-and-error processes central to technological progress.

These critiques underscore a deeper misalignment: the amortization mandate prioritized short-term fiscal scoring over the dynamic economic realities of innovation, where uncertainty, asymmetric payoffs, and knowledge spillovers prevail. This misalignment was compounded by administrative complexity. The breadth of capitalized expenditures encompassing software development and lacking initial statutory detail, engendered widespread uncertainty. In response, the IRS issued interim guidance in Notice 2023-63, clarifying scope (e.g., pre-readiness software activities capitalized; post-readiness maintenance excluded), sourcing (activity location), allocation methodologies, and interactions with long-term contracts and cost-sharing arrangements [58]. The notice also afforded procedural relief through automatic accounting method changes without §481(a) adjustments for pre-2022 amounts. Notably, this guidance arrived nearly two years after the provision's effective date, leaving taxpayers to navigate the 2022 filing season with significant uncertainty. While these measures mitigated some compliance burdens, they left the core economic penalty of the deferred deductibility intact. Moreover, unlike other TCJA provisions (e.g., bonus depreciation phaseouts), the §174 amendment included no statutory sunset, embedding persistent uncertainty and amplifying apprehensions over long-term U.S. innovation competitiveness [8]. These accumulated economic, administrative, and

structural burdens fueled sustained advocacy and ultimately the 2025 legislative reversal under the OBBBA. While corrective, this reversal highlights the costs of policy interventions that diverge from evidence-based alignment with the distinctive characteristics of R&E activity.

#### 4. Impact on Cash Flow for Technology and Biotechnology Firms

The amortization requirement imposed by the TCJA's amendment to Section 174 produced immediate and material cash-flow distortions for innovation-intensive industries, particularly technology, biotechnology, life sciences, and clean technology. In these sectors, R&E expenditures represent a dominant share of operating expenses, frequently exceeding 40% and, in many firms, reaching 70% or more [52],[14]. For early-stage or pre-revenue companies, R&E costs typically account for nearly all operating outlays, as revenue is minimal or nonexistent and expenses are driven almost entirely by research activities [20]. From a corporate finance perspective, immediate expensing under pre-TCJA §174 aligned deductions with cash outflows, preserving liquidity and lowering the user cost of R&E investment [28]. Amortization deferred these benefits, eroding present value due to the time value of money. For a \$100 domestic R&E expenditure subject to the midpoint convention, deductions are spread over six years: approximately 10% in year one, 20% in years two through five, and 10% in year six. At a 5% discount rate and 21% tax rate, the present value of the tax shield approximates \$82 (derived from statutory schedule; [42]). At higher risk-adjusted rates of 10–15% common for startups and biotech firms, reflecting uncertainty and capital constraints, present value falls to \$70–\$60 or lower, increasing the effective after-tax cost by 20–50% [13].

By deferring deductions, the provision artificially inflated taxable income and forced firms to remit cash taxes on income that did not reflect underlying economic performance. For early-stage companies, the impact was paradoxical and acute: firms with little or no revenue faced tax liabilities solely because the tax code disallowed full deduction of their primary operating expense. This phenomenon, commonly termed "phantom income", compelled firms to divert scarce capital away from research programs, laboratory infrastructure, and hiring toward tax payments [21]. In many cases, companies were forced to secure bridge financing, incur high-cost debt, dilute equity through unplanned fundraising rounds, or materially curtail research programs. These pressures were especially destabilizing in high-risk industries where capital efficiency and runway length are critical determinants of survival [46]. To illustrate, consider a representative software startup incurring \$200,000 in qualifying R&E expenditures in 2022. Under prior law, full expensing would have preserved approximately \$42,000–\$50,000 in liquidity, depending on effective tax rates. Under the amortization regime, only \$20,000 was deductible in the first year, increasing near-term tax liabilities and constraining operating flexibility. The resulting cash-flow compression directly affected hiring plans, product development timelines, and customer acquisition strategies.

Biotechnology firms experienced even more pronounced effects due to prolonged development timelines, substantial regulatory compliance costs, and high clinical attrition rates [7]. Drug development cycles frequently span a decade or more, with failure rates exceeding 90% across clinical phases [49]. The amortization regime therefore deferred tax benefits associated with expenditures that might never produce revenue, materially increasing the after-tax cost of failure. Industry estimates suggest that tens of billions of dollars in deductions were deferred across the economy in 2022 alone, disproportionately burdening small and medium-sized enterprises that lack diversified revenue streams or access to low-cost capital [13]. Even large, well-capitalized technology firms were not insulated from these effects. Although such firms possessed greater liquidity, the magnitude of deferred deductions, often in the hundreds of millions of dollars, altered internal capital allocation decisions and contributed to workforce rationalization in R&E-heavy divisions [46]. The policy thus operated not merely as a cash-flow inconvenience but as a structural disincentive to sustained investment in innovation.

Beyond liquidity constraints, the capitalization requirement introduced significant complexity into financial reporting and transaction planning. Under Accounting Standards Codification Topic 740 (ASC 740) (Income Taxes), the mandatory capitalization of research and experimental expenditures materially increased deferred tax assets by deferring the recognition of tax deductions relative to book expense recognition. This divergence between book and tax treatment required firms to reassess valuation allowances based on updated projections of future taxable income and the realizability of deferred tax assets [1]. For early-stage and loss-making firms, these accounting effects were not merely technical. The sudden expansion of deferred tax assets, coupled with uncertain profitability timelines, heightened auditor scrutiny of management forecasts and going-concern assumptions. In practice, this resulted in more conservative valuation allowance positions, expanded audit procedures, and higher compliance and professional services costs, diverting managerial attention and scarce financial resources away from core research activities [29]. In mergers and acquisitions, Section 174(d) created a "tax trap": sellers could not accelerate deductions for unamortized R&E costs upon disposition or abandonment, and buyers received no corresponding step-up in basis. This asymmetry

complicated deal structuring, depressed valuations for R&E-intensive targets, and introduced friction into innovation-driven consolidation.

The abstract cash-flow mechanics of Section 174 translated into concrete operational disruptions across the innovation economy. Early-stage biotechnology and clean-technology firms dependent on grant funding were among the most severely affected. Consider, for instance, iNFixion Biosciences, a San Diego-based biotechnology startup focused on therapies for rare genetic disorders. Operating with a small team and relying primarily on federal research grants, the firm incurred substantial R&E expenditures but generated no commercial revenue. The amortization requirement produced a material tax liability despite the absence of profits, consuming several months of operating runway and forcing management to suspend experiments and consider workforce reductions [19]. Although subsequent legislative relief allowed retroactive recovery of deductions, the interim liquidity shock materially delayed research progress and increased the firm's financing risk.

Similarly, OXbyEL Technologies, a Mesa, Arizona-based startup developing electrochemical solutions to destroy PFAS "forever chemicals" in water, a class of contaminants linked to cancer and affecting over 100 million Americans faced similar peril. Funded by National Science Foundation and U.S. Air Force grants, the four-employee firm incurred R&E costs that, under amortization, resulted in a \$40,000 tax bill despite generating no revenue. With a three-to-four-month cash runway, this liability prompted plans to eliminate one position, delaying commercialization of a technology with no existing destructive alternatives [19]. These cases were not isolated anomalies but representative of systemic pressures on grant-dependent innovators. At the sector level, the cumulative effect of these firm-level constraints was a measurable contraction in innovation activity. Surveys of R&E-intensive small businesses reported higher effective tax burdens, reductions in planned hiring, delayed clinical trials and software releases, and increased reliance on short-term financing [19],[3]. In aggregate, these responses raised the hurdle rate for innovation investment, skewed project selection toward shorter-horizon initiatives with faster payback periods, and discouraged speculative research with potentially transformative long-term returns.

The policy thus introduced a subtle but consequential bias in innovation portfolios. Projects with long gestation periods such as foundational artificial intelligence research, novel drug discovery platforms, and advanced materials science, were disproportionately disadvantaged relative to incremental or near-term commercial development. Over time, such distortions risk reshaping the composition of U.S. innovation toward lower-risk, lower-impact trajectories, with profound implications for long-run productivity growth and technological leadership.

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## 5. Financial Reporting, Compliance Challenges, and Cross-Provision Interactions

The §174 amortization mandate not only imposed direct cash-flow and present-value burdens but also generated cascading distortions through interactions with financial accounting standards, other Internal Revenue Code provisions, and transactional contexts. These effects compounded liquidity constraints and investment disincentives, particularly for early-stage and R&E-intensive firms. The cash-flow effects analyzed above were compounded by financial reporting consequences under U.S. accounting standards. Under Accounting Standards Codification Topic 740 (ASC 740), book accounting for R&E expenditures typically allows immediate expensing pursuant to ASC 730 (Research and Development), while tax treatment required capitalization and amortization under amended §174 for the 2022–2024 period. This book-tax difference created significant deferred tax assets (DTAs), as future deductible amortization would reduce taxable income relative to book expense recognition [1],[22]. For loss-making or pre-revenue firms, the expansion of DTAs necessitated reassessment of valuation allowances under ASC 740-10-30, based on projections of future taxable income and the likelihood of realizability. Uncertain profitability timelines common in biotechnology and software development, heightened auditor scrutiny of management forecasts, going-concern assumptions, and valuation allowance positions. This scrutiny often led to more conservative allowances, expanded audit procedures, and elevated compliance and professional services costs [29]. These non-cash burdens diverted scarce resources from innovation activities and indirectly tightened liquidity by increasing effective financing costs.

Perhaps even more consequential was the interaction with qualified small business stock under IRC §1202. Section 1202 incentivizes investment in early-stage firms by allowing noncorporate taxpayers to exclude up to 100% of capital gains on qualified small business stock (QSBS) held for more than five years, subject to eligibility limits. Pre-TCJA, internally developed intangibles such as software, algorithms, or pharmaceutical formulations typically carried little or no tax basis, helping firms remain below the \$50 million aggregate gross assets threshold for QSBS eligibility set forth in §1202(d) [53]. The amortization requirement under amended §174 fundamentally altered this dynamic by creating tax basis in previously zero-basis intangible assets. For each year of R&E expenditures, firms added capitalized costs to their adjusted tax basis (net of the 10% first-year deduction under the midpoint convention), with cumulative buildup over multiple years. Because gross assets under §1202(d) include adjusted tax basis, this newly created basis artificially

inflated balance sheets for tax purposes, accelerating breaches of the \$50 million threshold despite no corresponding change in economic scale or enterprise value. Consider a venture-backed software startup incurring \$10–20 million in annual R&E expenditures. Over the 2022–2024 period, such a firm could accumulate tens of millions of dollars in tax basis from capitalized R&E, pushing gross assets above \$50 million earlier than projected and disqualifying later stock issuances from QSBS treatment. This dynamic diminished QSBS attractiveness precisely when external capital was most critical for early-stage firms, potentially shifting venture funding toward later-stage or less R&E-intensive opportunities and raising the cost of entrepreneurial finance for the very kinds of high-risk, high-reward ventures the QSBS provision was designed to encourage [32].

The OBBBA mitigated future issues through several reforms. First, the Act restored immediate domestic expensing under new §174A effective for post-2024 expenditures, thereby preventing ongoing basis buildup from R&E capitalization. Second, it raised the gross assets threshold for QSBS eligibility to \$75 million (indexed for inflation after 2026) for stock issuances after July 4, 2025. Third, it expanded QSBS benefits by introducing tiered exclusion rates of 50% for holdings of three years, 75% for four years, and 100% for five years or more while establishing a per-issuer cap of \$15 million. However, firms that crossed the \$50 million threshold during the 2022–2024 interim period suffered permanent disqualification for affected equity rounds, illustrating the durable consequences of temporary policy misalignment.

Transactional contexts further magnified the provision's economic distortions. Section 174(d) restricted acceleration of unamortized R&E deductions upon disposition, abandonment, or dissolution, while simultaneously denying buyers any corresponding step-up in tax basis for acquired intangible assets. This asymmetry depressed valuations for R&E-heavy targets by denying acquirers the tax basis that would typically accompany purchased assets, effectively penalizing innovation-driven consolidation and introducing "tax traps" into deal structuring [19].

Beyond these transactional distortions, the mere implementation of amended §174 imposed substantial administrative burdens. The broad statutory scope of "specified research or experimental expenditures" which explicitly included software development costs combined with limited initial guidance to engender widespread uncertainty. As discussed above, the Internal Revenue Service issued interim guidance in Notice 2023-63, clarifying the scope of covered activities (e.g., pre-readiness coding and testing capitalized; post-development maintenance excluded), sourcing rules based on activity location, allocation methodologies, and procedures for automatic accounting method changes without §481(a) adjustments for pre-2022 amounts [58]. While this guidance provided procedural relief, the nearly two-year delay between the provision's effective date and definitive rules forced taxpayers to navigate the 2022 filing season with significant uncertainty, exposing them to potential underpayment penalties and audit risk.

These cross-provision interactions underscore how isolated tax changes cascade across the innovation ecosystem, amplifying liquidity constraints and distorting investment incentives far beyond their direct cash-flow effects [8]. The 2025 OBBBA reversal addressed many of these issues but left legacy harms for firms affected during the interim period; harms that illustrate the durable costs of policy misalignment with the economic realities of R&E activity.

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## 6. Lobbying Efforts and the Political Economy of Reversal

The business community's response to the R&E amortization penalty was swift and sustained. A broad coalition of industry associations including the National Foreign Trade Council, the R&D Coalition, and the Biotechnology Innovation Organization (BIO), alongside tax professionals and individual corporations, lobbied Congress aggressively for a retroactive reversal [47],[3]. Their core argument remained consistent: the policy was actively disincentivizing the very innovation the United States sought to lead, particularly in strategic sectors like biopharmaceuticals and advanced technology, by raising the after-tax cost of research and eroding U.S. competitiveness against nations offering more generous R&D incentives [3],[47].

Lobbying efforts intensified as mounting evidence through direct business testimonies, industry-wide surveys, public advocacy letters, and media reports during 2022–2024 made clear that the provision was inflicting real-time harm on cash flow and investment decisions. A high-profile 2024 letter signed by 1,171 small businesses from across the United States, coordinated by entrepreneurial and innovation-focused groups, detailed severe operational impacts: many owners reported having to borrow money, incur additional debt, lay off staff, or contemplate closures and bankruptcies simply to cover unexpected tax liabilities on non-profitable or grant-funded R&E activities [48]. Signatories emphasized that 2022 tax bills were, on average, four times higher than prior years for R&E-intensive firms, with the harm most acute for those making the largest innovation investments, precisely the companies driving U.S. leadership in critical fields.

Biotech and software startups provided particularly vivid examples in advocacy materials and media coverage. Industry groups like BIO highlighted how the provision further diminished already-shrinking capital pools for early-stage biotech projects, limiting funding for lifesaving treatments in areas such as rare diseases, Alzheimer's, and Parkinson's [3]. Software firms echoed similar pain, with reports of tax liabilities rising dramatically and forcing decisions like reduced hiring or delayed product launches [21]. These grassroots stories amplified through congressional outreach, coalition letters (e.g., a 2023 cleantech coalition of 30 organizations and 210 leaders urging action), and outlets like CNBC transformed theoretical concerns into undeniable evidence of cash flow compression, reduced investment thresholds for marginal projects, and threats to job growth and scientific breakthroughs [9].

Coalitions representing over 600 software companies, manufacturers, and biotech firms petitioned Congress, highlighting annual cash flow losses exceeding \$50 billion and threats to U.S. competitiveness against nations like China, which offer expansive R&E incentives [47]. Key legislative proposals included the American Innovation and R&D Competitiveness Act of 2025 (H.R. 2673), introduced by Representatives Ron Estes (R-KS) and John Larson (D-CT), which sought retroactive restoration of full expensing from 2022 [18]. Companion Senate legislation (S. 866), led by Senators Maggie Hassan (D-NH) and Todd Young (R-IN), garnered broad bipartisan support, emphasizing the need to outpace global rivals [31]. After several failed attempts to include a repeal or delay in broader legislation, success finally came with the enactment of the OBBBA, signed into law on July 4, 2025 [38].

The OBBBA restored the ability for taxpayers to immediately deduct domestic R&E expenditures for tax years beginning after December 31, 2024. Crucially, the legislation provided transition rules to address the "amortization trap" of the prior years:

- For eligible small businesses (those with average annual gross receipts of \$31 million or less), the OBBBA permits retroactive expensing. These taxpayers may file amended returns for tax years 2022, 2023, and 2024, recovering the cash taxes paid as a result of the amortization rule. This election must be made by July 4, 2026.
- For all other taxpayers, the remaining unamortized balances of R&E expenditures from the 2022–2024 period may be accelerated. Taxpayers may elect to deduct the entire remaining amount in the first tax year beginning after December 31, 2024 (i.e., 2025 for calendar-year taxpayers), or ratably over that year and the subsequent year.

While the OBBBA represents a significant victory for the innovation economy, it was not a full repeal of the TCJA's structure. The distinction between domestic and foreign R&E remains, with foreign-conducted research still subject to a 15-year amortization period; a policy signal intended to discourage offshoring of innovation activities. Furthermore, the restoration of immediate expensing for 2025 forward has created new technical complexity in its interaction with the Corporate Alternative Minimum Tax (CAMT). The "stacking" of accelerated prior-year deductions with current-year expensing could create a significant book-tax disparity that may inadvertently trigger CAMT liability for some firms, potentially offsetting portions of the intended relief.

Thus, while the OBBBA represented a significant legislative correction, the episode underscores how hastily enacted tax provisions can inflict durable harm and how even well-intentioned fixes may introduce new complexities. The R&E amortization penalty, though largely reversed, offers a cautionary tale about the unintended consequences of budget-driven tax policy.

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## 7. Broader Implications for Tax Code Design and Innovation Policy

The rapid emergence of industry opposition and subsequent legislative reversal of Section 174 amortization illuminate broader implications for the design of innovation-related tax incentives. Although the amortization requirement was introduced primarily as a budgetary measure within the TCJA, its economic consequences extended well beyond fiscal accounting. The experience provides an important case study in how the timing of tax deductions influences corporate investment behavior, liquidity management, and the financing of innovation, and exposes a central tension in tax policy: how to structure the code to encourage innovation without sacrificing fiscal responsibility.

### 7.1. The Limitations of Static Revenue Scoring

At its core, the episode exposes the limitations of static revenue scoring as a policymaking tool. Conventional budget frameworks employed by congressional scorekeepers estimate revenue impacts over fixed ten-year horizons while largely assuming taxpayer behavior remains unchanged [10]. The Section 174 case demonstrates the inadequacy of this approach. By deferring deductions, the provision appeared revenue-positive within the budget window as the Joint

Committee on Taxation estimated approximately \$120 billion over fiscal years 2018–2027 [36]. Yet this score reflected accelerated collections, not permanent base broadening.

In practice, firms responded to the changed tax treatment by adjusting investment timing, project selection, and geographic allocation of R&E activity. The deferral altered internal hurdle rates for research investments, causing marginal projects to be delayed, downsized, or abandoned. Over time, such behavioral responses erode the tax base itself by suppressing the innovation-driven growth that expands taxable income in future periods [17],[27]. A provision that appears revenue-positive in static, short-term terms may prove revenue-negative in dynamic, long-run terms. The Section 174 episode thus illustrates how tax provisions designed to achieve short-term budgetary objectives can inadvertently undermine the economic activities that generate sustainable revenue growth over time.

This tension between short-term fiscal metrics and long-term economic capacity was not an incidental feature of the policy but its central design flaw. By accelerating near-term tax collections, the amortization requirement increased the cost of capital for innovation; one of the primary engines of productivity growth and international competitiveness. The policy achieved a favorable revenue score within the congressional budget window, but it did so by sacrificing the future revenue base that innovation creates.

## **7.2. Innovation as a Distinct Policy Domain**

The episode also highlights the importance of aligning tax treatment with the economic substance of the activity being taxed. Innovation differs structurally from conventional capital investment. R&E expenditures are characterized by extreme uncertainty, asymmetric payoffs, and high rates of total loss. Many projects yield no commercially viable output, while successful projects generate value over indeterminate horizons through intangible channels such as knowledge spillovers, platform effects, and network externalities [30],[40]. Imposing rigid capitalization and amortization schedules on such expenditures reflects an accounting convention rather than an economically grounded model of value creation.

Proponents of immediate expensing argue it lowers the user cost of capital, enabling marginal investments that drive productivity and long-term GDP growth [25],[41]. Restoring full deductibility would better align tax incentives with the economic realities of R&E, which is inherently uncertain, high-risk, and often intangible. Section 41, which provides for the R&E tax credit and which survived the TCJA, has empirically boosted innovation outputs, though its efficiency varies and compliance burdens remain [24]. Critics of expensing point to revenue costs, as reversing amortization was estimated at \$120–139 billion over a decade, and the potential for abuse, such as overclaiming ordinary expenses as qualifying R&E or structuring transactions to accelerate deductions improperly [37]. They advocate addressing design flaws in credits alongside any return to full expensing [8]. Yet the original TCJA provision was never primarily about innovation policy; it was a budget offset for a permanent corporate rate cut from 35% to 21%, a reform projected to forgo trillions in revenue over ten years.

Tax systems that fail to recognize the distinctive characteristics of innovation risk penalizing experimentation and privileging incremental, lower-risk investments with shorter payback periods, thereby biasing the direction of technological progress. By raising the effective cost of long-horizon, high-uncertainty research, amortization tilted incentives toward projects with faster commercialization timelines and clearer monetization pathways. This dynamic may favor incremental software features or near-market applications over foundational research in areas such as advanced materials, life sciences, and frontier artificial intelligence. While such shifts may appear rational at the firm level under altered tax incentives, they can produce socially suboptimal outcomes by underinvesting in high-spillover research with transformative potential [45].

## **7.3. Unintended Consequences Across the Innovation Ecosystem**

The brief implementation of mandatory amortization also demonstrates the sensitivity of corporate investment decisions to changes in tax policy. Delaying the deductibility of R&E expenditures reduces internal cash flow and increases the effective cost of capital for innovation projects. For firms operating in research-intensive industries, these financial dynamics can meaningfully influence investment planning. Because many innovation projects involve significant upfront costs and uncertain future returns, access to internal financing is often critical. Policies that weaken near-term liquidity may therefore discourage investment in research activities or shift corporate resources toward alternative forms of capital expenditure. This relationship highlights a broader principle in corporate finance: the timing of tax deductions can affect not only the level of taxation but also firms' ability to finance investment activities. As a result, seemingly technical tax provisions may have substantial implications for innovation ecosystems.

The burden of amortization fell unevenly across firm types. Small and medium-sized enterprises (SMEs) and early-stage firms were disproportionately affected relative to large, diversified corporations. While larger firms could absorb deferred deductions through balance-sheet strength, geographic diversification, and sophisticated tax planning, startups and pre-revenue companies faced immediate liquidity constraints, limited access to low-cost capital, and heightened sensitivity to timing mismatches between cash outflows and tax benefits. Because SMEs generate a disproportionate share of radical innovation and entrepreneurial experimentation, tax policies that exacerbate their capital constraints risk suppressing precisely the segment of the economy most responsible for long-term productivity gains. Effective innovation policy therefore requires not only neutral treatment across firm sizes but affirmative consideration of differential financing constraints and spillover effects.

The international dimension further complicates the design challenge. Innovation is increasingly mobile, with multinational firms able to locate R&E functions in jurisdictions offering more favorable tax treatment, regulatory environments, and talent pools [4]. During the amortization period, U.S. policy diverged from the prevailing approach in many OECD countries, which offer enhanced deductions, super-credits, or refundable incentives exceeding 100% of qualifying R&E expenditures [44]. Such regimes reflect an explicit policy choice to subsidize innovation in recognition of its positive externalities and strategic importance. By contrast, the temporary U.S. shift toward capitalization risked placing domestic firms at a competitive disadvantage in global R&E markets, potentially accelerating the offshoring of research activity and eroding domestic innovation clusters. Although the retention of a 15-year amortization requirement for foreign R&E in subsequent legislation signaled a desire to discourage offshoring, the episode illustrates how sensitive innovation location decisions are to relative tax treatment.

#### **7.4. The Case for Coherent, Systems-Level Design**

The Section 174 case also demonstrates the importance of coherence and systems-level thinking in tax code design. Tax provisions do not operate in isolation; they interact with financial accounting rules, capital markets, venture financing incentives, and other areas of the tax code. The interaction between mandatory capitalization and the QSBS regime under §1202 is a salient example. By inflating the tax basis of internally developed intangible assets, the amortization rule inadvertently accelerated disqualification from QSBS eligibility, reducing after-tax returns to early-stage investors and raising the cost of capital for startups. Similarly, interactions with deferred tax accounting under ASC 740, limitations on loss utilization, and restrictions on deductibility in transactional contexts compounded the provision's economic impact. These cascading effects highlight the need for integrated policy design that anticipates cross-sectional interactions rather than evaluating provisions in isolation.

#### **7.5. Lessons for Sustainable Tax Reform**

The rapid emergence of political and industry pressure to reverse the amortization requirement suggests that the policy conflicted with long-standing assumptions about the role of tax incentives in promoting innovation. Historically, U.S. tax policy has emphasized the importance of reducing the cost of research investment to stimulate technological development and economic growth. The Section 174 episode offers several durable lessons.

First, the timing of tax deductions plays a critical role in shaping corporate investment incentives. Even when the total value of deductions remains unchanged, delaying their realization can significantly alter the financial attractiveness of investment projects. Second, innovation-related tax provisions should be evaluated not only in terms of their immediate fiscal impact but also in terms of their broader effects on corporate financing and investment behavior. Because R&E activities are inherently uncertain and often capital-intensive, policies that affect liquidity can have disproportionate effects on research-intensive sectors. Third, tax policy must account for the distinctive characteristics of innovation investment rather than treating R&E as a conventional cost center subject to generic base-broadening measures.

The Section 174 episode thus reinforces the normative case for treating innovation as a distinct policy domain within the tax system. The social returns to R&E investment routinely exceed private returns due to knowledge spillovers, labor market externalities, and downstream productivity effects [45]. Tax systems that fail to internalize these externalities through favorable treatment risk chronic underinvestment in innovation relative to the socially optimal level. While concerns about revenue loss and abuse are legitimate, they are better addressed through targeted anti-abuse rules, refined definitions of qualifying expenditures, and improved compliance mechanisms than through blunt structural changes that raise the cost of innovation across the board.

In retrospect, the Section 174 amortization requirement represents a natural policy experiment demonstrating how the structure and timing of tax deductions influence corporate investment decisions. The episode demonstrates that tax code design plays a formative role in shaping the innovation ecosystem. Policies that appear fiscally prudent in static budget terms may carry hidden costs in foregone technological progress, weakened competitiveness, and reduced long-

run revenue capacity. Sustainable tax reform must therefore incorporate dynamic economic analysis, account for the distinctive characteristics of innovation investment, and prioritize coherence across interconnected policy domains.

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## 8. Conclusion

The mandatory capitalization and amortization of R&E expenditures under amended IRC §174, implemented from 2022 to 2024 and partially reversed in 2025, constitutes one of the most significant disruptions to U.S. innovation tax policy in recent decades. What began as a fiscal offset to finance the TCJA's permanent corporate rate reduction from 35% to 21% evolved into a real-time policy experiment whose unintended consequences of liquidity compression, erosion of present value of tax shields, distortion of investment incentives, and cascading interactions across financial reporting, entrepreneurial finance, and transactional contexts, were both immediate and material. The rapid mobilization of industry coalitions, small-business advocates, and bipartisan legislators, culminating in the OBBBA's restoration of immediate domestic expensing (via new §174A), retroactive relief for qualifying small businesses, and acceleration options for others, demonstrated the political and economic limits of such interventions when they conflict with the established architecture of U.S. innovation incentives.

This study has examined the Section 174 amortization episode as an illustrative focus and case study in unintended tax policy consequences. By integrating statutory analysis, corporate finance rationale, qualitative evidence from industry advocacy and firm-level cases, and post-reversal dynamics, it contributes to the literature in three principal ways. First, it reframes the amortization mandate as an intertemporal tax policy intervention, quantifying how deduction deferral reduces the present value of tax shields and elevates the effective after-tax cost of R&E, particularly under risk-adjusted discount rates reflective of innovation uncertainty. Second, it extends research on R&E incentives by focusing on the effects of withdrawing a longstanding preference for immediate expensing, rather than the more commonly studied introduction or expansion of credits or deductions. Third, it situates the episode within broader debates on tax stability, liquidity constraints for early-stage firms, cross-provision interactions (notably with §1202 QSBS and ASC 740), and international competitiveness, offering evidence-based lessons for designing innovation-oriented tax provisions that better align with R&E's distinctive economic characteristics: high uncertainty, asymmetric payoffs, knowledge spillovers, and dependence on sustained private investment.

The analysis reveals a central tension in tax policy design: the pursuit of short-term fiscal balance through static revenue scoring can impose hidden dynamic costs on long-run growth engines such as innovation. The \$120 billion revenue estimate for amortization [36] reflected front-loaded collections assuming unchanged behavior; in reality, behavioral responses such as project delays, reduced hiring, curtailed speculative research, and potential offshoring likely eroded future taxable income, rendering the provision less revenue-positive over time. The reversal itself, while providing substantial relief, left legacy effects: permanent QSBS disqualifications for some pre-2025 equity rounds, interim liquidity shocks that delayed breakthroughs, and new complexities (e.g., CAMT interactions from accelerated deductions). These outcomes illustrate that even well-intentioned corrections cannot fully erase the durable harm of temporary misalignment.

Several areas warrant future research. First, empirical studies using post-OBBBA filings (2025–2026 10-Ks) could quantify the scale of cash recoveries from retroactive amendments and accelerations, and assess whether they fully offset interim distortions for small and mid-sized firms. Second, econometric analyses could exploit the 2022–2024 regime and its reversal as a quasi-natural experiment to estimate causal effects on R&E spending, patenting, hiring in innovation roles, and geographic allocation of research activity particularly across firm size, industry, and domestic vs. foreign operations. Third, comparative international work could evaluate how the U.S. episode affected relative competitiveness against OECD peers with enhanced or refundable R&E incentives, and whether the retained 15-year foreign amortization has materially influenced offshoring decisions. Finally, modeling efforts could refine estimates of dynamic revenue impacts, incorporating behavioral elasticities and spillover effects to better inform future base-broadening proposals.

Ultimately, the Section 174 episode serves as both cautionary tale and empirical validation of the need for dynamic, substance-aligned tax design in innovation policy. Sustainable reform must move beyond static scoring to incorporate behavioral responses, cross-provision interactions, and the unique economics of R&E. Policies that penalize experimentation or privilege incremental over transformative investment risk biasing the trajectory of technological progress toward lower-risk, lower-impact paths. As fiscal pressures and global competition intensify, the lessons of this brief but costly misalignment remain urgent: tax incentives for innovation should be evaluated not merely as revenue instruments, but as structural supports for the private-sector investment that drives long-run productivity, competitiveness, and societal welfare.

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## Compliance with ethical standards

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The authors declare no conflicts of interest related to this manuscript.

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