Taxation and Reallocation in the Secondary Market for Capital Goods

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This paper studies how the tax system shapes capital reallocation. In a general equilibrium model featuring a realistic tax system, I show that investment subsidies and corporate tax cuts increase capital formation but may decrease reallocation and entry. By contrast, subsidies for used asset purchases unambiguously increase reallocation. I use asset-level data from financed equipment transactions in Texas, firm-level data from Compustat, and industry-level data from the Business Dynamics Statistics to test the theory. I find that assets exposed to larger investment subsidies transact less, firms more exposed to investment subsidies invest more but have lower capital sales, and more-exposed industries experience persistently lower entry. Consistent with theory, these patterns reverse after the Tax Cuts and Jobs Act, which reduced the corporate tax rate and extended full expensing to used asset purchases.

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1 Introduction

Misallocation of physical capital is widespread and hinders productivity, output, and welfare (Hsieh and Klenow 2009). One reason it persists is that frictions impede reallocation through secondary markets for used assets. This paper studies a concrete policy wedge in that process: the tax treatment of capital purchases and sales. I show theoretically that tax policies which stimulate new capital formation can impede its subsequent reallocation and provide evidence that this tension is empirically important.

Three parts of the tax code jointly shape the reallocation of capital. First, when a corporation sells a depreciable asset, it is taxed on the difference between the sale price and the portion of the original purchase price that has not yet been deducted—the tax basis. Because this tax is realized only when the asset is sold, it can discourage reallocation and lock assets into their current owners (Hassett and Viard 2007; Hines 2016). Second, reallocation interacts with widely used investment subsidies such as accelerated depreciation through two countervailing forces. By spurring new investment, a subsidy may expand the stock of machines that eventually reaches the secondary market and thereby increase reallocation (Lanteri and Rampini 2023). On the other hand, accelerated depreciation reduces the tax basis carried by the subsidized asset. Its owner consequently has fewer future deductions to recover through sale, which can strengthen the incentive to retain the asset. Third, the purchaser of a used asset receives a new tax basis equal to the price it pays. More generous depreciation allowances for used purchases lower their after-tax cost, while the resetting of basis can itself encourage tax-motivated asset transfers (Gordon, Hines, and Summers 1987). Because these provisions affect both the supply of and demand for used capital, their equilibrium effect cannot be inferred from any one of these direct incentives alone.

I develop a new theoretical framework for secondary capital markets in a two-vintage model incorporating the tax treatment of capital purchases and sales.[1] In the model, capital lives for two periods. Incumbent firms are taxed at the corporate rate and produce using "new" and "old" capital, where old capital is the result of investment in the previous period. New investment is immediately productive and receives its own tax depreciation schedule, which can be accelerated via bonus depreciation. Incumbents also decide whether to retain their old capital or sell it to potential entrants subject to capital gains taxation. Potential entrants decide whether to operate and, conditional on entering, how much used capital to purchase; their purchases may receive accelerated depreciation of their own. The price of used capital adjusts to clear the market and

1. The two-vintage structure is related to Edgerton (2011), Lanteri (2018), and Lanteri and Rampini (2023). The key distinction is that I attach a depreciation schedule to each purchase cohort and jointly model the corporate tax rate, the taxation of resale, and depreciation allowances for new and used purchases.

affects incumbents' choice between sale and retention, entrants' purchases and participation, and the expected resale value of new investment. Importantly, entrant optimization and market clearing imply that reallocation and entry move together, consistent with evidence from Ma, Murfin, and Pratt (2022) that greater local availability of used capital increases startup entry. The model therefore links new capital formation, reallocation, and entry through a common equilibrium price.

The model's first prediction is that, in contrast to earlier work (Lanteri and Rampini 2023), investment subsidies for new capital have ambiguous effects on reallocation. While accelerated depreciation and investment tax credits accompanied by basis adjustments lower the after-tax cost of new investment, they also leave the subsidized asset with less tax basis, raising the tax burden on selling it in the following period. Allowing the used asset price to adjust does not eliminate this tension, which turns on the production technology, particularly the substitutability of new and retained capital and the curvature of their marginal products. If the vintages are complements or moderately substitutable, then investment rises in equilibrium when bonus rises, which is what we observe in practice (Zwick and Mahon 2017). However, reallocation may fall because lower basis makes selling less attractive and, when the vintages are complements, the resulting increase in new capital raises the marginal product of retaining old capital. Strong substitutability instead makes an increase in reallocation more likely, as is typically assumed in the neoclassical model, although the exact threshold also depends on curvature and is ultimately an empirical question. Accelerated depreciation can therefore create more capital while causing less of it to be subsequently reallocated.

The same ambiguous link between new asset subsidies and reallocation exists between corporate tax cuts and reallocation. I show that the decision to sell or retain used capital is affected by the corporate tax rate only through the value of the remaining deductions that sale brings forward. That is because, under current law, income from retaining the asset and the gain from selling it face the same rate, so the tax rate otherwise cancels from the decision. Consequently, even though a lower corporate tax rate encourages investment through the standard channel, it may also strengthen the incentive to retain old capital and thereby reduce reallocation. This operates through the same technological forces as bonus: when the vintages are not too substitutable, the retention response is more likely to dominate, although the exact threshold also depends on curvature. However, as long as used capital purchases are not fully expensed, tax cuts may expand entrant demand by reducing the cost of waiting for the remaining deductions, thereby making their ultimate effect on reallocation an empirical question.

The same ambiguity does not plague subsidies for used assets. At a given price, they operate directly on entrants and increase their demand for used capital. Given upward-sloping supply, the resulting excess demand raises the equilibrium price and induces incumbents to sell more, so reallocation and entry rise. This clean result reflects two simplifying assumptions: entrants choose only used capital rather than choosing between new and used machines, and the assets they purchase cannot be resold. Tax policy can thus reduce reallocation when it subsidizes the creation of new capital but increase it when it subsidizes demand for used capital.

I test the predictions of the model using two different policy episodes. First, I study investment, reallocation, and entry around bonus depreciation, which was repeatedly turned off and on for new capital until the 2017 Tax Cuts and Jobs Act (TCJA). Second, I study the same variables around TCJA, which bundled a corporate tax cut with full expensing for new and used asset purchases. To do this, I rely on three datasets. First, I study firm-level capital expenditures and capital sales using Compustat. Second, I study the quantity of physical transactions using Uniform Commercial Code filings from Texas. These filings contain the universe of financed equipment transactions in the state and have been previously used in other settings to study used asset transactions (Edgerton 2011; Ma, Murfin, and Pratt 2022). Finally, I use industry-level data from the Census Bureau's Business Dynamics Statistics to study the downstream effects of tax reform on entry.

First, I analyze the effects of bonus depreciation. Following Zwick and Mahon (2017), I exploit variation across firms in their predetermined exposure to bonus deprecation to estimate the joint effect of the subsidies on investment and capital sales in Compustat. I find that a one-percentage-point increase in exposure to bonus depreciation raises investment by approximately 3.5 percent, but it decreases capital sales by approximately 11 percent. Thus, the same policy that encourages firms to purchase new capital also makes them less likely to sell capital. However, Compustat used capital sales are in volumes and with an endogenous price, it is difficult to pin down whether reallocation is genuinely falling. I resolve the ambiguity with the UCC evidence from Texas by studying the quantity of transactions. I find that vintages of equipment originally purchased during bonus episodes are around 25 percent less likely to appear in secondary market transactions than nonbonus vintages. I find that the gap is increasing in statutory bonus exposure and largest when the asset received full rather than partial expensing. There is also no longer a significant gap after the standard MACRS recovery schedule has been exhausted. Thus, Compustat and UCC evidence together provide evidence that bonus depreciation increases investment while reducing reallocation, the central tension in the model.

TCJA provides a complementary policy experiment because it changed every relevant tax instrument at once. That also makes the resulting evidence less clean to interpret. Using Compustat, I follow Crawford and Markarian (2024) and Chodorow-Reich et al. (2025) by using both a difference-in-differences and a synthetic control approach to comparing American to foreign firms operating in the same industry. Both strategies show capital sales rising significantly following TCJA, as does an event study. While the DiD and the event study both show investment significantly increasing as well, the synthetic control does not. The UCC data corroborate the apparent increase in reallocation following TCJA. I find that the composition of sales shifts from old equipment to young equipment. In particular, the share of sales of used assets between one and five years old—all of which has tax basis remaining—increases by 15 percentage points following TCJA. Moreover, I find that once the purchase cohort is held fixed, the post-TCJA response is 21 percent larger among bonus vintages with remaining basis in 2018 than among bonus vintags whose basis gap had already been exhausted. These results are consistent with the TCJA changing both the incentive to sell existing capital and the demand for used assets. However, because the Act bundled a corporate tax cut with full expensing for new and used purchases, the estimates cannot isolate any single provision or establish that the aggregate number of transactions increased. I therefore interpret the TCJA as a complementary contrast to the cleaner bonus evidence.

Finally, I test the model's downstream prediction that the tax system influences entry through reallocation. Using the same predetermined industry exposure to bonus depreciation from Zwick and Mahon (2017), I estimate the industry-level response of the entry rate to a one-percentage-point increase in the present value of depreciation deductions. In a panel local projections framework, the entry response is initially small but becomes statistically significant after one year and is largest three to four years after the reform, consistent with subsidized machines reaching the secondary market only after they have aged. More importantly, I show that this plausibly runs through reallocation. I interact the bonus exposure with a measure of how liquid the industry's secondary market for capital is from Kermani and Ma (2022) and find that the decline in entry is larger in industries whose equipment retains more value in secondary markets. That mediating factor suggests that the mechanism for the entry decline is secondary markets. I also estimate the effects of TCJA on entry and the point estimates suggest it rose, but they are imprecisely estimated. Together, the results trace the model's full chain from investment subsidies to subsequent reallocation and, ultimately, firm entry.

In sum, I find that subsidies for new investment can be a source of misallocation rather than a remedy for it. That follows from the theoretical result that such subsidies can increase investment while simultaneously decreasing the subsequent reallocation of capital, and the empirical findings which largely support it. That stands in contrast to the standard argument that these policies expand the capital stock and, consequently, the supply of used assets to young and unconstrained firms (Smith 2009; Lanteri, Medina, and Tan 2023).

Related Literature. This paper relates to three main strands of literature.

First, my paper builds on the literature on secondary markets for capital and capital reallocation (Eisfeldt and Rampini 2006). In my model, a population of entrants purchases used capital from incumbent firms. This structure is motivated by Eisfeldt and Rampini (2007), who show that financially constrained firms rely disproportionately on used capital, and Ma, Murfin, and Pratt (2022), who show that startups purchase older machines and that local used capital availability shapes startup hiring and subsequent investment. Darmouni and Sutherland (2024) similarly show that shortages of new equipment cause intermediate-age firms to turn toward used capital, increasing the competition faced by younger firms. The willingness of these firms to absorb used capital depends on its price. Following Lanteri (2018), I therefore make the resale price endogenous, so that it equates incumbent sales with entrant demand and feeds back into investment, used capital purchases, and entry. The closest theoretical paper is Lanteri and Rampini (2023). They show that subsidizing new investment expands the future supply of old capital. While I retain this force, I add an opposing one generated by how investment subsidies affect the tax treatment of future resale.[2] Accelerated depreciation encourages new investment, but it also leaves the subsidized capital with less tax basis when it subsequently reaches the secondary market, strengthening its owner's incentive to retain it. Whether reallocation rises therefore depends on which force dominates. Investment subsidies can consequently create more capital while causing less of it to be reallocated.

Second, my paper contributes to the literature on how taxation affects reallocation of durable assets, including housing and financial capital. For example, on the seller side, realization-based taxation can discourage sales because tax on any gain becomes due only when an asset is sold. This lock-in effect has been documented for corporate stock (Feldstein, Slemrod, and Yitzhaki 1980), corporate dispositions of property, plant, and equipment (Desai and Gentry 2004), and depreciable business assets more generally (Hines 2016).[3] In my model, this seller-side wedge is determined jointly by the corporate tax rate and the asset's remaining basis, so an investment subsidy can create a subsequent incentive to retain the subsidized asset. On the buyer side, a taxable transfer establishes a new depreciable basis, and the resulting deductions can encourage trade. Prior work shows that this force can generate tax-motivated transfers of real estate and structures (Hendershott and Ling 1984; Gordon, Hines, and Summers 1987; Hassett and Viard 2007). I incorporate both sides of the transaction: the seller carries the basis created by the asset's original depreciation schedule, while the buyer receives a new basis equal to the purchase price, whose deductions may themselves be accelerated. A smaller empirical literature shows that tax policy toward new capital can affect contemporaneous used equipment prices and sales (Smith

2. Baley, Blanco, and Oviedo (2025) study how corporate taxes interact with fixed adjustment costs and an exogenous purchase–resale price wedge. They allow capital losses upon resale to be deducted, but do not track purchase-cohort tax basis, depreciation recapture, a buyer-side basis reset, or an endogenous secondary-market price.

3. Related work on housing finds that transaction taxes distort prices and reduce trade (Kopczuk and Munroe 2015; Best and Kleven 2018). Because those taxes apply to the sale price rather than the realized gain, they provide evidence on taxes as barriers to trade rather than realization lock-in itself.

2009; Edgerton 2011; Basu, Kim, and Singh 2024). I ask what happens one step later, when the tax-favored machine itself becomes old and can return to the market. Because it carries the depreciation schedule from its purchase vintage, the subsidy that encouraged its initial purchase may discourage its subsequent sale. I place these seller- and buyer-side forces in an equilibrium market in which the used price, new investment, and entry are endogenous and test the model's vintage-specific predictions using individual equipment transactions.

Finally, this paper contributes to an empirical literature on the effects of business tax policy on investment and entry. Following Hall and Jorgenson (1967), this literature typically studies the effects of tax policy through its effect on the user cost of capital. For example, House and Shapiro (2008) shows that temporary bonus depreciation creates strong incentives to move investment into the subsidy window, while Kitchen and Knittel (2011), Zwick and Mahon (2017), and Ohrn (2019) provide empirical evidence that accelerated depreciation raises investment. I recover this investment response, but treat it as the beginning rather than the end of the analysis. Because accelerated depreciation also reduces the tax basis of the capital being purchased, it changes the incentive to sell that capital later. I therefore follow the same reforms from new investment into capital sales, physical transactions in used capital, and firm entry. Chodorow-Reich et al. (2025) similarly combines administrative tax data with a model of global investment to estimate the domestic and foreign investment responses to the TCJA. In my setting, however, the TCJA is not simply another shock to the user cost of new capital: its corporate tax cut and extension of full expensing to used purchases also change incentives on both sides of the secondary market. Whereas the investment literature asks how strongly tax policy stimulates capital formation, I show that this response does not reveal whether the capital it creates is subsequently reallocated. Moreover, Sapollnik and Swonder (2025) and Fairlie et al. (2026) both show, at a different level of aggregation than I use, that lower taxes lead to business dynamism. By contrast, I show that at the industry level, investment subsidies reduce entry, and the mechanism for that is the secondary market for capital goods.

2 The Tax Treatment of New and Used Assets

Tax policy analysis tends to start and end at the point when a firm purchases a machine. However, the tax treatment of the machine does not: the rules that apply when it is purchased interact with those that apply if it is later sold. This section develops that connection in two steps, beginning with the rules for buying new and used capital and then turning to the rules governing resale.

2.1 Rules for Buying Capital

Historically, the government has subsidized investment through a mixture of tax credits and accelerated depreciation policies. The latter has been dominant since the Tax Reform Act of 1986. Under the Modified Accelerated Cost Recovery System (MACRS), capital is depreciated over a prescribed recovery period that typically understates its economic useful life. Since firms discount the future at a positive rate (Gormsen and Huber 2022), one dollar of tax depreciation spread over several years has less than one dollar of value in present value terms. To see that concretely, suppose a non-negative fraction d_t of a dollar of investment can be deducted in each period t, with $\sum_{t=0}^{T} d_t = 1$ and some deductions occurring after the purchase period. Then, with a discount rate $r > 0$, the present value of those deductions is

$$z = \sum_{t=0}^{T} \frac{d_t}{(1+r)^t} < 1.$$

If the asset is held through its scheduled recovery period, the associated tax savings have present value τz, where τ is the business income tax rate. With an investment tax credit c, the tax-adjusted price of a dollar of investment is therefore $1 - c - \tau z$. The value of the subsidy depends on both the timing of the deductions, summarized by z, and the tax rate at which they are claimed.

Bonus depreciation, which has been studied extensively with respect to new capital (House and Shapiro 2008; Kitchen and Knittel 2011; Zwick and Mahon 2017), allows firms to deduct a percentage θ of investment immediately, with the remainder following the standard MACRS schedule. The modified present value of depreciation allowances is

$$\widetilde{z} = \theta + (1-\theta)z.$$

The associated tax savings are $\tau\widetilde{z}$, so a higher bonus rate lowers the tax-adjusted purchase price. Historically, bonus depreciation has consequently raised new investment. Bonus was first introduced at 30% in 2002, raised to 50% in 2003, allowed to lapse in 2005, reinstated at 50% in 2008, temporarily raised to 100% in 2011, and raised again to 100% for several years following the 2017 Tax Cuts and Jobs Act; Appendix Table A.1 lists the statutory schedule. Before 2018, bonus depreciation was limited by the original-use requirement and therefore generally applied only to new capital. Purchasers of used equipment could still deduct their purchase cost under the ordinary MACRS schedule, but they could not claim bonus depreciation. The TCJA extended bonus depreciation to qualifying used property acquired after September 27, 2017, making used equipment eligible for bonus depreciation for the first time.

As these deductions are claimed, the portion of the asset's purchase price that has not yet been deducted declines. This remaining amount is the asset's tax basis. The depreciation rules that apply when a machine is purchased therefore determine the basis it carries into a subsequent sale. The next subsection explains how that basis is treated when the machine is sold.

2.2 Rules for Selling Used Capital

The statutory rules governing sales of used capital have been relatively stable since the Tax Reform Act of 1986 (TRA86), but the tax due when an asset is sold has varied with depreciation policy and the business income tax rate. Since TRA86, the basic principle has been that firms pay tax on the difference between the sale price and the asset's remaining tax basis. Suppose that an asset purchased in period s is sold at the beginning of period t, before the period-t deduction is claimed. If q_s is its original purchase price and d_i is the fraction of that price deducted in period i, its basis immediately before sale is

$$B_t = q_s \left(1 - \sum_{i=s}^{t-1} d_i\right).$$

If the firm sells the asset for q_t, its after-tax proceeds are

$$q_t - \tau(q_t - B_t) = (1 - \tau)q_t + \tau B_t.$$

The tax on the gain $q_t - B_t$ is known as depreciation recapture.[4] This expression describes the tax due conditional on sale. Holding the sale price fixed, the liability is larger when prior deductions have reduced B_t or when the business income tax rate is higher. Bonus depreciation therefore increases the tax due upon a subsequent sale by reducing the asset's basis more quickly. Under full expensing, $B_t = 0$, so the entire sale price is included in taxable income.

Whether the firm chooses to sell, however, depends on the alternative of retaining the asset. If the asset is retained, its remaining basis is recovered through the remaining depreciation deductions. If it is sold, that basis offsets taxable sale proceeds immediately. The relevant comparison therefore depends on the deductions whose recovery sale brings forward and on the tax rate that determines their value, rather than simply on total basis at the sale date.

The purchaser's tax treatment also matters. The seller's adjusted basis does not transfer with the asset: a buyer of used capital receives a new basis equal to the purchase price and deducts that basis under the rules applicable at the time of acquisition. The tax system therefore applies

4. Strictly, §1245 recapture applies only to the portion of the gain attributable to prior depreciation deductions, i.e., $\min(q_t - B_t, q_s - B_t)$. Any gain above the original purchase price, $q_t - q_s$, is a §1231 capital gain. For used equipment, the sale price almost always falls below the original purchase price, so the entire gain is recapture. For corporations, the distinction is immaterial in either case because both are taxed at rate τ.

separately to the gain recognized by the seller and the deductions received by the buyer.

Until 2018, sellers could also defer recapture by exchanging equipment for like-kind property under Section 1031. The TCJA changed several of these rules simultaneously: it increased bonus depreciation for new capital, extended bonus depreciation to used property, reduced the corporate tax rate from 35 to 21 percent, and repealed like-kind treatment for equipment. Because these provisions operate at different points in the transaction, the tax due conditional on sale does not by itself determine their effect on the used asset market. The following section separates these policy changes and studies how they affect investment, selling, and purchasing once the used price adjusts in equilibrium.

3 A Model of the Used Asset Market

The previous section detailed how the tax system treats the purchases and sales of new and used assets. This section formally studies how that institutional structure affects the market for used assets in general equilibrium.

3.1 Environment

Time is discrete and runs from $t = 0, \dots, \infty$. All firms discount future cash flows at rate $\beta \in (0, 1)$. There are two types of firms: a unit mass of incumbents and a unit mass of potential entrants.

Incumbents. Incumbents produce output by combining "new" and "old" machines. At the beginning of period t, an incumbent purchases I_t units of new capital. New capital is immediately available for production in period t, becomes old capital in period $t + 1$, and has no productive or resale value in period $t + 2$, when it is retired. The stock of old capital therefore evolves according to $K_{t+1} = I_t$. At the beginning of period t, the incumbent also chooses how much of its old capital to sell on the secondary market at price q_t. If it sells S_t, it retains

$$R_t = K_t - S_t$$

for production. Output is $Y_t = F(I_t, R_t)$. I impose standard regularity conditions on the production technology.

Assumption 1 (Technology). *The production function $F : \mathbb{R}^2_+ \to \mathbb{R}_+$ is twice continuously differentiable on $\mathbb{R}^2_{++}$, strictly increasing, and has a negative-definite Hessian. It satisfies the Inada conditions in each input, holding the other input fixed and positive.*

I impose no sign restriction on F_{12}. New and retained capital may therefore be complements, $F_{12} > 0$, or substitutes, $F_{12} < 0$.

The output good is the numeraire, and new machines are elastically supplied at a price of one. The tax treatment of incumbents has three components. First, operating income is taxed at rate $\tau_t \in [0, 1)$. Second, a machine purchased in period t receives a depreciation schedule

$$d_{0,t}, \quad d_{1,t}, \quad d_{2,t} \geq 0, \qquad d_{0,t} + d_{1,t} + d_{2,t} = 1.$$

The firm deducts $d_{0,t}$ upon purchase, $d_{1,t}$ when the machine becomes old in period $t + 1$, and $d_{2,t}$ when it is retired in period $t+2$. Thus, $d_{1,t}+d_{2,t}$ is the machine's remaining basis when it enters the secondary market, while $d_{2,t}$ is the portion that remains outstanding after the secondary-market date if the machine is retained.

Finally, I assume that firms can use all deductions at the applicable tax rate and that gains and losses from asset sales are taxed symmetrically. If a machine purchased in period $t - 1$ is sold in period t, its remaining basis immediately before sale is $d_{1,t-1} + d_{2,t-1}$, and the seller receives

$$(1 - \tau_t)q_t + \tau_t(d_{1,t-1} + d_{2,t-1})$$

after tax. If the machine is retained, the incumbent deducts $d_{1,t-1}$ in period t, leaving $d_{2,t-1}$ to be deducted upon retirement in period $t + 1$. Sale therefore does not change the timing of $d_{1,t-1}$; relative to retention, its only timing effect is to recognize $d_{2,t-1}$ one period earlier.

Given sequences of prices and policies, and an initial stock K_0 with its remaining depreciation schedule, the incumbent solves

$$\begin{aligned} V_t(K_t) = \max_{I_t, S_t} \Big\{ & (1 - \tau_t)F(I_t, K_t - S_t) - (1 - \tau_t d_{0,t})I_t \\ & + \left[(1 - \tau_t)q_t + \tau_t(d_{1,t-1} + d_{2,t-1})\right] S_t \\ & + \tau_t d_{1,t-1}(K_t - S_t) \\ & + \beta \left[\tau_{t+1} d_{2,t-1}(K_t - S_t) + V_{t+1}(I_t)\right] \Big\}, \end{aligned} \tag{1}$$

subject to $I_t \geq 0$, $0 \leq S_t \leq K_t$, and $K_{t+1} = I_t$.[5] The appendix derives the incumbent's dynamic optimality and envelope conditions. The analysis below concerns stationary equilibria. Under constant policies and prices, and at an interior allocation, the incumbent's optimality conditions

5. Depreciation schedules are attached to purchase cohorts. Thus, K_t carries the remaining schedule $(d_{1,t-1}, d_{2,t-1})$, while I_t carries $(d_{1,t}, d_{2,t})$ into period $t + 1$. These predetermined schedules are absorbed by the time subscript on V_t.

reduce to

$$F_1 = 1 + \frac{\tau(1-\beta)}{1-\tau}(1-d_0) - \beta q, \tag{2}$$

$$F_2 = q + \frac{\tau(1-\beta)}{1-\tau} d_2. \tag{3}$$

Equation (2) governs the creation of new capital by equating its marginal product with its user cost. The unit purchase price is the first term on the right-hand side. The second term is the cost of deferring the basis not deducted immediately, $1 - d_0 = d_1 + d_2$, while the final term subtracts the machine's discounted resale value. The cost of deferral is greater when the corporate tax rate is higher, more basis remains after purchase, or future deductions are discounted more heavily. Thus, holding retained capital fixed, greater immediate expensing or a lower corporate tax rate reduces the user cost of new capital, while a higher anticipated resale price increases the value of investing. At an interior sale-retention choice in the following period, the machine's continuation value can be written using its sale value, which recognizes all remaining basis at that date. This is why d_1 and d_2 enter (2) through their sum rather than with separate discount factors.

Equation (3) governs the choice between selling and retaining old capital. Retaining yields the marginal product F_2, while selling yields q and recognizes the terminal basis d_2 one period earlier. The deduction d_1 is available in the current period under either choice and therefore cancels. The tax benefit from accelerating d_2 is larger when d_2 or the corporate tax rate is higher and smaller when the firm places greater value on future deductions. Consequently, holding the other choices fixed, a higher used price or more terminal basis makes selling more attractive, while a lower corporate tax rate or less terminal basis strengthens the incentive to retain the machine.

The two conditions reveal how prices and taxes jointly govern the incumbent's decisions. The used price enters as the anticipated resale value of new investment and as the opportunity cost of retaining old capital. The corporate tax rate determines the value of changing the timing of deductions, while the depreciation schedule determines how much basis is exposed to that timing. If $\tau = 0$ or $\beta = 1$, both tax-timing wedges disappear. Otherwise, creation depends on the total basis deferred beyond purchase, $d_1 + d_2$, whereas circulation depends only on the terminal basis d_2 that sale accelerates. Both depreciation reforms and corporate tax changes can therefore affect capital creation and capital circulation.

Entrants. To close the used asset market, I assume that each period a unit mass of potential entrants decides whether to operate. An active entrant purchases U_t used machines from incumbents and produces for one period according to $h(U_t)$, after which the machines retire. This reflects evidence from Ma, Murfin, and Pratt (2022) that the buyers of used capital are young, financially constrained firms who struggle to acquire new capital, though of course it is a simplification. Entrants do not accumulate productive capital or become incumbents; they statically decide whether to enter every period. Each potential entrant draws a deductible fixed operating cost c from a continuous distribution G on $\mathbb{R}_+$; that cost governs entry. To ensure that entrants are well-behaved, I make assumptions about both h and G:

Assumption 2 (Entrant Regularity)**.** *h and G are governed by the following regularity conditions:*

(i) The function $h : \mathbb{R}_+ \to \mathbb{R}_+$ is continuous on $\mathbb{R}_+$, twice continuously differentiable, strictly increasing, and strictly concave on $\mathbb{R}_{++}$, and satisfies $h(0) = 0$ and

$$\lim_{U \downarrow 0} h'(U) = \infty, \qquad \lim_{U \to \infty} h'(U) = 0.$$

(ii) G is continuously differentiable with positive density over its support, with $G(0) = 0$ and $0 < G(c) < 1$ for every finite $c > 0$.

Entrants are taxed at the same corporate tax rate as incumbents. A used machine purchased for q_t receives a new tax basis equal to its purchase price. The entrant deducts a share $\theta_t^U \in [0, 1]$ of that basis in the current period and the remaining share $1 - \theta_t^U$ when the machine is retired in period $t + 1$. Although the entrant carries no productive capital forward, it remains able to use this terminal deduction. Conditional on operating, it therefore solves

$$\pi_t(c) = \max_{U_t \geq 0} \left\{ (1 - \tau_t)\left[h(U_t) - c\right] - q_t(1 - \tau_t \theta_t^U)U_t + \beta \tau_{t+1}(1 - \theta_t^U) q_t U_t \right\}. \tag{4}$$

The appendix gives the corresponding time-dependent optimality condition. Under constant policies and prices, an active entrant's interior choice satisfies

$$h'(U) = q \left[1 + \frac{\tau(1 - \beta)}{1 - \tau}(1 - \theta^U) \right]. \tag{5}$$

The right-hand side is the tax-adjusted cost of used capital. The purchase price is q, while the second term reflects the cost of postponing the deduction for the share $1 - \theta^U$. This cost is larger when the corporate tax rate is higher or future deductions are discounted more heavily. Thus, holding the used price fixed, greater immediate expensing increases purchases by each active entrant. When some basis is deferred, a lower corporate tax rate does so as well

Because c is a fixed cost, it does not affect the optimal choice of U, and all active entrants purchase the same quantity. Using (5), the marginal entrant's zero-profit condition is

$$\bar{c} = h(U) - h'(U)U. \tag{6}$$

An entrant operates if and only if $c \leq \bar{c}$. Entrants below the cutoff earn positive profits, while only the marginal entrant earns zero. The active mass is therefore $\lambda = G(\bar{c})$, and aggregate demand for used capital is λU.

3.2 Stationary Competitive Equilibrium.

To obtain transparent analytical comparative statics, I consider constant policies and evaluate the dynamic equilibrium along a stationary path. Prices and allocations are then constant, but firms continue to solve the same dynamic problems described above.

Definition 1 (Stationary competitive equilibrium). Given constant policies $(\tau, d_0, d_1, d_2, \theta^U)$, a stationary competitive equilibrium consists of $(I, S, R, U, \bar{c}, \lambda, q)$ such that, taking q as given, the constant choices $I_t = I$ and $S_t = S$ solve the incumbent's problem from the stationary stock $K_t = I$, with $R = I - S$. Conditional on operating, each entrant optimally chooses U, the entry cutoff is given by (6), and $\lambda = G(\bar{c})$. Finally, the used capital market clears:

$$S = \lambda U. \tag{7}$$

Given policies, individual optimization maps each used price q into incumbent sales and aggregate entrant purchases. The equilibrium price equates these two quantities. To ensure that the resulting supply and demand schedules have a unique interior crossing, I impose the following condition.

Assumption 3 (Stationary used capital market)**.** *The set of used prices at which the stationary incumbent and entrant problems admit finite interior solutions is an interval. At every incumbent allocation induced by a price in this interval,*

$$F_{11} + (1 + \beta)F_{12} + \beta F_{22} < 0. \tag{8}$$

Moreover, aggregate used capital demand exceeds incumbent sales at some price in this interval, while incumbent sales exceed aggregate demand at a higher price.

Condition (8) governs how incumbent sales vary with the used price across stationary allocations. Along a stationary path, q is both the current sale price of old capital and the anticipated resale price of new investment. Investment and retention therefore adjust together when q changes. Condition (8) ensures that their net response raises $S = I - R$ when q rises. It holds automatically when new and retained capital are substitutes and limits the strength of their complementarity otherwise. For entrants, a higher q raises the tax adjusted cost of used capital, reducing purchases per entrant, the entry cutoff, and participation. Stationary supply therefore rises with q, while aggregate demand falls. The final part of the assumption ensures that the two schedules cross in the interior, yielding the following result

Lemma 1 (Stationary equilibrium)**.** *Under the technology, entrant, and stationary market assumptions, there exists a unique interior stationary competitive equilibrium. In particular,*

$$I > 0, \qquad R > 0, \qquad 0 < S < I, \qquad U > 0, \qquad 0 < \lambda < 1.$$

The proof is in Appendix B.2, which also shows that the equilibrium remains interior under sufficiently small changes in the policy parameters. This allows the stationary equilibrium conditions to be differentiated in the comparative statics below.

3.3 Tax Policy and Reallocative Distortions in General Equilibrium

Having characterized the stationary equilibrium, I now consider three policy experiments: accelerated depreciation for new capital, accelerated depreciation for used capital, and a corporate tax rate cut. Each reform can affect new investment, capital reallocation, and entry into the used capital market. Reallocation and entry are not independent outcomes, however. Market clearing links the amount of capital sold by incumbents to both purchases per entrant and the mass of active entrants.

Lemma 2 (Reallocation and entry.)**.** *Around an interior stationary equilibrium, S, U, $\bar{c}$, and λ move in the same direction.*
Proof: Appendix B.3.

The cutoff and market clearing conditions imply that greater purchases per entrant raise both participation and aggregate reallocation. Consequently, the subsequent results can focus on investment and reallocation; once the response of S is known, the entry response follows from the lemma.

Bonus Depreciation

Accelerated depreciation moves deductions from future periods toward the purchase date. Its effects differ depending on whether it applies to a new or used purchase. Bonus for new capital changes both the cost of creating capital and the tax basis that the resulting machines carry into the secondary market. Bonus for used capital instead changes the acquisition cost faced by buyers. I consider each case in turn.

Bonus depreciation for new capital. Consider first an increase in bonus depreciation for new equipment. I represent the reform as an increase in d_0 financed by proportional reductions in the remaining deductions:

$$\Delta d_0 > 0, \qquad \Delta d_1 = -\frac{d_1}{d_1 + d_2}\Delta d_0, \qquad \Delta d_2 = -\frac{d_2}{d_1 + d_2}\Delta d_0.$$

The incumbent conditions show why this reform does not operate through a single margin. Holding retention and the used price fixed, increasing d_0 encourages capital formation:

$$\left.\frac{\partial I}{\partial d_0}\right|_{R,q} = -\frac{\tau(1-\beta)}{(1-\tau)F_{11}} > 0.$$

At the same time, the sale condition depends on the depreciation schedule only through d_2. Holding the capital stock, new investment, and the used price fixed,

$$\left.\frac{\partial S}{\partial d_2}\right|_{K,I,q} = -\frac{\tau(1-\beta)}{(1-\tau)F_{22}} > 0.$$

Because proportional bonus raises d_0 but lowers d_2, it encourages the creation of new capital while weakening the subsequent incentive to sell that capital. These two derivatives isolate the opposing policy forces. They do not by themselves determine the equilibrium responses because investment, retention, and the used price adjust together.

Proposition 1 (Accelerated depreciation for new capital)**.** *Suppose* $\tau \in (0,1)$*. At the interior stationary equilibrium, a proportional acceleration of depreciation for new capital has the following effects:*

(i) Investment rises if $F_{12} \geq F_{22}$*.*

(ii) Reallocation and entry fall if and only if

$$d_2 F_{11} - (d_1 + d_2)F_{22} - d_1 F_{12} < 0. \tag{9}$$

In this case, q *rises. If the inequality is reversed, reallocation and entry rise and* q *falls. At equality, reallocation, entry, and* q *have no first-order response.*

Part (i) separates the reduction in the cost of new capital from its full equilibrium effect. Pulling future deductions into d_0 always encourages investment when retention and the used price are held fixed. In equilibrium, however, the reform also changes the incentive to retain old capital, and both retention and q feed back into the investment decision. If new and retained capital are sufficiently strong substitutes, the incentive to retain more old capital can reduce the marginal product of new capital enough to offset the reduction in its tax-adjusted cost. The condition $F_{12} \geq F_{22}$ rules out this case. It holds whenever the two inputs are complements and also permits them to be substitutes, provided that substitutability is not too strong.

Part (ii) asks whether the capital created by the reform subsequently circulates. Under the condition in part (i), bonus raises investment and therefore expands the stock that will become available for sale. But bonus also reduces d_2, making sale less attractive and increasing desired retention. Since $S = I - R$, reallocation falls when retention rises by more than investment, which is exactly the condition in part (ii).

The curvature terms determine which response dominates. A more negative F_{11} causes the marginal product of new capital to decline more quickly as investment rises. Bonus then produces a smaller expansion in the capital stock, making a decline in reallocation more likely. A more negative F_{22} causes the marginal product of retained capital to decline more quickly as retention rises. Incumbents then retain less additional capital, making the expansion in investment more likely to translate into greater reallocation. Finally, F_{12} governs the interaction between the two inputs. When they are complements, additional investment raises the marginal product of retained capital and reinforces retention. When they are substitutes, additional investment lowers the marginal product of retained capital and encourages incumbents to sell. The weights d_1 and d_2 reflect the timing of the reform: pulling either deduction into d_0 encourages investment, whereas only the reduction in d_2 changes the incentive to sell.

The condition in part (ii) also determines the equilibrium price response. When it holds, the reform reduces incumbent sales at the original q, while leaving entrant demand unchanged. The resulting excess demand causes q to rise until the market clears. The higher price draws some capital back onto the market while reducing purchases per entrant and participation. Nevertheless, because the new equilibrium lies along the unchanged downward-sloping demand schedule, reallocation and entry are lower. The price adjustment moderates the initial supply contraction but does not change its sign. Combined with part (i), bonus therefore creates more capital while causing less of that capital to circulate. If the condition is reversed, capital creation dominates retention, incumbent supply expands, and the price and quantity responses reverse.

Bonus depreciation for used capital. Consider next an increase in bonus depreciation for used capital, represented by a higher θ^U. At a fixed used price, the reform lowers the tax-adjusted acquisition cost faced by entrants. Purchases per entrant therefore rise:

$$\left.\frac{\partial U}{\partial \theta^U}\right|_q = -\frac{q\tau(1-\beta)}{(1-\tau)h''(U)} > 0.$$

The increase in U also raises the entry cutoff and participation, so aggregate entrant demand shifts outward. This describes desired purchases at the original q, however, rather than the equilibrium response of reallocation, because the used price must adjust to clear the market.

Proposition 2 (Accelerated depreciation for used capital)**.** *Suppose $\tau \in (0,1)$ and $\theta^U < 1$. At the interior stationary equilibrium, an increase in θ^U has the following effects:*

(i) Reallocation and entry rise, and q rises.

(ii) Investment rises if and only if $F_{12} + \beta F_{22} < 0$. If the inequality is reversed, investment falls. At equality, investment has no first-order response.

Part (i) follows from the outward shift in entrant demand. At the original price, entrants demand more capital while incumbent supply is unchanged, creating excess demand. The used price therefore rises until the market clears. Because stationary incumbent supply is upward sloping under Assumption 3, the higher price draws more capital onto the market, so equilibrium reallocation rises. Lemma 2 then implies that purchases per entrant, the entry cutoff, and participation rise as well. Unlike bonus for new capital, bonus for used capital shifts demand rather than incumbent supply. The used price and reallocation therefore rise together.

The increase in q also feeds back into new capital formation. A higher resale price raises the continuation value of new investment, but it also strengthens the incentive to sell rather than retain old capital. When new and retained capital are substitutes, the movement away from retention reinforces the investment response. When they are complements, it reduces the marginal product of new capital and can offset the resale-value channel. The condition $F_{12} + \beta F_{22} < 0$ rules out complementarity strong enough to do so. It holds automatically when new and retained capital are substitutes and also permits complementarity, provided that it is not too strong.

Bonus for used capital therefore has a clearer effect on circulation than bonus for new capital. By shifting entrant demand outward, it necessarily raises reallocation under the maintained upward supply condition. Its effect on new investment is an equilibrium spillover operating through the higher resale price.

Corporate Tax Cuts

Finally, consider a permanent reduction in the corporate tax rate, holding the depreciation schedules d_0, d_1, d_2 and θ^U fixed. Because deductions received at different dates are discounted differently, a lower tax rate reduces the cost associated with deferring basis. Holding retention and the used price fixed,

$$\left.\frac{\partial I}{\partial \tau}\right|_{R,q} = \frac{(1-\beta)(d_1+d_2)}{(1-\tau)^2 F_{11}} < 0,$$

so a tax cut encourages investment. The same change reduces the value of recovering terminal basis early through sale. Holding the capital stock, new investment, and the used price fixed,

$$\left.\frac{\partial S}{\partial \tau}\right|_{K,I,q} = -\frac{(1-\beta)d_2}{(1-\tau)^2 F_{22}} > 0,$$

so a tax cut strengthens the incentive to retain old capital.

Tax timing also enters the buyer's decision. When used capital is not fully expensed, holding q fixed gives

$$\left.\frac{\partial U}{\partial \tau}\right|_{q} = \frac{q(1-\beta)(1-\theta^U)}{(1-\tau)^2 h''(U)} < 0.$$

A lower corporate tax rate therefore increases purchases per entrant and shifts aggregate entrant demand outward. A corporate tax cut thus combines the incumbent-side tension generated by bonus for new capital with the demand shift generated by bonus for used capital.

Proposition 3 (Corporate tax cuts)**.** *Suppose $\tau \in (0,1)$ and $0 \leq \theta^U < 1$. At the interior stationary equilibrium, a marginal permanent reduction in τ has the following effects:*

(i) Investment rises if $F_{22} \leq F_{12} < -\beta F_{22}$.

(ii) The used market response is governed by the sign of $d_2F_{11} - (d_1+d_2)F_{22} - d_1F_{12}$. If this expression is positive, reallocation and entry rise, while the response of q is ambiguous. If it equals zero, q, reallocation, and entry all rise. If it is negative, q rises, while the responses of reallocation and entry are ambiguous.

The sufficient condition in part (i) combines the investment restrictions from the two bonus experiments. The lower bound $F_{12} \geq F_{22}$ rules out substitutability strong enough to overturn the incentive to create capital, while the upper bound $F_{12} < -\beta F_{22}$ rules out complementarity strong enough to overturn the investment response through retention and the used price. Because a corporate tax cut operates through both sets of equilibrium feedbacks, imposing both restrictions ensures that investment rises. The condition still permits new and retained capital to be either substitutes or complements, provided that neither relationship is too strong.

The expression in part (ii) is the same condition that governs reallocation under bonus for new capital. On the incumbent side, a tax cut reduces both the cost of deferring basis on new investment and the benefit from accelerating d_2 through sale. When the expression is negative, the retention response dominates and incumbent supply shifts inward at the original q. When it is positive, capital creation dominates and incumbent supply shifts outward. At the same time, because $\theta^U < 1$, the tax cut shifts entrant demand outward. The equilibrium response therefore depends on whether the incumbent supply shift reinforces or opposes the expansion in entrant demand.

When incumbent supply expands, supply and demand both shift outward. Reallocation and entry must then rise, but the price response depends on which schedule moves farther. When incumbent supply contracts, supply shifts inward while demand shifts outward. The used price must then rise, but reallocation depends on whether the increase in entrant demand is sufficient to overcome the supply contraction. At equality, incumbent supply does not shift at the original price, so the outward movement in demand raises both the used price and reallocation. Lemma 2 gives the corresponding entry responses.

The outward demand shift is also what distinguishes incomplete depreciation from full expensing for used capital. When $\theta^U = 1$, the entrant's problem is independent of τ, so a tax cut does not shift used capital demand. The investment result in part (i) continues to hold, but the used market response is determined entirely by incumbent supply. If the expression in part (ii) is negative, q rises while reallocation and entry fall. If it is positive, reallocation and entry rise while q falls. At equality, the tax cut has no first-order effect on the used market. In this limiting case, the tax cut has the same price and quantity logic as the supply shift generated by bonus for new capital.

3.4 Synthesis

The model's central implication is that policies which encourage capital formation need not encourage capital circulation. Bonus depreciation for new capital can raise investment while reducing subsequent reallocation because moving deductions to the purchase date both lowers the cost of creating a machine and removes future basis whose recovery a later sale would otherwise accelerate. The circulation response should therefore be stronger when the reform removes more future basis and should disappear once no such basis remains. When reallocation falls, the entry lemma implies that participation in the used asset market falls with it. Policies directed toward purchasers of used capital operate differently: they shift demand outward and raise reallocation, while a corporate tax cut changes both incumbent supply and entrant demand. The investment response to a tax reform therefore does not by itself reveal its effect on either reallocation or entry.

4 Data

I test the model's predictions using three primary datasets. First, I use Compustat to examine the joint behavior of capital sales and new capital investments. However, the firm-level data only allows us to analyze the volume of capital sales and the volume of investment rather than prices or quantities alone. As a result, I use a second dataset: uniform commercial code (UCC) filings in Texas. They provide asset-level records of equipment entering secured lending relationships, allowing me to identify the vintage, type, and age of individual machines which get sold on secondary markets. Finally, the model predicts that whatever happens with quantities should correlate downstream with what we observe about entry. As a result, I use the Census Bureau's industry-level Business Dynamics Statistics (BDS) to show what happens to firm entry and exit following tax reforms. I supplement these sources with data from the Statistics of Income on bonus depreciation take-up.

4.1 Compustat

First, I use firm-level data from Compustat to measure capital expenditures and cash proceeds from sales of property, plant, and equipment. In terms of the model, capital expenditures (item `capx`) are the closest empirical counterpart to new investment I, while the proceeds from used capital sales (item `sppe`) correspond to qS, the used price multiplied by the quantity of capital sold. Compustat therefore allows me to examine the joint behavior of capital formation and the value of capital sales, but it does not allow me to separately recover used capital prices and quantities. Nevertheless, capital sales in Compustat have been used extensively to study reallocation (Eisfeldt and Rampini 2006; Eisfeldt and Shi 2018).

I construct two samples to examine two separate reform episodes. The first sample, which I use to analyze the responses of investment and used capital sales to bonus depreciation, contains U.S.-domiciled nonfinancial firms with positive sales, assets, and net PPE and nonnegative capital expenditures. I match each firm to its four-digit industry exposure to bonus depreciation as constructed by Zwick and Mahon (2017). It spans 1995–2016 and contains 102,466 firm-years from 11,674 firms. Next, I construct a second sample to examine the 2017 Tax Cuts and Jobs Act. That sample adds foreign-domiciled firms listed in Compustat as a control group. It spans 2011–2019, contains 17,480 firm-years from 1,620 U.S. and 660 foreign firms, and restricts both groups to firms with sufficient pre-reform variation and four-digit NAICS industries represented among foreign firms. All values in Compustat North America are already reported in U.S. dollars. Appendix C describes the outcome construction, sample restrictions, and treatment of missing sale proceeds in detail for both samples.

4.2 Used Capital Transactions in Texas

Compustat's main shortcoming is that it observes qS, and that object can change if the price or quantity changes, and the model does not make an unconditional prediction about the effects of tax reform on their product. However, my second dataset allows me to observe the quantity of used asset transactions S alone. Many used asset transactions involve financing, and when a business uses equipment as collateral, the lender typically files a financing statement with the state government to document its claim. These Uniform Commercial Code (UCC) filings are a standard feature of commercial lending in the United States and have been used in recent work on equipment markets, capital reallocation, and small business lending (Edgerton 2012; Ma, Murfin, and Pratt 2022; Basu, Kim, and Singh 2024). The filings are a near-complete universe of financed used asset transactions because lenders have a strong incentive to file; it gives them priority in bankruptcy proceedings. The records consequently provide broad coverage of equipment entering secured lending relationships, although they exclude unfinanced purchases. I use the universe of UCC filings in Texas, which I obtained from Jensen (2024).

Each UCC filing identifies the borrower and secured party and describes the collateral in free-form text. Although some descriptions contain only a blanket claim on the borrower's assets, many itemize specific pieces of equipment and report their type, manufacturer, model year, and serial number. I use these descriptions to identify the individual machines associated with each financed transaction and recover their characteristics. A filing that lists multiple machines therefore contributes multiple observations, allowing me to construct transaction quantities by equipment type and vintage.[6] I date the age of each machine using the filing event on which it appears and comparing that to the model year recovered from the description. The description also allows me to figure out the equipment type. Many filings contain an identifier like a serial number or a vehicle identification number, which then makes it straightforward to figure out the model year. Age is then filing year less the model year. I exclude blanket liens, legal and financing boilerplate, and collateral records that cannot be reconstructed unambiguously. Appendix D.1 describes these procedures in detail.

The key fields are equipment type, model year, and asset age because together they link each transaction to the tax system. Equipment type determines the applicable MACRS depreciation schedule. Construction equipment and trucks are generally five-year property, while agricultural equipment is generally seven-year property, so there is some variation in recovery period across assets. Next, I treat model year as the original purchase vintage. That allows me to identify where a particular machine was exposed to bonus depreciation when it was originally sold to the first owner. Third, asset age indicates how far the machine has progressed through the applicable depreciation schedule. Together, these fields allow me to construct the predicted statutory basis remaining when the equipment appears in the UCC data, which is the empirical counterpart to the model's remaining-basis margin. For example, a three-year-old machine appearing in 2010 belongs to the 2007 non-bonus vintage and would have followed ordinary MACRS, while a three-year-old machine appearing in 2011 belongs to the 2008 bonus vintage. The machines are the same

6. UCC filings do not report transaction prices, loan amounts, or loan terms. I therefore observe the quantity and characteristics of equipment involved in financed transactions but not the prices at which it sells.

age but have different predicted remaining basis because only the latter was exposed to bonus depreciation.

I retain equipment assigned to five- or seven-year property with an identified equipment type, model year, and valid age. The resulting sample contains 246,712 equipment items from 2001 through 2019. Using age zero to identify new equipment and positive age to identify used equipment, the sample contains 60,398 new and 186,314 used equipment items. Appendix Tables D.1, D.2, and D.3 report the sample construction, summary statistics, and largest equipment categories.

4.3 Business Dynamics Statistics

Finally, I use the Business Dynamics Statistics (BDS), published annually by the Census Bureau from the Longitudinal Business Database, to study entry. The BDS provides industry-level counts of firms, establishments, entry, and exit for the near-universe of U.S. employer businesses. I use it to test the effects of tax reform on entry, focusing on the 4-digit NAICS level. Within the BDS there are several options for defining entry. For example, one could look at the startup rate for firms or establishments, or one could analyze a stock-flow measure. Guided by the model, in which entry is not necessarily from newly created legal entities, I focus on a stock-flow measure defined by the flow of firms into an industry's active population rather than only the number of firms legally born that year. Letting $F_{N,t}$ denote the number of firms operating in industry N and $D_{N,t}$ the number of firm deaths, the entry rate is

$$\frac{F_{N,t} - F_{N,t-1} + D_{N,t}}{F_{N,t-1}}.$$

At the four-digit industry level, this includes both de novo startups and the net entry of continuing firms into an industry, which is consistent with the broader participation margin in the model. By contrast, the BDS count of age-zero firms captures only de novo startups and therefore imposes a narrower definition of entry than the model requires. Nevertheless, I report robustness to other definitions of the entry rate in the appendix.

Just as with the Compustat data, I construct two separate samples for the two reform episodes. For the bonus depreciation analysis, which spans 1996-2017, I merge the BDS panel with industry-level bonus depreciation exposure from Zwick and Mahon (2017). This yields 4,984 industry-years across 227 industries. The TCJA analysis spans 2012–2019 (1,608 industry-years across 201 industries) and uses a treatment variable constructed from investment-weighted baseline depreciation allowances using BEA fixed asset tables; Appendix E describes the construction. I link both samples to a time-invariant measure of secondary asset market liquidity from Kermani and Ma (2022). Summary statistics appear in Table E.1.

5 Capital Investment and Sales in Compustat

This section studies the behavior of firm-level investment and capital sales across bonus depreciation episodes as well as around the 2017 Tax Cuts and Jobs Act.

5.1 Bonus Depreciation

I begin by studying bonus depreciation for new capital, which was repeatedly varied by policymakers from 2001-2016. In the model, Proposition 1 states that bonus unambiguously raises capital investment, but it is ex ante ambiguous whether the same holds for capital sales. Compustat provides a firm-level test of that possibility because it reports both capital expenditures and cash proceeds from sales of property, plant, and equipment. However, it does not report the number or prices of the assets sold, so capital sale proceeds correspond approximately to qS rather than S alone.

To identify the effect of bonus depreciation on each outcome, I follow the same strategy as Zwick and Mahon (2017). Firms vary in their production technologies; some firms rely on long-lived equipment, while others rely to a greater extent on shorter-lived equipment. That creates predetermined variation in exposure to bonus depreciation because the net present value of a dollar of depreciation deductions varies across firms prior to bonus, with it being more valuable to those firms with longer-lived equipment (House and Shapiro 2008). Zwick and Mahon (2017) provide a measure of this exposure at the four-digit NAICS industry level using pre-bonus investment expenditures to form a composite net present value of depreciation deductions z_N. Applying bonus rate θ, that becomes $\tilde{z}_{N,t} = \theta_t + (1 - \theta_t)z_N$. Consequently, I identify the effect of bonus by comparing changes within firms from more- and less-exposed industries while absorbing permanent firm differences and aggregate year effects. The identifying assumption is that, absent changes in bonus depreciation, capital expenditures and capital sales would not have changed differentially across industries according to this predetermined exposure. Standard errors are clustered by four-digit NAICS industry, the level at which exposure varies.

Table 1 reports the results for four different outcomes. The first three columns decompose capital sale proceeds into the unconditional amount, an indicator for reporting positive proceeds, and proceeds conditional on positive sales. The final column estimates the corresponding investment response, which Zwick and Mahon (2017) already show is significantly positive. The results indicate that capital sales and capital investment move in opposite directions. Whereas a one-percent-point increase in exposure to bonus $\tilde{z}$ raises investment by approximately 3.5 percent, it reduces unconditional capital sale proceeds by approximately 11 percent. Moreover, this difference seems driven by the extensive margin because the probability that a firm reports positive proceeds falls by 0.64 percentage points, whereas it is not possible to distinguish the intensive margin used capital sale response from zero, although the sign is consistent.[7]

Table 1: Bonus Depreciation, Capital Sale Proceeds, and Investment

	Capital Sale Proceeds (sppe)			Investment (capx)
	Unconditional	Any Proceeds	Positive Proceeds	Unconditional
	(1)	(2)	(3)	(4)
$\tilde{z}$	-11.858***	-0.641***	-2.470	3.402**
	(2.286)	(0.242)	(1.580)	(1.684)
Estimator	PPML	LPM	PPML	PPML
Sample	All	All	Sellers	All
Firm FE	X	X	X	X
Year FE	X	X	X	X
Observations	69,445	102,466	30,917	102,210

Notes: Capital sale proceeds are cash proceeds from sales of property, plant, and equipment (sppe); investment is capital expenditures (capx). $\tilde{z}$ is the present value of depreciation deductions from Zwick and Mahon (2017). The sample consists of U.S. nonfinancial Compustat firms from 1995–2016. Standard errors are clustered by four-digit NAICS industry. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

The results in Table 1 rely on statutory exposure, but Kitchen and Knittel (2011) show that take-up of bonus is far from complete, so statutory exposure may be incomplete. Indeed, while the model does not endogenize this margin, firms may choose to opt out of bonus if they know that they may resell the asset, which would increase net proceeds from sale. I test this idea using data from the Statistics of Income, which I use to construct a coarse two-digit NAICS industry-level take-up measure using Form 4562. By interacting the take-up measure with a time-invariant metric of industry-level asset tradeability from Kermani and Ma (2022), I test whether industries with stronger secondary markets are less likely to claim bonus. I find that the interaction is negative, meaning that when bonus becomes more generous, bonus take-up claiming rises less in industries whose capital retains more value in secondary markets. The relationship is similar after controlling for profitability, but the estimate loses precision when dropping agriculture. In

7. I do not report an extensive margin result because practically all Compustat firms report positive investment.

other words, take-up behavior is roughly consistent with the resale mechanism implied by the model.

5.2 The Tax Cuts and Jobs Act

In the model, policy affects investment and used asset sales through the tax treatment of new and used capital and through the corporate tax rate. Among other provisions, the 2017 Tax Cuts and Jobs Act (TCJA) cut the corporate tax rate and extended full expensing to used asset purchases. The model unambiguously predicts that used asset expensing increases reallocation, whereas the effect of a corporate tax cut is generally ambiguous. The preceding bonus results are consistent with the region in which retention dominates capital creation. In that region, both additional expensing for new capital and the incumbent-side response to the tax cut contract used supply, while the tax cut and expensing of used purchases expand demand. The TCJA therefore raises the used price but has an ambiguous effect on physical reallocation. Because Compustat observes qS, this section identifies only the bundled reform's net effect on capital sale proceeds.

Because the TCJA applied to all U.S. firms at the same time, we cannot use the same identification strategy as before. Instead, following Crawford and Markarian (2024) and Chodorow-Reich et al. (2025), I construct a variety of tests comparing US-domiciled firms, which are exposed to the tax cut, to a control group of foreign firms. For the first test, I estimate

$$\mathbb{E}\left[Y_{it} \mid \mathrm{US}_i, \mathrm{Post}_t, \alpha_i, \gamma_t\right] = \exp\left[\alpha_i + \gamma_t + \beta\left(\mathrm{US}_i \times \mathrm{Post}_t\right)\right], \tag{10}$$

where Post_t indicates fiscal years 2018 and 2019, α_i are firm fixed effects, and γ_t are year fixed effects. I estimate (10) by PPML for capital sale proceeds and investment and use a linear probability model for whether the firm reports positive proceeds. Standard errors are clustered by firm. The identifying assumption is that, absent the TCJA, outcomes for U.S. and foreign firms represented in the same industries would have changed similarly. Because some foreign firms have U.S. operations, any exposure of the control group to the reform would tend to attenuate the estimated difference. The results in Table 2 show that investment and capital sale proceeds both increased following the TCJA, drawing a sharp contrast to the effects of bonus. The investment results are similar to those obtained by a variety of studies also showing higher investment following TCJA (Chodorow-Reich et al. 2025; Kennedy et al. 2023; Hartley, Hassett, and Rauh 2025; Crawford and Markarian 2024). However, unlike the bonus results, the capital sales response is concentrated along the intensive margin rather than the extensive margin.

Table 2: TCJA, Capital Sale Proceeds, and Investment

	Capital Sale Proceeds (sppe)			Investment (capx)
	Unconditional	Any Proceeds	Positive Proceeds	Unconditional
	(1)	(2)	(3)	(4)
Post-TCJA × US	0.196^{**}	-0.015	0.123^{*}	0.144^{***}
	(0.084)	(0.019)	(0.069)	(0.033)
Estimator	PPML	LPM	PPML	PPML
Firm FE	X	X	X	X
Year FE	X	X	X	X
Observations	17,480	17,480	10,310	17,471

Notes: Capital sale proceeds are cash proceeds from sales of property, plant, and equipment (sppe); investment is capital expenditures (capx). Post-TCJA indicates fiscal years 2018 and later, and US identifies U.S.-domiciled firms; foreign-domiciled Compustat firms form the control group. The sample spans 2011–2019. Standard errors are clustered by firm. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

The difference-in-differences analysis in Table 2 relies on parallel trends for the comparison to be valid. Appendix Figure C.1 gives an event study version of the table and provides support for this interpretation, showing that no pretrends exist from 2013 through enactment, with both investment and capital sales rising thereafter. However, the sales coefficients have wider confidence bands in the individual years following enactment than the pooled estimate above.

In a third test, I construct a firm-specific synthetic control using foreign firms from the same three-digit industry. Each synthetic control matches the U.S. firm on pre-TCJA capital sales, investment, revenue, the stock of property, plant, and equipment, and total assets. Figure C.3 shows that among the firms with close matches, the actual-minus synethic gap is approximately zero throughout 2013-2017 and increases considerably in both post-reform years. Compared to their synthetic counterparts, U.S. firms increase capital sales by roughly 0.1 inverse-hyperbolic sine units.

In short, the TCJA results diverge from those under bonus, though they are consistent with each other in theory. However, there are several important shortcomings. First, in contrast to bonus, which solely changed expensing for new investment, TCJA bundled several reforms simultaneously, so it is difficult to distinguish the effects of any individual provision on capital sales and investment. Second, Compustat solely measures the volume of capital sales qS, so the increase in proceeds could reflect a higher used price, greater physical reallocation, or both. The UCC evidence in the following section isolates S.

6 Used Equipment Reallocation in UCC Filings

Compustat's main shortcoming is that it observes price times quantity rather than prices or quantities alone. This section isolates quantities using UCC filings from Texas and analyzes reallocation around both the bonus depreciation episode, as well as the Tax Cuts and Jobs Act.

6.1 Bonus Depreciation and Subsequent Reallocation

This section studies the effects of bonus depreciation on the quantity of used asset transactions. In particular, I compare transactions involving equipment originally created during bonus periods—known as *bonus vintages*—to equipment plausibly created and sold during nonbonus periods, which I refer to as *nonbonus vintages*. The model highlights that the comparison between the two is *ex ante* ambiguous. On the one hand, bonus encourages firms to create more capital, expanding the cohort that may eventually reach the secondary market. At the same time, the resulting machines carry less remaining basis, which strengthens the incentive to retain them when they become used. The analysis asks which force dominates in the subsequent circulation of bonus-treated cohorts.

To study which force dominates, I aggregate the UCC data into cells defined by equipment type, MACRS recovery class, filing year, and asset age. Let $N_{e,t,a}$ denote the number of transactions in a cell, where e indexes an equipment-type-by-MACRS-class group, t is the filing year, and a is the asset's age. I use model year as a proxy for the machine's original purchase vintage, $v = t - a$, and estimate

$$\mathbb{E}\left[N_{e,t,a} \mid \alpha_e, \gamma_t, \delta_a\right] = \exp\left[\alpha_e + \gamma_t + \delta_a + \beta\, \text{BonusVintage}_v, \right]. \tag{11}$$

where the equipment type fixed effects α_e absorb persistent difference in secondary markets for particular equipment types, γ_t is a time fixed effect absorbing common shocks, and δ_a are age fixed effects absorbing the ordinary age profile of transactions. I cannot estimate a vintage fixed effect because it is collinear with age and time. I estimate (11) by PPML over filing years 2001–2017 and cluster standard errors by vintage, which is the level at which bonus eligibility changes.

Identification comes from changes in the statutory bonus schedule across vintages. Conditional on equipment type, MACRS recovery class, year, and asset age, the empirical design compares the number of transactions involving machines from bonus and nonbonus purchase vintages. The identifying assumption is that, absent their differential tax treatment, bonus and nonbonus vintages would have otherwise appeared with similar frequency in used equipment transactions. However, as noted previously, because vintage is determined by filing year and age, the baseline specification cannot also absorb vintage fixed effects. The baseline estimate may therefore partly reflect differences in the initial size or composition of purchase cohorts, or other economic conditions associated with their purchase years. Table 3 reports the results.

Column (1) shows that bonus-vintage equipment appears substantially less often in subsequent used asset transactions; the coefficient implies approximately 25 percent fewer transactions than nonbonus vintages. There are two countervailing theoretical reasons for this. First, by encouraging investment, bonus expands the cohort of machines potentially available for later sale. However, by reducing their remaining basis, it also strengthens the incentive to retain those machines when they become used, and the negative coefficient is consistent with the retention response dominating the cohort-creation force.

At first glance, the results may appear to differ from those in Basu, Kim, and Singh (2024), who find that bonus depreciation increases used asset transactions and lowers their prices. However, my analysis studies a different margin of reallocation than theirs. Their estimate captures a replacmeent margin, in which machines purchased before the bonus episode are sold that the firm replaces with subsidized new capital. That margin does not delineate between bonus and nonbonus vintages. In contrast, the treatment here is attached to the transacted machine's own purchase vintage, so the coefficient measures whether the replacement cohort subsequently returns to the secondary market. Bonus can therefore increase the contemporaneous sale of inherited, pre-bonus machines while reducing the later circulation of the bonus-treated machines that replace them. The distinction motivates asking whether the latter gap follows the statutory tax treatment attached to the cohort.

The remaining columns provide that evidence. Column (2) replaces the binary indicator with statutory bonus exposure, defined as the corporate tax rate times the bonus rate when the machine was purchased times the fraction of ordinary MACRS basis remaining at its transaction age. This measure summarizes how much of the original bonus-induced basis difference remains relevant when the machine appears in the UCC data. I find that a ten-percentage-point increase in exposure is associated with approximately 19 percent fewer transactions since $\exp(-0.211) - 1 \approx -0.19$.

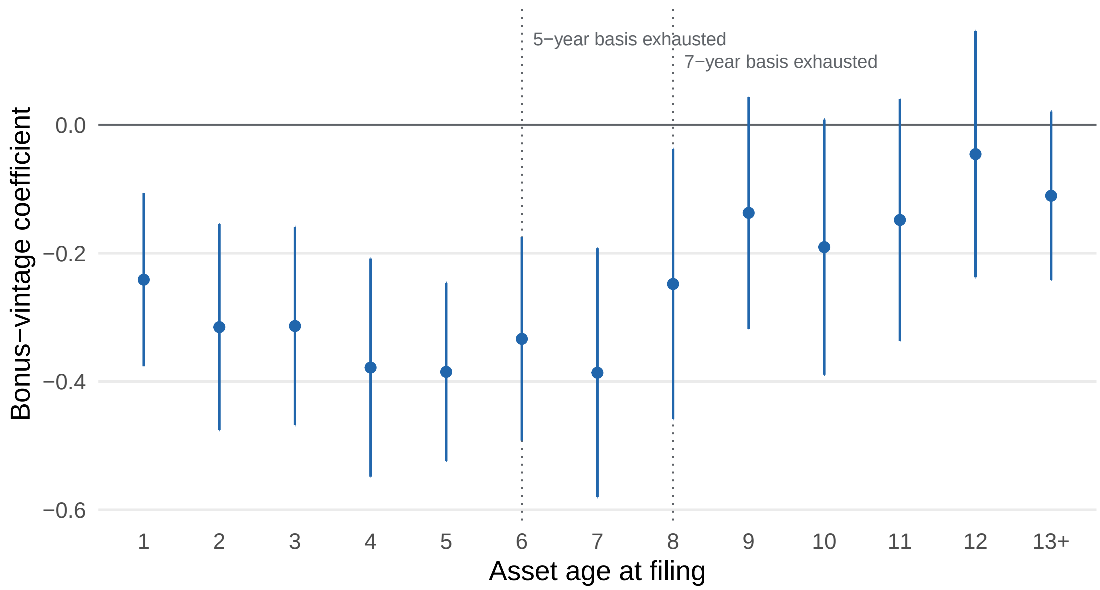
Nevertheless, the observed gap between bonus and nonbonus vintages could reflect economic conditions associated with particular purchase years. However, bonus temporarily lapsed from 2005 to 2007, and leveraging that lapse provides a sharper test because it exploits a break in tax treatment between the surrounding bonus episodes. Focusing only on that distinction, column (3) separately identifies bonus and lapse vintages and reports the difference between their estimated transaction counts. After removing equipment-type-by-MACRS-class, filing-year, and asset-age effects, bonus vintages transact approximately 29 percent less than lapse vintages. However, the lapse vintages themselves transact more than the broader set of nonbonus vintages, so this estimate should be understood as an adjacent-vintage comparison rather than evidence that the lapse vintages exactly reproduce the broader nonbonus benchmark. Column (4) provides a complementary test based on the generosity of the policy, and simultaneously provides a test for monotonicity. Since full expensing automatically removes the entirety of the tax basis, it creates a stronger subsequent incentive to retain the equipment. Consistent with that prediction, full-expensing vintages transact approximately 11 percent less than partial-bonus vintages.

Appendix Table D.5 provides two additional checks on the mechanism. First, I compare seven-year property to five-year property. This is closely related to, but not quite the same, as the monotonicity test in the main text. I find that seven-year assets tend to transact less than five-year assets, consistent with the idea that remaining basis determines propensity to transact. Second, I examine whether cohort size mechanically generates the results. Restricting the sample to product-vintage cohorts observed at age zero and controlling for their age-zero equipment count yields a result that remains significantly negative when comparing bonus to nonbonus vintages.[8]

Table 3 shows that bonus-eligible vintages transact considerably less than non-bonus vintages, but it pools across ages. Figure 1 estimates the same bonus-nonbonus transaction gap by gap. The resulting age profile is informative because bonus and nonbonus vintages receive different tax treatment upon sale only while they have different amounts of bonus remaining. Once ordinary MACRS deductions have been exhausted, sale can no longer accelerate that basis, so the tax-related component of the transaction gap should disappear. The disappearance is visible in the age profile of Figure 1. Until age eight, the estimated transaction gap is negative and roughly constant, but becomes statistically insignificant by age nine. By that age, both five- and seven-year property would have exhausted ordinary MACRS deductions. Consequently, the timing supports the prediction that the tax-related transactoin gap disappears once bonus and nonbonus equipment no longer differ in tax basis.

8. Appendix Table D.4 provides a number of additional checks against whether the results are a spurious result of data construction. I find that the estimate remains similar when I retain only initial financing statements, omit the first observable purchase vintage, and restrict the analysis to product-vintage cohorts observed at age zero. Completing the supported cohort-age profiles with zero-transaction cells makes the estimate slightly more negative. The result therefore does not appear to be driven by later filing events, the boundary of the sample, or the omission of cells in which no transactions are observed.

Figure 1: The Bonus-Vintage Transaction Gap by Asset Age



Notes: The figure plots PPML coefficients comparing bonus and nonbonus vintages at each asset age. Negative coefficients indicate fewer transactions involving bonus vintages. The specification includes equipment-type-by-MACRS-class, filing-year, and asset-age fixed effects. Standard errors are clustered by model-year vintage, and the bars report 95% confidence intervals. The dotted lines mark ordinary basis exhaustion for five- and seven-year MACRS property.

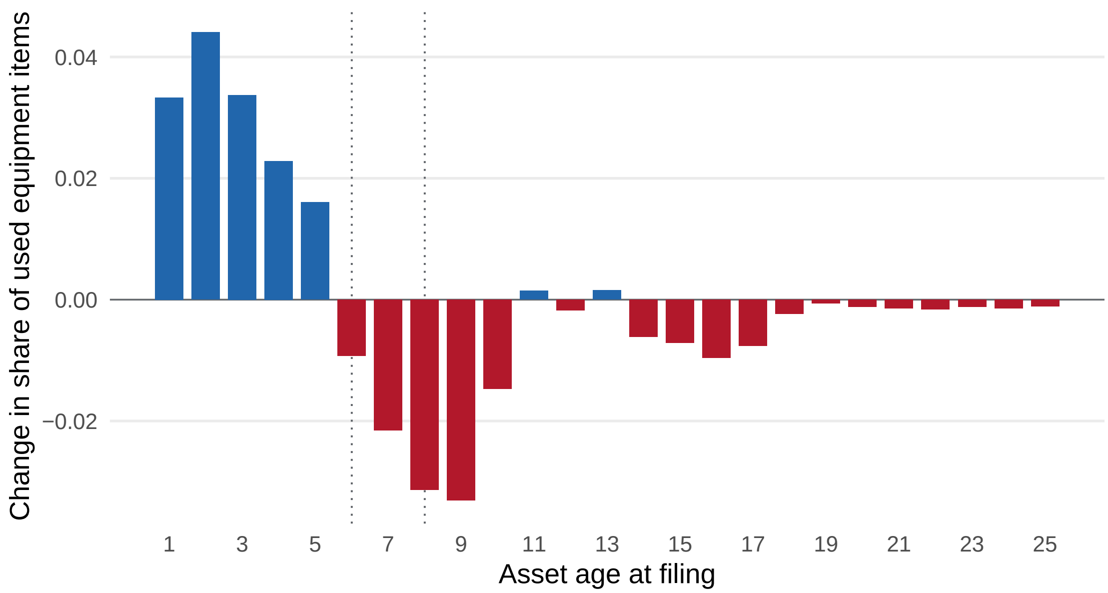
Paired with the bonus-induced decline in sales observed in Compustat, it is apparent that bonus also induced a lower quantity of transactions, which supports the idea in the model that investment subsidies do not necessarily promote reallocation. The next section uses the Tax Cuts and Jobs Act to examine how transactions change within fixed vintages when the tax treatment of the used asset market changes.

6.2 Reallocation Following TCJA

The Compustat results show that U.S. firms increased both investment and capital sale proceeds following TCJA relative to foreign firms. That finding is important because TCJA bundled several reforms with ambiguous effects on reallocation, but Compustat cannot distinguish between the price and quantity responses Since the preceding subsection and the Compustat evidence finds that bonus depreciation for new capital reduced subsequent used equipment sales and transactions, we can take that result through the model to sign the effect of the tax cut theoretically since they are governed by the same condition. In particular, a corporate tax cut pushes used capital supply inward, since the same condition governs the two responses. On the buyer side, however, the rate cut and the extension of expensing to used purchases shift demand outward. Thus, there are two countervailing effects on the market in equilibrium, and it is ex ante unclear which will dominate the reallocative force.

Figure 2 provides initial descriptive evidence that the composition of used asset sales substantially changed post-TCJA. It plots the change in each age's share of used equipment transactions between 2012-2017, when policy was stable, and 2018-2019.

Figure 2: The Age Distribution of Used Equipment Transactions Following the TCJA



Notes: The figure plots the change in each asset age's share of used equipment transactions between 2012–2017 and 2018–2019. The sample contains used equipment items between ages one and 25. Positive values indicate that an age accounted for a larger share of transactions following the TCJA. The dotted lines mark ordinary basis exhaustion for five- and seven-year MACRS property.

The distribution shifts sharply toward transactions of younger equipment post-TCJA. Ages one through five, which would typically have some basis remaining in the pre-TCJA era, gain approximately 15 percentage points of transaction shares, while assets aged six through ten lose 11 percentage points. This shift is potentially significant because the rate cut associated with TCJA narrowed the tax disadvanage of selling bonus vintages compared to nonbonus vintages and therefore may provide evidence of reduced lock-in. Providing further evidence of that, Appendix Table D.7 estimates a corresponding 9.6-percentage-point increase in the probability that used equipment falls within the ordinary recovery period, while Appendix Figure D.2b finds no comparable shift at earlier placebo dates.

Nevertheless, because the figure plots shares, it does not establish that total transactions increased. Importantly, it also does not hold purchase-cohort size fixed; higher investment may have enlarged the unobserved stock of young equipment available for subsequent sale. I address this concern by restricting the sample to model-year vintages no later than 2016 and following transactions involving these preexisting cohorts over time using the same PPML framework as in the previous subsection. A cohort is defined by equipment type, MACRS class, and model-year vintage, while filing year records when its transactions occur. Column (1) of Table 4 asks whether bonus vintages experienced a larger post-TCJA change in transactions than nonbonus vintages. The remaining columns test whether that relative response was concentrated where a bonus-induced basis gap remained. Because all nonbonus vintages were fully depreciated by 2018, they provide a common benchmark; the reported "positive minus zero" contrast itself compares bonus vintages with one another. Older bonus vintages whose basis gap had disappeared provide a placebo for younger bonus vintages whose gap remained, since only the latter had basis-related lock-in for the rate cut to reduce. Column (2) measures the gap at the filing date, while columns (3) and (4) fix its status and amount in 2018. Cohort fixed effects absorb permanent differences in cohort size and composition, equipment-type × filing-year fixed effects absorb common market changes, and age fixed effects absorb the normal life-cycle transaction pattern. Identification requires that, absent the TCJA, bonus and nonbonus vintages would have experienced similar age-adjusted changes and that those changes would not otherwise have varied with the remaining basis gap.

Column (1) provides a pooled benchmark by comparing the post-TCJA change in transactions involving bonus vintages with the contemporaneous change for the much older nonbonus vintages that remain in the UCC data. The coefficient of 0.122 implies a 13 percent larger age-adjusted change for bonus vintages, although the nonoverlapping vintage support makes this comparison less informative than the within-bonus comparisons that follow. This reflects a relative catch-up by preexisting cohorts rather than an estimate of the aggregate change in transactions. Column (2) pins the mechanism to lock-in release. Catch-up is concentrated among bonus vintages with a positive tax basis at sale, with a response 0.252 log points larger than that of bonus vintages whose gap has been exhausted. However, vintages can change groups as their basis gets exhausted, so column (3) makes a cleaner comparison by fixing each cohort's status using its basis gap in 2018. The difference remains 0.188 log points, or approximately 21 percent. Finally, column (4) shows that every additional ten percentage points of the 2018 basis gap is associated with a 0.127-log-point larger response, while the relative response at a zero gap is small and statistically insignificant.

The central empirical result is that the post-TCJA reallocation response is larger for bonus vintages whose prior tax treatment still implies a statutory basis gap. Equation (3) motivates this comparison because remaining basis enters the sale decision, but it does not imply that the rate cut alone generated the observed ordering; it could have also come from the demand-side expensing provision. Thus, the result is therefore suggestive rather than dispositive, but it is compelling alongside the Compustat evidence. Importantly, Appendix Table D.6 shows that the results survive restricting the sample to initial filings, adding supported zero-count cells, omitting 2017, and allowing product-specific year and age effects. Nevertheless, the comparison cannot isolate a single TCJA provision or rule out every post-reform change specific to younger equipment.

The evidence from Compustat and the UCC together provide complementary evidence on different parts of the secondary market response to both bonus depreciation and TCJA. That degree of alignment, as implied by the model, suggests something downstream about entry. The following section turns to that margin.

7 Consequences for Firm Entry

The preceding evidence shows that machines purchased during bonus depreciation episodes subsequently circulate less. In the model, this contraction in reallocation also reduces entry. Lemma 2 establishes that reallocation and entry move together: when incumbents sell fewer machines, the used price rises, purchases per entrant fall, and marginal entrants no longer find it profitable to operate. This mechanism is especially relevant for young and financially constrained firms, which rely disproportionately on used capital for their initial capital stock (Eisfeldt and Rampini 2007; Ma, Murfin, and Pratt 2022).

The empirical effect of bonus depreciation on entry nevertheless need not be negative. Entrants purchase only used equipment in the model, whereas in practice some potential entrants can purchase new equipment and benefit directly from bonus depreciation. The estimates therefore capture the net effect of these competing forces. The used capital mechanism also has a more specific implication: any decline in entry should be larger in industries where capital is more readily traded on secondary markets.

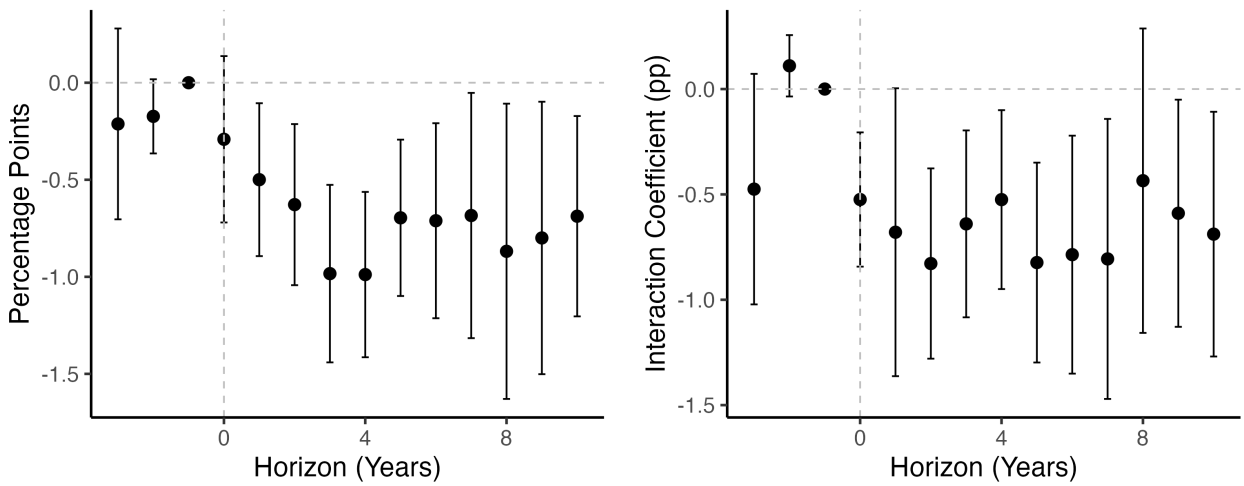
I test these predictions using panel local projections of the four-digit NAICS industry entry rate on the present value of depreciation deductions $\tilde{z}_{N,t}$ from Zwick and Mahon (2017). I estimate

$$y_{N,t+h} - y_{N,t-1} = \alpha_N + \gamma_t + \beta_h \tilde{z}_{N,t} + \text{Controls} + \varepsilon_{N,t}, \tag{12}$$

where $y_{N,t}$ is the stock-flow entry rate defined in Section 4, α_N and γ_t are industry and year fixed effects, and the controls include two-digit NAICS quadratic time trends. The identifying variation comes from national changes in bonus depreciation interacted with predetermined differences in the assets used by each industry. The identifying assumption is therefore that industries with different exposure would otherwise have experienced similar changes in entry after accounting for the fixed effects and industry trends. Standard errors are clustered by four-digit NAICS industry. Because bonus policies are persistent, the coefficients trace the dynamic reduced-form response to greater depreciation generosity rather than the effect of an isolated one-year policy shock.

Figure 3 reports the results. Panel (a) shows that the entry response is negative on impact but initially imprecise. It becomes statistically distinguishable from zero at horizon one, reaches approximately -1 at horizons three and four, and remains negative thereafter. Since both y and $\tilde{z}$ are expressed as shares, a coefficient of -1 means that a one-percentage-point increase in the present value of depreciation deductions is associated with a one-percentage-point decline in the entry rate. The delayed response is consistent with the timing of the secondary-market mechanism: machines subsidized when new reach the used market only in subsequent years.

Figure 3: Bonus Depreciation and Firm Entry



(a) Entry response

(b) Asset tradeability interaction

Notes: Panel (a) plots coefficients from panel local projections of the four-digit NAICS entry rate on the present value of depreciation deductions $\tilde{z}_{N,t}$. Panel (b) plots coefficients on the interaction of $\tilde{z}_{N,t}$ with the demeaned PPE recovery rate from Kermani and Ma (2022), expressed as a fraction. All specifications include industry and year fixed effects and two-digit NAICS quadratic time trends. Bars report 95% confidence intervals using standard errors clustered by four-digit NAICS industry. A coefficient of -1 represents a one-percentage-point decline in the entry rate for a one-percentage-point increase in $\tilde{z}$.

The baseline response is consistent with the model, but it does not by itself establish that used capital is the operative channel. Panel (b) therefore asks whether the decline is larger in industries where secondary markets are more important. I measure asset tradeability using the PPE recovery rate from Kermani and Ma (2022), which reports the fraction of asset value recoverable upon liquidation. Industries with high recovery rates use standardized capital that retains substantial value in resale, while industries with low recovery rates use more specialized capital with limited secondary-market value. The interaction is negative across the post-reform horizons and is statistically significant over much of the medium run. Thus, the decline in entry is larger in industries where capital is more readily traded, as the secondary-market mechanism predicts.

Recovery rates may also be related to other features of an industry's capital and firms. Appendix Figure E.1 therefore adds interactions with average firm size, capital duration, entry cyclicality, and external finance dependence, both individually and jointly. The medium-run tradeability interaction remains negative. The result is also similar when utilities are excluded and when entry is measured at the establishment level. Finally, Appendix Figure E.4 shows that the decline is concentrated among firms aged zero to five, while the stock of older firms changes little. Because the stock of young firms can also change through exit and aging, I interpret this decomposition as supporting evidence rather than a separate measure of firm entry.

These findings may initially appear to contrast with Basu, Kim, and Singh (2024), who find that bonus depreciation increases the number of establishments with five to nine employees. The outcome and timing of their analysis differ from those studied here. Their estimates can capture the immediate release of existing capital when incumbents respond to bonus by replacing old machines. The UCC analysis instead follows the bonus-treated replacement cohort into the secondary market and shows that these machines circulate less later in their lives. The two results can therefore coexist: bonus may increase the contemporaneous reallocation of inherited capital while reducing the subsequent circulation of the new machines it creates. Moreover, their outcome is the stock of small establishments rather than a flow measure of entry, so it does not correspond directly to the BDS measure used here.

The TCJA provides a second, weaker test of the entry mechanism. In addition to cutting the corporate tax rate and increasing bonus depreciation for new capital, the Act extended full expensing to purchases of used equipment. Used capital expensing shifts demand outward in the model and therefore increases reallocation and entry, although the other provisions of the Act can generate offsetting effects. Appendix Figure E.6a shows that entry rises after 2018 in industries where the reform most reduced the preexisting tax disadvantage of used equipment. With only two post-reform years before the pandemic, the estimates are imprecise, so I treat this evidence as directional rather than conclusive. Moreover, quantitative evidence from Sedlacek and Sterk (2019) and Zeida (2022) points toward higher entry through other channels like higher returns to entrepreneurship post-TCJA, which I cannot distinguish from here.

Taken together, the results extend the reallocation evidence to firms that depend on the used capital market. Industries more exposed to bonus depreciation experience a subsequent decline in participation, and that decline is larger where capital is more readily traded. This pattern is consistent with the model's prediction that reduced circulation makes used capital more costly and discourages entry by marginal firms.

8 Conclusion

This paper studies how the tax system shapes capital reallocation. I show that tax policies which stimulate new capital formation may simultaneously impede its subsequent reallocation. That ambiguity arises from the actual implementation of investment subsidies through the tax code. Accelerated depreciation lowers the after-tax cost of purchasing new capital, but it also leaves the subsidized asset with less tax basis when it later reaches the secondary market, strengthening the incentive to retain it. Corporate tax cuts operate through the same tradeoff while also affecting demand for used capital. By contrast, subsidies for used asset purchases directly expand demand and therefore increase reallocation and entry. Thus, a policy's effect on investment alone does not reveal its effect on the allocation of capital.

I find consistent evidence across three datasets. In Compustat, greater exposure to bonus depreciation raises investment while reducing capital sales. In the Texas UCC data, equipment from bonus vintages subsequently transacts about 24 percent less than equipment from nonbonus vintages. The transaction gap increases with the generosity of the original subsidy and disappears after the ordinary depreciation schedule has been exhausted, when the difference in tax basis no longer affects the incentive to sell. Industries more exposed to bonus depreciation also experience persistent reductions in entry, particularly where capital is more readily traded. These patterns reverse following the TCJA, which cut the corporate tax rate and extended full expensing to used purchases: investment and capital sales rise, used equipment transactions shift toward younger assets, and entry increases in the industries most affected by the reform.

In sum, investment subsidies can create more capital while causing less of that capital to be subsequently reallocated. This matters because young and financially constrained firms rely disproportionately on secondary markets for their capital. Policies that impede those markets may therefore affect not only which firms own existing capital, but also which firms are able to operate. This paper establishes that this tradeoff is theoretically and empirically important, but it does not quantify its aggregate welfare consequences or characterize optimal policy. Doing so is an important direction for future research.

Table 3: Bonus Depreciation and Used Equipment Filings Before the TCJA

	Binary	Statutory exposure	Lapse comparison	Bonus rate
	(1)	(2)	(3)	(4)
Bonus vintage	-0.285***		-0.147	
	(0.071)		(0.095)	
Statutory bonus exposure (10 pp)		-0.211***		
		(0.055)		
Lapse vintage (2005–07)			0.200**	
			(0.081)	
Bonus minus lapse			-0.347***	
			(0.061)	
Full-expensing vintage				-0.398***
				(0.057)
Partial-bonus vintage				-0.279***
				(0.071)
Full minus partial				-0.119**
				(0.052)
Type × MACRS class FE	X	X	X	X
Filing year FE	X	X	X	X
Asset age FE	X	X	X	X
Observations	18,847	18,847	18,847	18,847

Notes: The dependent variable is the number of used equipment transactions in equipment-type × MACRS-class × filing-year × asset-age cells from 2001–2017. Model year proxies for purchase vintage; bonus indicators measure statutory eligibility, not whether bonus was claimed. Statutory exposure is the tax rate times the bonus rate times ordinary MACRS basis remaining, in ten-percentage-point units. Models are estimated by PPML, with standard errors clustered by model-year vintage. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

Table 4: TCJA and Used Equipment Filings Within Fixed Cohorts

	Average response	Gap at filing date	Gap fixed in 2018	2018 gap amount
	(1)	(2)	(3)	(4)
Post-TCJA response of bonus vintages				
All bonus vintages	0.122**			
	(0.056)			
No remaining basis gap		0.021	0.051	
		(0.044)	(0.055)	
Positive remaining basis gap		0.273***	0.239***	
		(0.078)	(0.071)	
Difference: positive minus zero		0.252***	0.188**	
		(0.083)	(0.088)	
Response at zero 2018 basis gap				0.057
				(0.053)
Additional response per 10 pp of basis gap				0.127***
				(0.044)
Filing-date basis-gap control		X		
Type-class-vintage FE	X	X	X	X
Type × filing year FE	X	X	X	X
Asset age FE	X	X	X	X
Observations	10,353	10,353	10,353	10,353

Notes: The dependent variable is the number of used equipment transactions in equipment-type × MACRS-class × model-year-vintage × filing-year cells from 2012–2019; all cohorts predate the TCJA. The basis gap is the reduction in remaining tax basis caused by bonus depreciation relative to ordinary MACRS. Column (2) measures it at the filing date; columns (3) and (4) fix it as of 2018, with column (4) scaled in ten-percentage-point units. Models are estimated by PPML, with standard errors clustered by model-year vintage. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

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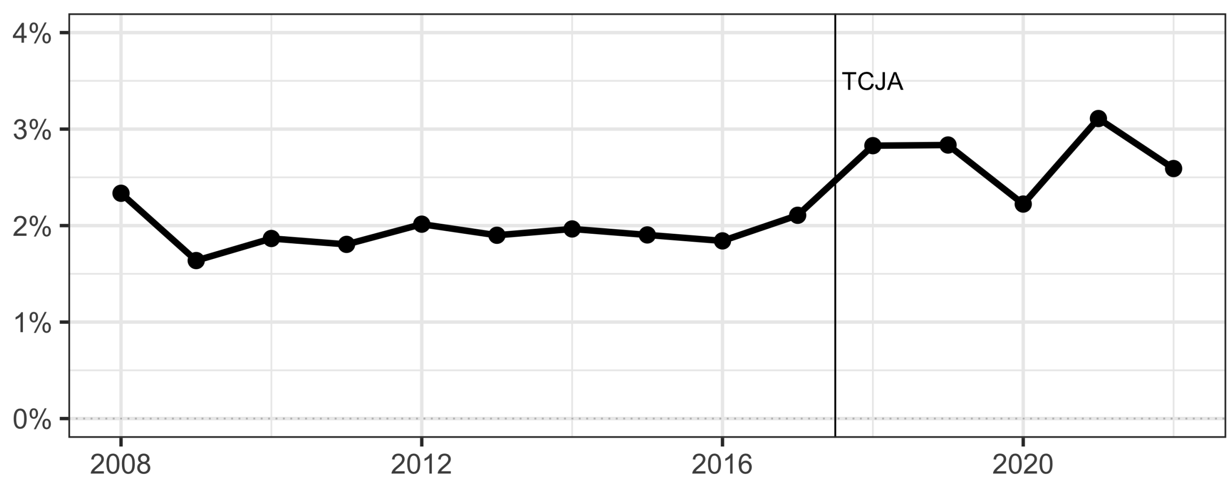
A Institutional Detail

Table A.1: Depreciation of Used and New Five-Year Assets under 50% Bonus for New Capital

Year:	0	1	2	3	4	5	Total	z_i
Used assets								
Deductions (000s)	200	320	192	115	115	58	1,000	
Tax benefit ($\tau = 35\%$)	70	112	67.2	40.3	40.3	20.2	350	0.890
Tax Benefit (Present Value)	70	104.7	58.7	32.9	30.7	14.4	311.4	
New Assets (50 percent bonus)								
Deductions (000s)	600	160	96	57.5	57.5	29	1,000	
Tax benefit ($\tau = 35\%$)	210	56	33.6	20.2	20.2	10	350	0.945
Tax Benefit (Present Value)	210	52.3	29.3	16.5	15.4	7.1	330.7	

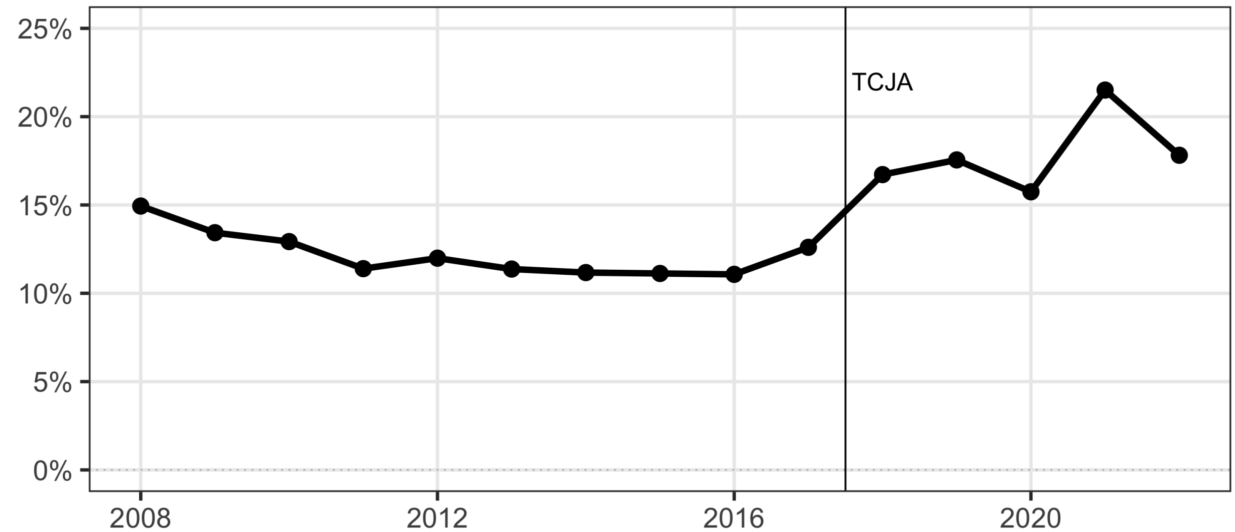
Notes: This table adapts Table 1 from Zwick and Mahon (2017). The used asset follows ordinary MACRS, while the new asset receives 50% bonus depreciation with the remainder deducted under MACRS. Tax savings use a 35% tax rate and a 7% discount rate. The z_i column gives the present value of depreciation deductions per dollar of investment.

Figure A.1: Used Equipment Sales Relative to Total Equipment Capital Stock (%)



Note: Used equipment sales are aggregate Section 1245 dispositions from Form 4797 as published in Statistics of Income Publication 5108. The equipment capital stock is from Fixed Asset Table 4.1 Line 18. The 2015 value of the Section 1245 series is linearly interpolated.

Figure A.2: Used Equipment Sales Relative to New Investment (%)



Note: Used equipment sales are aggregate Section 1245 dispositions from Form 4797 as published in Statistics of Income Publication 5108. New investment is from Fixed Asset Table 4.7 Line 18. The 2015 value of the Section 1245 series is linearly interpolated.

B Theoretical Derivations

B.1 Dynamic Optimality Conditions and Equilibrium

Incumbents. Along an interior path, the first-order conditions for investment and sales in (1) are

$$0 = (1-\tau_t)F_1(I_t, R_t) - (1-\tau_t d_{0,t}) + \beta V_{K,t+1}, \tag{A.1}$$

$$\begin{aligned} 0 = &-(1-\tau_t)F_2(I_t, R_t) + \left[(1-\tau_t)q_t + \tau_t(d_{1,t-1} + d_{2,t-1})\right] \\ &- \tau_t d_{1,t-1} - \beta\tau_{t+1} d_{2,t-1}. \end{aligned} \tag{A.2}$$

The deduction $d_{1,t-1}$ cancels because it is taken in period t whether the machine is sold or retained. The sales condition can therefore be written

$$F_2(I_t, R_t) = q_t + \frac{\tau_t - \beta\tau_{t+1}}{1-\tau_t} d_{2,t-1}. \tag{A.3}$$

The envelope condition for inherited capital is

$$V_{K,t} = (1-\tau_t)F_2(I_t, R_t) + \tau_t d_{1,t-1} + \beta\tau_{t+1} d_{2,t-1}. \tag{A.4}$$

Using (A.3) in this expression replaces the marginal value of retention with the value of sale:

$$V_{K,t} = (1-\tau_t)q_t + \tau_t(d_{1,t-1} + d_{2,t-1}). \tag{A.5}$$

For a machine purchased in period t, the corresponding value one period later is

$$V_{K,t+1} = (1 - \tau_{t+1})q_{t+1} + \tau_{t+1}(d_{1,t} + d_{2,t}). \tag{A.6}$$

Substitution into (A.1), together with $d_{1,t} + d_{2,t} = 1 - d_{0,t}$, leaves

$$F_1(I_t, R_t) = 1 + \frac{\tau_t - \beta\tau_{t+1}}{1 - \tau_t}(1 - d_{0,t}) - \beta\frac{1 - \tau_{t+1}}{1 - \tau_t}q_{t+1}. \tag{A.7}$$

Equations (A.3) and (A.7) are the time-dependent interior conditions. At a boundary, the relevant condition is replaced by its Kuhn–Tucker inequality.

Entrants. The interior first-order condition in (4) is

$$0 = (1 - \tau_t)h'(U_t) - q_t(1 - \tau_t\theta_t^U) + \beta\tau_{t+1}(1 - \theta_t^U)q_t, \tag{A.8}$$

or

$$h'(U_t) = q_t\left[1 + \frac{\tau_t - \beta\tau_{t+1}}{1 - \tau_t}(1 - \theta_t^U)\right]. \tag{A.9}$$

The fixed cost does not affect U_t. Evaluating profits at the conditional optimum and applying (A.9) gives

$$\pi_t(c) = (1 - \tau_t)\left[h(U_t) - h'(U_t)U_t - c\right]. \tag{A.10}$$

Hence

$$\bar{c}_t = h(U_t) - h'(U_t)U_t, \tag{A.11}$$

and the active mass is

$$\lambda_t = G(\bar{c}_t). \tag{A.12}$$

Competitive equilibrium.

Definition 2 (Competitive equilibrium). Given K_0, its remaining depreciation schedule, and a policy sequence

$$\left\{\tau_t, d_{0,t}, d_{1,t}, d_{2,t}, \theta_t^U\right\}_{t=0}^{\infty},$$

a competitive equilibrium consists of value functions and allocations

$$(\{V_t\}_{t\geq 0}, \{K_t, I_t, S_t, R_t, U_t, \bar{c}_t, \lambda_t, q_t\}_{t\geq 0})$$

such that, in every period: (i) V_t satisfies (1) and I_t, S_t attain the maximum; (ii) U_t solves (4), firms enter if and only if $c \leq \bar{c}_t$, and $\lambda_t = G(\bar{c}_t)$; (iii) $K_{t+1} = I_t$, $R_t = K_t - S_t$, and all feasibility constraints hold; and (iv) the used capital market clears,

$$S_t = \lambda_t U_t.$$

New capital is elastically supplied at its normalized price of one, and $q_t \geq 0$.

With constant policies, a stationary competitive equilibrium has constant prices and allocations. It satisfies $K = I$, and (A.7)–(A.9) reduce to (2), (3), and (5). A stationary allocation is a constant equilibrium path from period zero only when $K_0 = I$ and the inherited machines carry the stationary remaining schedule (d_1, d_2). Otherwise it is only a steady-state allocation; the equilibrium from the given initial condition may exhibit transition dynamics.

B.2 Stationary Supply, Demand, and Local Equilibrium

Proof of Lemma 1. Fix the stationary policies. Assumption 3 ensures that the conditional choices below solve the firms' stationary problems and are interior. Differentiating the two incumbent conditions with respect to q gives

$$\begin{pmatrix} F_{11} & F_{12} \\ F_{12} & F_{22} \end{pmatrix} \begin{pmatrix} I_q \\ R_q \end{pmatrix} = \begin{pmatrix} -\beta \\ 1 \end{pmatrix}.$$

Let

$$\Delta \equiv F_{11}F_{22} - F_{12}^2 > 0.$$

The conditional responses are

$$I_q = -\frac{F_{12} + \beta F_{22}}{\Delta}, \tag{A.13}$$

$$R_q = \frac{F_{11} + \beta F_{12}}{\Delta}. \tag{A.14}$$

Since $S = I - R$,

$$S_q = -\frac{F_{11} + (1+\beta)F_{12} + \beta F_{22}}{\Delta} > 0, \tag{A.15}$$

where the sign follows from Assumption 3.

For entrants, the right-hand side of (5) is strictly increasing in q, while strict concavity makes h' strictly decreasing. Purchases per entrant are therefore continuous and strictly decreasing in the used price. The cutoff $\bar{c}(U) = h(U) - h'(U)U$ is strictly increasing in $U > 0$, and strict concavity together with $h(0) = 0$ gives $\bar{c}(U) > 0$. It follows that aggregate entrant demand,

$$D(q) \equiv G(\bar{c}(q))U(q),$$

is continuous and strictly decreasing in q.

Excess demand $Z(q) = D(q) - S(q)$ is consequently strictly decreasing. The boundary-crossing condition in Assumption 3 places opposite signs on Z at two admissible prices. Continuity then gives an interior clearing price, and strict monotonicity makes it unique. Negative definiteness of the incumbent Hessian and strict concavity of h make the conditional choices unique, so this price also pins down a unique allocation. At that price, $U > 0$, $\bar{c} > 0$, and $0 < \lambda = G(\bar{c}) < 1$; market clearing gives $S = \lambda U > 0$. The conditional incumbent solution has $I > 0$ and $R > 0$, so $S = I - R < I$. This is the interior allocation in the lemma.

The entrant slopes at the clearing allocation are

$$U_q = \frac{1 + \dfrac{\tau(1-\beta)}{1-\tau}(1-\theta^U)}{h''(U)} < 0, \tag{A.16}$$

$$\bar{c}_q = -h''(U)UU_q < 0,$$

$$D_q = g(\bar{c})\bar{c}_q U + G(\bar{c})U_q < 0. \tag{A.17}$$

The incumbent Hessian is nonsingular as well, so all conditional choices are continuously differentiable in q and in nearby policies. Since $Z_q = D_q - S_q < 0$, the implicit function theorem also makes the clearing price and allocation locally differentiable. Interiority is preserved for sufficiently small admissible policy changes. □

B.3 Comparative Statics Proofs

Reallocation and Entry

Proof of Lemma 2. The cutoff in (6) satisfies

$$\bar{c}_U = -h''(U)U > 0.$$

It follows that

$$\lambda_U = g(\bar{c})\bar{c}_U > 0$$

and, using market clearing,

$$\frac{dS}{dU} = \frac{d}{dU}\{G(\bar{c}(U))U\} = \lambda + Ug(\bar{c})\bar{c}_U > 0.$$

Thus S, U, $\bar{c}$, and λ have the same local direction of change. □

Accelerated Depreciation for New Capital

Proof of Proposition 1. Let

$$a = \frac{\tau(1-\beta)}{1-\tau} > 0, \qquad m = d_1 + d_2 > 0, \qquad \Delta = F_{11}F_{22} - F_{12}^2 > 0.$$

All derivatives of F are evaluated at the initial equilibrium. Use primes for derivatives with respect to d_0 along the proportional reform path. Then

$$d_1' = -\frac{d_1}{m}, \qquad d_2' = -\frac{d_2}{m}.$$

New-capital bonus depreciation does not enter the entrant's problem, so aggregate demand $D(q) = G(\bar{c}(q))U(q)$ changes only through the used price, with $D_q < 0$ by (A.17). Differentiating the incumbent conditions along the reform path gives

$$F_{11}I' + F_{12}R' = -a - \beta q', \tag{A.18}$$

$$F_{12}I' + F_{22}R' = q' - a\frac{d_2}{m}. \tag{A.19}$$

Market clearing requires

$$I' - R' = S' = D_q q'. \tag{A.20}$$

Solving these three equations yields

$$q' = -\frac{a\left[d_2F_{11} - mF_{22} - d_1F_{12}\right]}{m\Delta(S_q - D_q)}, \tag{A.21}$$

$$S' = -\frac{aD_q\left[d_2F_{11} - mF_{22} - d_1F_{12}\right]}{m\Delta(S_q - D_q)}. \tag{A.22}$$

Because $S_q - D_q > 0$ and $D_q < 0$, S' has the sign of

$$d_2F_{11} - (d_1 + d_2)F_{22} - d_1F_{12},$$

while q' has the opposite sign. This proves part (ii), including the equality case. Lemma 2 gives the entry response.

The solution for investment is

$$I' = \frac{a\left[m + \beta d_2 - D_q\left(d_2F_{12} - mF_{22}\right)\right]}{m\Delta(S_q - D_q)}. \tag{A.23}$$

If $F_{12} \geq F_{22}$, then

$$d_2F_{12} - mF_{22} = d_2(F_{12} - F_{22}) - d_1F_{22} \geq 0.$$

Because $D_q < 0$ and $m > 0$, the numerator in (A.23) is strictly positive. Hence $I' > 0$, proving part (i). □

Accelerated Depreciation for Used Capital

Proof of Proposition 2. Let

$$a = \frac{\tau(1-\beta)}{1-\tau} > 0, \qquad \chi = 1 + a(1 - \theta^U) > 0, \qquad \Delta = F_{11}F_{22} - F_{12}^2 > 0.$$

Write aggregate entrant demand as

$$D(q, \theta^U) = G(\bar{c}(U))U.$$

Holding q fixed in (5) gives

$$U_{\theta^U} = -\frac{aq}{h''(U)} > 0. \tag{A.24}$$

Holding θ^U fixed instead gives

$$U_q = \frac{\chi}{h''(U)} < 0. \tag{A.25}$$

Demand is strictly increasing in purchases per entrant because

$$D_U = G(\bar{c}) + Ug(\bar{c})\bar{c}_U > 0.$$

Consequently,

$$\begin{aligned} D_{\theta^U} &= D_U U_{\theta^U} > 0, \\ D_q &= D_U U_q < 0. \end{aligned} \tag{A.26}$$

The reform does not enter the incumbent conditions. Their responses to the used price are

$$I_q = -\frac{F_{12} + \beta F_{22}}{\Delta}, \tag{A.27}$$

$$S_q = -\frac{F_{11} + (1+\beta)F_{12} + \beta F_{22}}{\Delta} > 0, \tag{A.28}$$

where the last sign follows from Assumption 3. Differentiating market clearing gives

$$q_{\theta^U} = \frac{D_{\theta^U}}{S_q - D_q} > 0. \tag{A.29}$$

Since the reform shifts demand but not incumbent supply directly,

$$S_{\theta^U} = S_q q_{\theta^U} > 0.$$

Reallocation therefore rises, as does entry by Lemma 2.

Finally,

$$I_{\theta^U} = I_q q_{\theta^U}.$$

Because $q_{\theta^U} > 0$,

$$I_{\theta^U} > 0 \iff F_{12} + \beta F_{22} < 0,$$

with $I_{\theta^U} < 0$ under the reversed inequality and no first-order response at equality. □

Corporate Tax Cuts

Proof of Proposition 3. Let

$$a_\tau = \frac{1-\beta}{(1-\tau)^2} > 0, \qquad m = d_1 + d_2, \qquad \Delta = F_{11}F_{22} - F_{12}^2 > 0,$$

and write

$$E = d_2 F_{11} - mF_{22} - d_1 F_{12}.$$

This is the expression in (9). The derivatives below are with respect to τ; a marginal tax cut reverses their signs.

For entrant demand, define

$$\rho = \frac{q(1-\theta^U)}{1 + \dfrac{\tau(1-\beta)}{1-\tau}(1-\theta^U)} > 0.$$

Here $\rho > 0$ because $\theta^U < 1$ and the entrant condition implies $q > 0$ at an interior equilibrium. Writing D_τ for the fixed-price demand shift, comparison with U_q gives

$$D_\tau = a_\tau \rho D_q < 0. \tag{A.30}$$

Differentiating the two incumbent conditions gives

$$F_{11} I_\tau + F_{12} R_\tau = a_\tau m - \beta q_\tau, \tag{A.31}$$
$$F_{12} I_\tau + F_{22} R_\tau = a_\tau d_2 + q_\tau. \tag{A.32}$$

Market clearing requires

$$I_\tau - R_\tau = D_q q_\tau + D_\tau = D_q(q_\tau + a_\tau \rho). \tag{A.33}$$

Solving gives

$$q_\tau = \frac{a_\tau \left(E + \Delta \rho D_q\right)}{\Delta(S_q - D_q)}, \tag{A.34}$$
$$S_\tau = \frac{a_\tau D_q \left(E + \rho \Delta S_q\right)}{\Delta(S_q - D_q)}, \tag{A.35}$$
$$I_\tau = \frac{a_\tau}{\Delta(S_q - D_q)}\left[- D_q \left\{ (mF_{22} - d_2 F_{12}) + \rho(F_{12} + \beta F_{22}) \right\} - (m + \beta d_2) \right]. \tag{A.36}$$

Under $F_{22} \le F_{12} < -\beta F_{22}$,

$$mF_{22} - d_2 F_{12} = d_1 F_{22} + d_2(F_{22} - F_{12}) \le 0,$$

while $F_{12} + \beta F_{22} < 0$. Since $\rho > 0$, the expression in braces in (A.36) is strictly negative. The remaining term is nonpositive, so $I_\tau < 0$. A marginal tax cut therefore raises investment.

For part (ii), first suppose $E > 0$. Since $S_q > 0$, $D_q < 0$, and $\rho > 0$, equation (A.35) gives $S_\tau < 0$. A tax cut therefore raises reallocation, while (A.34) leaves the response of q ambiguous. If $E = 0$, the two equations give $q_\tau < 0$ and $S_\tau < 0$, so a tax cut raises both. If $E < 0$, equation (A.34) gives $q_\tau < 0$, while the sign of S_τ is ambiguous. A tax cut then raises q, with an ambiguous reallocation response. Lemma 2 gives the corresponding entry responses. □

Extension: full expensing of used capital. The preceding proposition assumes $\theta^U < 1$. When $\theta^U = 1$, entrant demand is independent of τ, so $D_\tau = 0$. The price and quantity derivatives become

$$q_\tau = \frac{(1-\beta)\left[d_2 F_{11} - (d_1 + d_2) F_{22} - d_1 F_{12}\right]}{(1-\tau)^2 \Delta(S_q - D_q)},$$

$$S_\tau = \frac{D_q(1-\beta)\,[d_2F_{11} - (d_1+d_2)F_{22} - d_1F_{12}]}{(1-\tau)^2\Delta(S_q - D_q)}.$$

A tax cut reverses these signs. The used market responses therefore follow only the incumbent supply shift: a negative value of the expression in (9) raises q and lowers reallocation and entry; a positive value lowers q and raises reallocation and entry; at zero there is no first-order used market response.

C Evidence from Compustat

I use S&P Global's Compustat North America Annual files to construct separate samples for the bonus-depreciation and TCJA analyses. The first contains U.S. firms; the second adds foreign firms as a comparison group. Both use the same outcomes but different sources of policy variation.

C.1 Outcome Measurement and Sample Construction

I measure new investment with capital expenditures (`capx`) and the value of capital sales with sales of property, plant, and equipment (`sppe`). Because `sppe` is approximately the price of used capital times the quantity sold, it does not separately identify either component. It also understates total dispositions by excluding noncash transactions such as asset-for-equity swaps, involuntary conversions, and retirements (Bai et al. 2022).

In the baseline samples, I set missing or negative `sppe` to zero. This treats absent reporting as no material separately reported sales, so an indicator for positive `sppe` combines the decision to sell with the decision to report those sales separately. The reporting checks instead retain nonmissing, nonnegative observations or firms that report `sppe` in every observed sample year. Because reporting may respond to policy, I treat these restrictions as sensitivity checks rather than corrections for selection.

Bonus depreciation sample. I retain U.S.-domiciled firms outside NAICS 52 with positive total assets, net property, plant, and equipment (`ppent`), and sales, and nonnegative reported capital expenditures. I match each firm to the industry-level present value of depreciation deductions from Zwick and Mahon (2017). The exposure, $\widetilde{z}_{N,t}$, combines predetermined differences in industry capital composition with the bonus rate in year t. The 1995–2016 sample contains 102,466 firm-years from 11,674 firms. I winsorize `sppe` at the 3rd and 97th percentiles but do not winsorize capital expenditures in the baseline. Table C.1 reports summary statistics.

Table C.1: Summary Statistics: Compustat Sample

	Mean	Median
Panel A: Firm Characteristics		
Total Assets ($M)	2143.9	152.9
Net PPE ($M)	803	23.4
Sales ($M)	1683.4	137
Capital Expenditure ($M)	120.8	5.4
Asset Sales ($M)	1.2	0
% Firm-Years with Positive Asset Sales	30.2%	
% Firm-Years with Positive CapEx	98%	
Panel B: Scaled Ratios (%)		
Asset Sales / Total Assets	0.46	0
CapEx / Total Assets	5.83	3.45
Asset Sales / PPE	6.39	0
CapEx / PPE	37.15	21.57
Panel C: Tax and Heterogeneity Variables		
PV of Depreciation Deductions (z)	0.908	0.041 (SD)
% Profitable (OIBDP > 0)	71.3%	
% with Net Operating Losses	42.7%	
PPE Recovery Rate (Kermani-Ma)	34.551	34.87

Notes: Sample consists of U.S. non-financial Compustat firms with positive sales, assets, and PPE, 1995–2016. Firm-years: 102,466. Unique firms: 11,674. z is the present value of depreciation deductions per dollar of investment, computed from industry-level MACRS recovery schedules and the bonus depreciation rate. Asset sales (`sppe`) are set to zero when missing or negative and winsorized at the 3rd and 97th percentiles. PPE recovery rate is the industry-level liquidation value from Kermani and Ma (2022).

TCJA sample. I compare U.S. firms with foreign firms in Compustat North America; the latter are generally cross-listed or trade as American depositary receipts. Both groups report in U.S. dollars, so I make no exchange-rate conversion. I apply the same operating restrictions to both groups and, over 2011–2019, require at least four usable firm-years and nonzero pre-reform variation in `sppe`. I also require each four-digit NAICS industry to contain at least two foreign firm-years. Within the U.S. and foreign groups, I winsorize capital sales and investment at the 97th percentile, preserving zeros, and sales, assets, and net PPE at the 3rd and 97th percentiles. The difference-in-differences sample contains 17,480 firm-years from 1,620 U.S. and 660 foreign firms. Because the sample requires pre-reform variation in `sppe`, the positive-sales decomposition does not measure entry into selling among firms with uniformly zero pre-TCJA sales. Any direct TCJA exposure among cross-listed foreign firms would attenuate the comparison. Table

C.2 reports summary statistics.

Table C.2: Summary Statistics: TCJA Difference-in-Differences Sample

	US Firms	Foreign Firms
Firms	1,620	660
Firm-Years	12,496	4,984
Total Assets ($M)	2,938.2	13,026.5
Net PPE ($M)	908.5	4,820.1
Sales ($M)	2,243.3	7,431.3
Capital Expenditure ($M)	151.6	727.5
Capital Sale Proceeds ($M)	6.70	24.44
% with Positive Sale Proceeds	55.3%	68.3%
Sample Period	2011–2019	

Notes: The U.S. sample contains nonfinancial Compustat firms with positive sales, assets, and PPE, at least four usable firm-years, and nonzero pre-period variation in capital sale proceeds. Foreign firms are foreign-domiciled firms in Compustat North America satisfying the same restrictions. All values are reported in U.S. dollars. Both groups are restricted to four-digit NAICS industries containing at least two foreign firm-years. Capital sale proceeds and investment are winsorized at the within-group 97th percentile, preserving zeros; other dollar amounts are winsorized at the within-group 3rd and 97th percentiles.

C.2 Bonus Depreciation

The model places the investment response at purchase and the sales response after capital becomes old. Table C.3 accordingly uses current bonus exposure for investment and the previous year's schedule for sales, both separately and jointly. Tables C.4 and C.5 vary the treatment of missing `sppe`, reporting histories, upper tails, scaling, and the exposure denominator.

Table C.3: Bonus Depreciation: Timing of Investment and Capital Sales

	Capital Sale Proceeds (sppe)			Investment (capx)
	Unconditional	Any Proceeds	Positive Proceeds	Unconditional
	(1)	(2)	(3)	(4)
Panel A: Inherited-cohort timing				
$\tilde{z}_{t-1}$	-10.134***	-0.577**	-1.466*	
	(1.628)	(0.269)	(0.862)	
$\tilde{z}_{t}$				3.242**
				(1.632)
Panel B: Joint current and lagged exposure				
$\tilde{z}_{t}$	-8.600***	-0.371**	-2.483	2.779**
	(2.277)	(0.148)	(1.708)	(1.186)
$\tilde{z}_{t-1}$	-4.344***	-0.343*	-0.048	0.743
	(0.732)	(0.192)	(0.770)	(0.761)
Sum	-12.944***	-0.714**	-2.531*	3.522*
	(2.262)	(0.319)	(1.450)	(1.904)
Estimator	PPML	LPM	PPML	PPML
Firm FE	X	X	X	X
Year FE	X	X	X	X
Panel A observations	64,497	96,323	28,926	96,070
Panel B observations	64,497	96,323	28,926	96,070

Notes: Panel A isolates the model's inherited-cohort timing: capital sale outcomes use the previous year's bonus generosity, $\tilde{z}_{t-1}$, while investment uses current generosity, $\tilde{z}_{t}$, over the same lag-available years, 1996–2016. Panel B includes current and lagged generosity jointly, allowing for the contemporaneous equilibrium response; Sum reports their linear combination. All specifications include firm and year fixed effects, with standard errors clustered by four-digit NAICS industry. Columns (1), (3), and (4) are estimated by Poisson pseudo-maximum likelihood, and column (2) is a linear probability model. Column (3) conditions on positive proceeds. Capital sale proceeds are winsorized at the 3rd and 97th percentiles. ***, **, and * denote significance at the 1, 5, and 10 percent levels.

Table C.4: Bonus Depreciation and the Reporting of Capital Sale Proceeds

	Sale Proceeds		Any Proceeds		Observed Sample
	Baseline	Observed SPPE	Baseline	Observed SPPE	Indicator
	(1)	(2)	(3)	(4)	(5)
Panel A: Alternative treatment of missing SPPE					
$\tilde{z}$	-11.858***	-9.187***	-0.641***	-0.413	-1.828***
	(2.286)	(2.584)	(0.242)	(0.435)	(0.151)
Estimator	PPML	PPML	LPM	LPM	LPM
Firm FE	X	X	X	X	X
Year FE	X	X	X	X	X
Observations	69,445	59,696	102,466	83,092	102,466
Panel B: Firms with SPPE observed in every sample year					
$\tilde{z}$	-7.382***		-0.205		
	(2.469)		(0.657)		
Observations	36,627		52,068		

Notes: In the baseline sample, missing and negative values of Compustat capital sale proceeds (`sppe`) are coded as zero. Observed-SPPE specifications instead exclude observations for which the raw item is missing or negative; sale proceeds are then winsorized within that sample at the 3rd and 97th percentiles. The outcome in column (5) is an indicator that raw SPPE is nonmissing and nonnegative, and thus that the observation enters columns (2) and (4). Panel B restricts the sample to firms for which raw SPPE is nonmissing and nonnegative in every observed firm-year. Because reporting is endogenous, these restrictions are sensitivity checks rather than corrections for selection. All specifications include firm and year fixed effects, with standard errors clustered by four-digit NAICS industry. ***, **, and * denote significance at the 1, 5, and 10 percent levels.

Table C.5: Bonus Depreciation: Outcome Construction and Scale

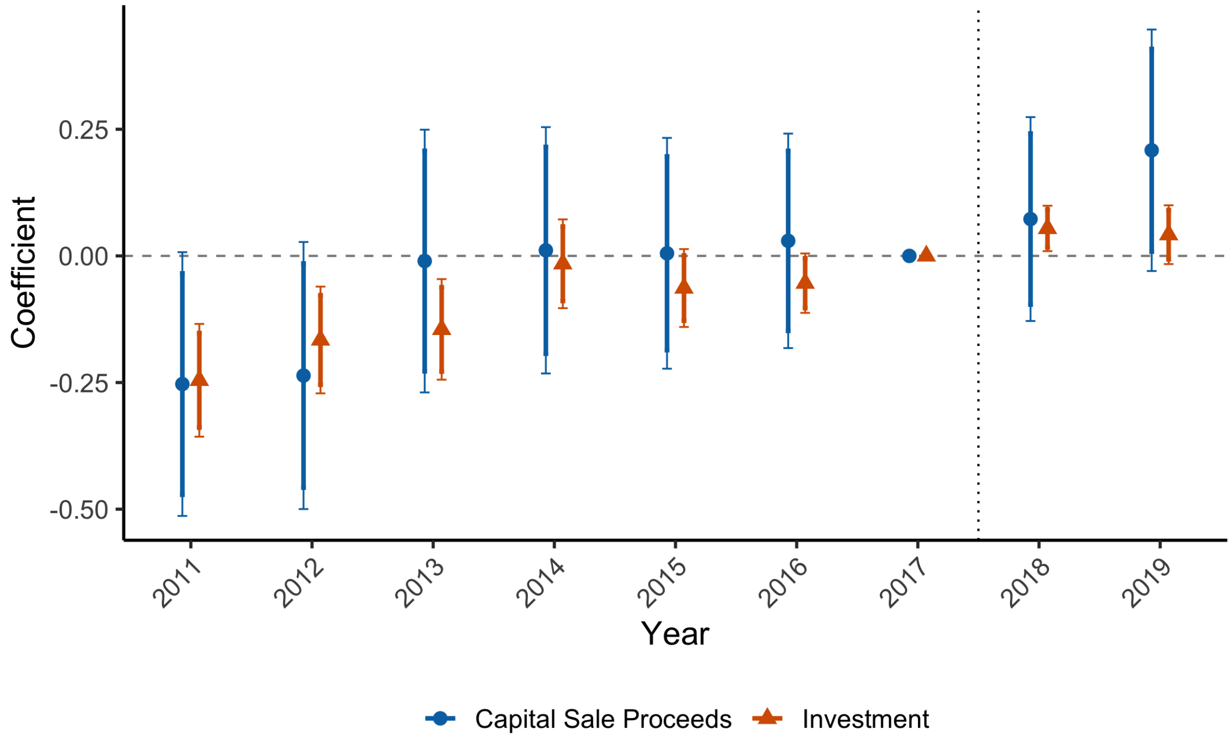
	Capital Sale Proceeds (sppe)			Investment (capx)
	Unconditional	Any Proceeds	Positive Proceeds	Unconditional
	(1)	(2)	(3)	(4)
Panel A: Alternative treatment of the SPPE upper tail				
No winsorization	-28.375***	-0.641***	-11.787*	3.402**
	(5.722)	(0.242)	(6.882)	(1.684)
1st/99th percentiles	-14.585***	-0.641***	-2.452	3.402**
	(3.026)	(0.242)	(2.123)	(1.684)
3rd/97th percentiles (baseline)	-11.858***	-0.641***	-2.470	3.402**
	(2.286)	(0.242)	(1.580)	(1.684)
5th/95th percentiles	-10.071***	-0.641***	-1.541	3.402**
	(2.310)	(0.242)	(1.455)	(1.684)
Observations	69,445	102,466	30,917	102,210
Panel B: PPML exposure offsets				
Lagged total assets offset	-9.991***	-0.601**	-1.646	5.179***
	(1.221)	(0.233)	(1.059)	(0.687)
Observations	65,750	96,926	29,675	96,666
Lagged net PPE offset	-11.584***	-0.604**	-2.573**	3.491***
	(1.201)	(0.234)	(1.057)	(0.496)
Observations	65,501	96,411	29,639	96,150
Panel C: Alternative outcome transformations				
Inverse hyperbolic sine	-4.476***	-0.641***	-4.004	5.047***
	(1.221)	(0.242)	(3.686)	(0.398)
$\log(1+y)$	-3.914***	-0.641***	-3.570	5.028***
	(1.087)	(0.242)	(3.256)	(0.369)
Observations	102,466	102,466	30,917	102,466

Notes: Each row reports a separate set of regressions. Panel A varies the upper-tail treatment of SPPE; capital expenditures remain unwinsorized. Panel B estimates PPML specifications with the logarithm of the indicated lagged firm size measure as an exposure offset. The denominators are taken from the preceding calendar year, and the extensive-margin regressions use the corresponding lag-available sample without an offset. Panel C estimates OLS regressions after applying the indicated transformation to each continuous outcome; its coefficients are not directly comparable in scale to Panels A and B. All specifications include firm and year fixed effects, with standard errors clustered by four-digit NAICS industry. Column (2) is a linear probability model, and column (3) conditions on positive proceeds. ***, **, and * denote significance at the 1, 5, and 10 percent levels.

C.3 Tax Cuts and Jobs Act

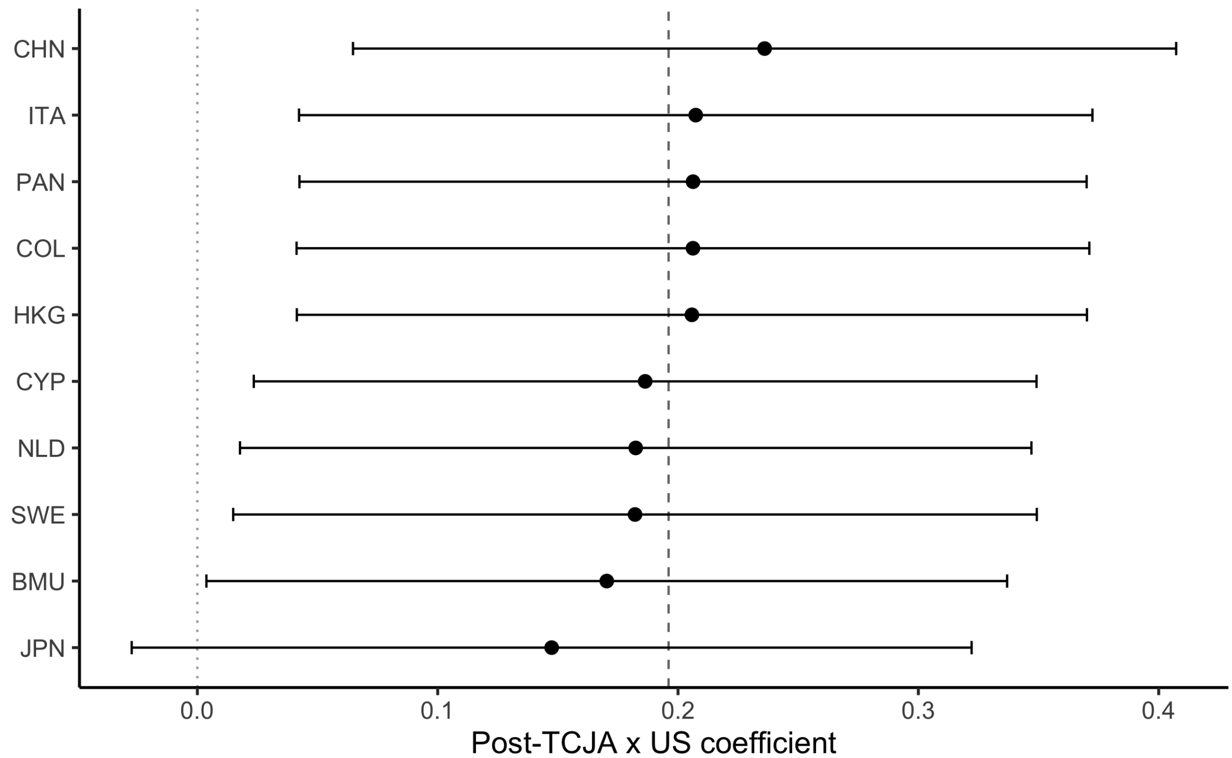
Difference-in-differences. Table 2 in the main text reports the difference-in-differences estimates. Figure C.1 reports the corresponding event study, and Figure C.2 excludes each donor country in turn.

Figure C.1: Event Study of Capital Sales and Investment Around TCJA



Notes: This figure plots event-study coefficients for U.S. firms relative to non-U.S. firms around the TCJA. Outcomes are capital sales (sppe) and capital expenditures (capx), estimated by Poisson pseudo-maximum likelihood with firm and year fixed effects. The reference year is 2017. Thick bars report 90% confidence intervals and thin bars report 95% confidence intervals from standard errors clustered by firm. The vertical dotted line marks enactment of the TCJA.

Figure C.2: TCJA Difference-in-Differences: Leave One Donor Country Out



Note: Each point re-estimates the U.S. × Post-TCJA capital sales coefficient after excluding one of the 56 donor countries. The figure shows the five smallest and five largest estimates; the dashed line is the full-sample coefficient. Bars report 95% confidence intervals from standard errors clustered by firm.

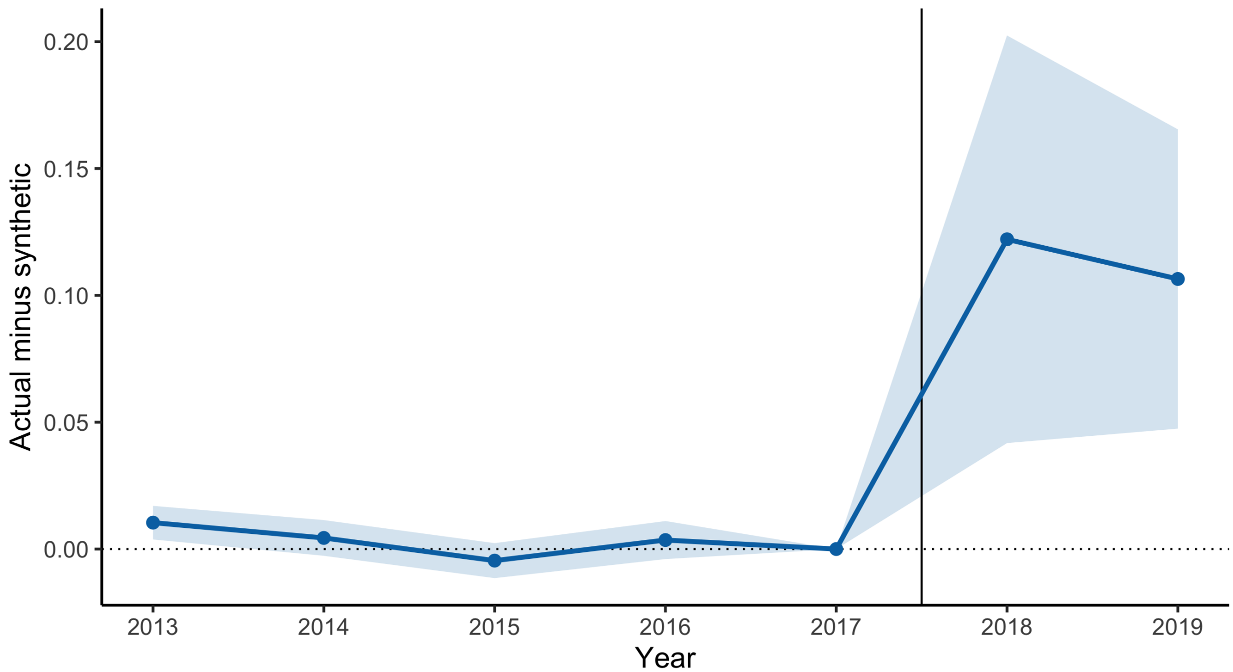
Synthetic control. The event study and difference-in-differences estimates use the full sample. The synthetic-control exercise additionally requires complete observations from 2013 through 2019, nonzero pre-period variation in capital sales, and at least two foreign donors in the same three-digit NAICS industry. I match each U.S. firm on annual pre-TCJA capital sales, investment, and revenue and on average PPE and assets. The preferred sample retains firms whose mean absolute pre-treatment gap in inverse-hyperbolic-sine capital sales does not exceed 0.10.

Table C.6: Summary Statistics: Synthetic-Control Sample

	Actual Proceeds	Synthetic Proceeds	Actual Investment	Synthetic Investment
Pre-TCJA	1.44	1.47	48.15	59.93
Post-TCJA	1.84	1.19	58.31	61.14

Notes: The sample contains the 383 U.S. firms satisfying the pre-treatment fit screen used in column (1) of Table C.7. Entries are unweighted firm-year means in millions of U.S. dollars.

Figure C.3: U.S. Capital Sales Relative to Synthetic Control around the 2017 Tax Cuts and Jobs Act



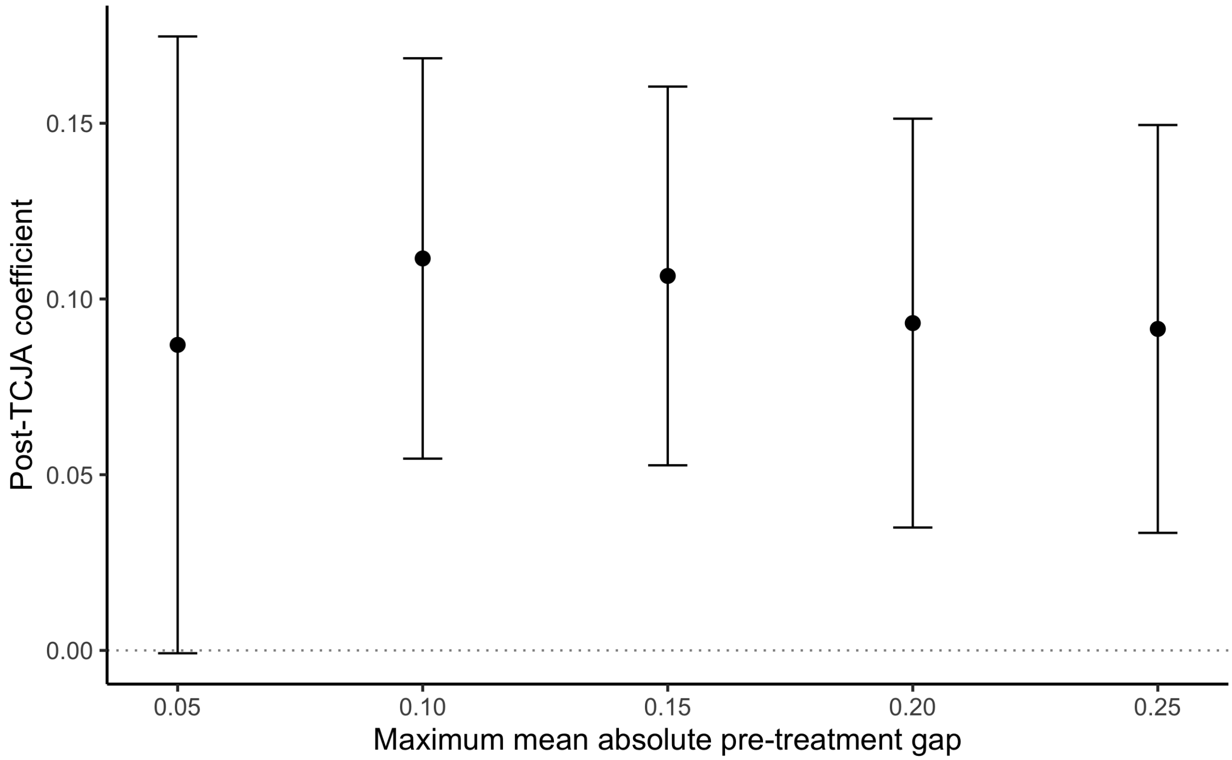
Note: This figure plots coefficients from a regression of the firm-level gap between actual and synthetic capital sales, $\text{asinh}(\text{SPPE}) - \text{asinh}(\text{SPPE}^{\text{synth}})$, on year indicators with firm fixed effects, with 2017 as the reference year. Each U.S. firm's synthetic control is built from foreign firms listed on U.S. exchanges in the same 3-digit NAICS industry, and the sample keeps firms whose mean absolute pre-period gap is below 0.10. The shaded region is the 95% confidence interval from standard errors clustered by firm. The vertical line marks the enactment of the TCJA.

Table C.7: Synthetic Control: Post-TCJA Capital Sale Proceeds Gap

	Good Pre-Treatment Fit	All Matched Firms
	(1)	(2)
Post-TCJA	0.112^{***}	0.039
	(0.029)	(0.040)
Firm FE	X	X
Pre-treatment fit screen	X	
Firms	383	816
Observations	2,681	5,712

Notes: The dependent variable is $\text{asinh}(\text{sppe}) - \text{asinh}(\text{sppe}^{\text{synth}})$ over 2013–2019. Each U.S. firm is matched to a weighted combination of foreign firms in the same three-digit NAICS industry using 2013–2017 capital sale proceeds, investment, revenue, PPE, and assets. Column (1) keeps firms whose mean absolute pre-treatment outcome gap does not exceed 0.10; column (2) keeps every successfully matched firm. Both specifications contain firm fixed effects and cluster standard errors by firm.

Figure C.4: Synthetic Control: Sensitivity to Pre-Treatment Fit Threshold



Note: This figure plots the post-TCJA coefficient from the firm fixed-effects regression of the gap between actual and synthetic capital sales on a post indicator, at varying thresholds for the pre-treatment fit screen. The x-axis denotes the maximum allowed mean absolute inverse-hyperbolic-sine gap between actual and synthetic capital sales over the pre-period (2013–2017). Bars represent 95% confidence intervals based on standard errors clustered by firm.

D UCC Filings

D.1 Parser Details

This appendix describes the pipeline that transforms raw Texas UCC financing statements into the analysis sample of equipment transactions. The raw data consist of fixed-width text files from the Texas Secretary of State's bulk data file. Seven record types contain master filing records, organization and individual debtor records, organization and individual secured-party records, filing-event records, and collateral descriptions. A final trailer reports the number of records of each type in the file.

Record Reconstruction and Filing Events

I first validate the record code and required width of each physical line and reconcile the resulting counts with the file trailer. Two records in the raw files contain genuine embedded line breaks. I reconstruct those logical records using a narrow rule based on their fixed-width signatures before extracting any fields. After these repairs, the record counts match the trailer and no record has an invalid code or width.

Collateral descriptions are stored in consecutive Code 7 records containing 80-character text slices. I concatenate the raw slices before normalizing padding and whitespace, which avoids inserting a false space when a word or identifier crosses a record boundary. I also require the sequence numbers within each filing-event group to be consecutive. Three collateral groups fail this check, corresponding to 96 otherwise eligible item rows, and are excluded rather than reconstructed ambiguously.

The bulk files distinguish original financing statements from later filing events. I link each noninitial collateral record to its event using two identifiers: the original statement number and the UCC3 event number. Matching on both identifiers prevents an event from being attached to the wrong original statement when the shorter UCC3 identifier is not unique. Original statements are dated at their initial filing date, while later collateral records are dated at the corresponding event date. I retain the original filing year separately, but define the observation year as the year of the event in which the equipment appears. Asset age is therefore the observation year minus the model year. In the paper, I refer to this observation year as the filing year.

Blanket Lien Filtering

Before splitting collateral descriptions into individual items, I flag blanket liens at the filing-event level. A filing is classified as a blanket lien if its collateral description contains phrases such as "all personal property," "all inventory," "all assets," "general intangibles," "accounts receivable," or "now owned or hereafter acquired." These filings pledge the borrower's entire estate without naming specific equipment. The pipeline parses 7,022,114 candidate items; 2,981,088 remain after dropping items from blanket-lien filings.

Item Splitting

Many filings list multiple pieces of equipment in a single collateral description. I split multi-equipment descriptions into individual items using six delimiter rules, applied in sequence:

1. Numbered-item prefixes (e.g., "1-NEW," "2-USED");
2. Semicolons;
3. Comma followed by a recognized manufacturer name from a dictionary of approximately 100 manufacturers;
4. Ampersand preceded by a serial-number-like string (4+ alphanumeric characters) and followed by a quantity digit or manufacturer name;
5. Quantity digit followed by a manufacturer name, when preceded by 6+ alphanumeric characters (separates serial numbers from the next item's quantity-manufacturer prefix);
6. Manufacturer name following a serial number with two or more intervening spaces.

After splitting, I flag item-level boilerplate: parsed fragments consisting of legal language ("together with all accessions," "products and proceeds," "purchase money security interest"), financing terms ("24 pmts," dollar amounts), or very short text (fewer than 10 characters). After the blanket-lien and boilerplate filters, 2,109,751 items remain; collateral-sequence validation reduces this count to 2,109,655.

Field Extraction

For each clean item, the pipeline extracts five fields.

Equipment type. I match item text against an ordered dictionary of approximately 80 canonical equipment types. Ordering ensures specific types are matched before generic ones (e.g., "wheel loader" before "loader," "gooseneck trailer" before "trailer"). The dictionary covers construction equipment, agricultural equipment, trucks and trailers, forklifts and material handling, forestry equipment, and office/IT equipment. Named model series are used only when the corresponding manufacturer has also been identified, which prevents generic model names from generating false classifications. Manufacturer-specific model prefixes recover additional types when the description does not contain an explicit equipment keyword. The final parser and enrichment pipeline identifies an equipment type for 971,632 items.

Manufacturer. I match against a dictionary of approximately 100 manufacturers using regular expressions. To improve performance on the clean-item dataset, each regex is paired with a fixed-string pre-filter: a 3+ character uppercase substring is extracted from the pattern and used to quickly exclude non-candidate items before applying the full regex. The dictionary covers major equipment manufacturers (John Deere, Caterpillar, Case IH, Kubota, Komatsu, Bobcat), truck manufacturers (Peterbilt, Kenworth, Freightliner), and trailer and specialty equipment makers. Common misspellings and abbreviations are handled within the patterns (e.g., "MASSEY FERGERSON," "ARTIC CAT," "NEWHOL").

Model year. I evaluate all plausible four-digit years from 1940 through 2029 in the item text. A year is retained when the surrounding text identifies it as equipment information, when it is the only plausible year outside a legal or calendar-date expression, or when repeated equipment anchors consistently imply the same year. Years embedded in legal date phrases or comma-separated quantities are excluded, and descriptions containing conflicting machine years are left unclassified. For items containing a 17-character string that matches the VIN format, I validate the check digit before decoding the model-year character and resolve the 30-year VIN cycle relative to the filing-event year. The enrichment pipeline described below provides additional model-year sources. Before enrichment, 242,766 items have both a parser-assigned equipment type and model year; enrichment raises this count to 288,137.

Serial number. I extract serial numbers that follow explicit S/N, SER, SERIAL, VIN, PIN, or S# labels, and I separately retain valid 17-character VINs. I do not treat a bare number sign as sufficient evidence that the following text is an asset identifier. This restriction avoids confusing model numbers and other numbered text with serial identifiers. VINs are validated using the NHTSA check-digit algorithm before they enter the enrichment stage.

New/used label. I detect explicit NEW and USED labels in the item text. To avoid false positives, I first exclude boilerplate contexts where these words do not indicate equipment condition (e.g., "whether new or used," "now owned or hereafter acquired," "used in the operation of," "as used herein"). I then strip "New Holland" variants before testing for NEW, since "1 USED NEW HOLLAND TRACTOR" should be classified as used. USED takes priority over NEW when both appear.

The parser also records quantities when the description contains an explicit count. Because a number preceding an equipment name can instead be part of a model designation, these quantities are not used as analytical weights. The regressions count parsed equipment mentions rather than summing the quantity field.

Enrichment

The enrichment pipeline augments missing parser fields using four sources. First, I decode every validated 17-digit VIN using a pinned cache of NHTSA results, which provides manufacturer, vehicle type, body class, model year, and gross vehicle weight. The cache contains all 148,252 unique valid VINs in the parsed data, and NHTSA information is applied to 154,042 item rows. Second, for John Deere items with non-VIN serial numbers and no parser-assigned model year, I decode the production year from the Deere PIN format and reject implausible results relative to the filing-event year. Third, for Caterpillar items with serial numbers but no equipment type, I map serial-number prefixes to equipment models. Fourth, for items with an identified manufacturer and model number but no equipment type, I apply manufacturer-specific model conventions. Parser classifications are retained when available; enrichment fills missing fields rather than overwriting a valid parser classification.

MACRS Classification

I assign recovery class only after consolidating the best equipment type, manufacturer, model year, and secured-party information. The classification follows the specific asset categories where they are observed. Over-the-road tractor units are 3-year property and therefore fall outside the analysis sample; trailers are 5-year property. A generic "semi" or "tractor-trailer" does not reveal which component was pledged, so I leave it unclassified. I likewise exclude generic aircraft and boats because the use needed to determine their recovery class is not observed.

Farm property requires a purchase-vintage rule. I use model year as the purchase-vintage proxy: farm machinery through 2017 is assigned to the 7-year class, apart from the temporary 5-year rule for machinery placed in service in 2009, while post-2017 farm machinery is assigned to the 5-year class under the maintained assumption that original use began with that owner. Typed farm equipment and agricultural trailer categories identify farm use directly. An agricultural secured-party name is used only as a fallback, and never overrides a truck or construction classification.

Recovery class and depreciation method are separate. Pre-2018 farm-use property in either the 5- or 7-year class follows the corresponding 150-percent declining-balance schedule under the half-year convention. Nonfarm property and post-2017 farm cohorts follow 200-percent declining balance. Each row retains the class, method, and rule that generated the assignment.

Purchase Vintage and Statutory Exposure

Model year also anchors the empirical design. It proxies the seller's original purchase year, so the resulting exposure is a statutory intent-to-treat measure rather than the seller's actual adjusted basis. Prior ownership and deduction histories are not observed.

For an asset of age a, the baseline exposure uses ordinary basis remaining after the filing-year deduction, which is the schedule evaluated at $a+1$. Basis at the start of the filing year, evaluated at a, provides an alternative timing convention. Under the baseline timing, future basis is exhausted at age 5 for 5-year property and age 7 for 7-year property. The pre-TCJA exposure multiplies the future basis gap by a 35-percent C-corporation benchmark. Because the UCC sample also contains pass-through firms, this is a statutory benchmark rather than an estimate of each seller's tax liability. The fixed-2018 TCJA specification instead uses the basis gap itself.

The annual bonus-rate series is a calendar-year proxy, not an exact transaction-date measure. It uses the rate governing most of the year: 2001 is coded zero, while 2003, 2010, and 2017 are coded at 50 percent despite within-year changes.

Sample Construction

The analysis sample contains observations from 2001 through 2019 with a valid collateral sequence, an identified equipment type and model year, a nonnegative age no greater than 50, and a final 5- or 7-year recovery class with an assigned basis method. The final sample contains 238,184 equipment mentions. Table D.1 reports attrition through each stage. Tables D.2 and D.3 describe the resulting sample.

Table D.1: UCC Sample Construction

Step	Items
Total parsed equipment items	7,022,114
After dropping blanket liens	2,981,088
After dropping item-level boilerplate	2,109,751
After validating collateral sequences	2,109,655
With identified equipment type	971,632
With parser type and model year	242,766
With enriched type and model year	288,137
Restricted to MACRS 5- or 7-year property	246,712

Notes: Filing years 2001–2019. Items are individual pieces of equipment parsed from collateral descriptions in Texas UCC financing statements. Blanket liens pledge all assets without naming specific equipment. Boilerplate items are parsed legal or financing text rather than identifiable machines. Collateral sequence validation excludes items whose continuation records cannot be linked unambiguously.

Table D.2: Summary Statistics for the UCC Analysis Sample

Equipment	Filing years	Items	Mean age	Median age	Positive basis (%)	Years remaining
New equipment	2001–2017	51,685	0.0	0	100.0	6.7
New equipment	2018–2019	8,713	0.0	0	100.0	6.7
Used equipment	2001–2017	157,147	9.9	7	44.1	1.6
Used equipment	2018–2019	29,167	8.5	5	54.3	2.1

Notes: The analysis sample contains equipment items with an identified equipment type, model year, and five- or seven-year MACRS class. Positive Basis indicates that the ordinary MACRS schedule has basis remaining at the asset's observed age. Years Remaining is the number of years until that ordinary basis is exhausted, censored at zero.

Table D.3: Largest Equipment Categories in the UCC Analysis Sample

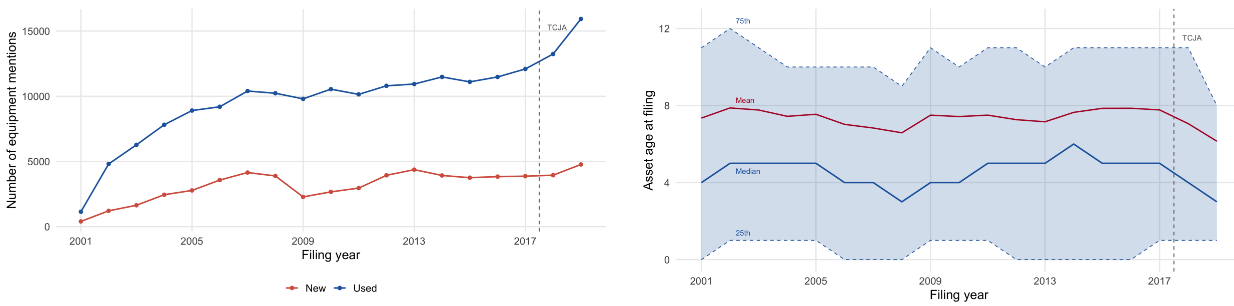
Equipment type	MACRS	Items	New (%)	Mean used age	Positive basis (%)
Trailer	5	77,647	33.1	8.0	63.7
Tractor	7	43,804	12.9	13.6	48.0
Truck	5	15,551	25.5	8.8	53.7
Mower/Cutter	7	9,035	42.6	4.5	90.6
Dozer	5	6,332	3.5	14.5	21.6
Excavator	5	6,138	15.1	7.6	54.2
Loader	7	5,711	20.2	9.5	62.6
Skid Steer	5	5,467	16.6	6.6	58.7
Gooseneck Trailer	7	5,403	22.5	9.5	61.9
Forklift	5	4,216	21.6	8.9	47.2
Backhoe	5	3,723	6.1	11.9	29.7
Truck-Tractor	5	3,453	8.6	7.9	41.5
Baler	7	2,963	20.6	8.5	64.5
Boat	7	2,902	23.3	9.0	64.0
Center Pivot	7	2,644	51.6	12.1	70.0

Notes: Categories are equipment-type × MACRS-class cells ranked by the number of items in the analysis sample. Mean Used Age excludes age-zero items.

The number of equipment mentions rises sharply early in the sample. The bulk files do not let me separate changes in filing volume from changes in coverage, so I do not attribute that rise to either source. The regressions absorb filing-year effects. Figure D.1 also shows the age support: the distribution is fairly stable through 2017 and shifts toward younger equipment in 2018 and 2019.

Figure D.1: UCC Sample Diagnostics

(a) Equipment mentions by filing year　　　　(b) Age distribution by filing year



Notes: Panel (a) plots equipment mentions by filing year. "New" denotes age zero and "used" denotes positive age; these are model-year proxies rather than observed purchase status. Panel (b) plots the mean and median age and the interquartile range. Asset age is filing year minus model year. The vertical line marks the TCJA.

D.2 Additional Results

The main text reports the pre-TCJA transaction gap, its age profile, and the response of fixed equipment cohorts to the TCJA. This section reports the supporting specifications.

Pre-TCJA Results

Table D.4 shows that the bonus-vintage association is stable when I retain only initial filings, omit model-year 2001, or control for observed cohort size. The final two columns restrict attention to type-class-method-vintage cohorts observed at age zero; adding supported zero-count cells strengthens the estimate.

Table D.4: Robustness of the Pre-TCJA Bonus-Vintage Association

	Baseline	Initial filings	Omit 2001 vintage	Cohort size control	Supported positive	Supported with zeros
	(1)	(2)	(3)	(4)	(5)	(6)
Bonus vintage	-0.285***	-0.272***	-0.306***	-0.244***	-0.302***	-0.322***
	(0.071)	(0.068)	(0.067)	(0.046)	(0.071)	(0.073)
Product, filing year, and age FE	X	X	X	X	X	X
Log product-vintage cohort size				X		
Zero-count supported cells						X
Observations	18,847	17,989	18,145	6,562	6,562	9,612

Notes: Each column reports the bonus-vintage coefficient from a pre-TCJA Poisson regression with equipment-type by MACRS-class, filing-year, and asset-age fixed effects. Column (2) retains initial UCC filings. Column (3) omits model-year 2001. Column (4) controls for the log number of age-zero items in the exact product-vintage cohort and is therefore restricted to cohorts observed at age zero. Columns (5) and (6) use that supported risk set over ages 1–25; column (6) records unobserved supported cells as zero. Standard errors clustered by vintage are in parentheses.

Table D.5 allows the exposure coefficient to differ by recovery class and controls directly for observed cohort size. The larger coefficient for 7-year property is consistent with slower recovery, but class also reflects equipment composition and the interaction is not a separate source of identification. Neither cohort-size control eliminates the binary or continuous relationship.

Table D.5: Class Heterogeneity and Cohort-Size Diagnostics

	Class heterogeneity (1)	Binary with cohort size (2)	Exposure with cohort size (3)
Bonus vintage		-0.244***	
		(0.046)	
Statutory bonus exposure (10 pp)	-0.093		-0.066
	(0.068)		(0.050)
Exposure × 7-year property	-0.241***		
	(0.050)		
Log product-vintage cohort size		0.226***	0.255***
		(0.033)	(0.067)
Product, filing year, and age FE	X	X	X
Observations	18,847	6,562	6,562

Notes: Poisson regressions on the pre-TCJA cell sample. Column (1) allows the statutory exposure association to differ between five- and seven-year property. This variation is suggestive because MACRS class is closely related to equipment composition. Columns (2) and (3) control for the observed number of age-zero items in the exact product-vintage cohort. Standard errors clustered by vintage are in parentheses.

TCJA Results

Table D.6 repeats the exact-cohort comparisons among initial filings, after adding supported zero-count cells, after omitting 2017, and with saturated fixed effects. The current-gap comparison and the continuous fixed-2018 dose remain positive. The binary fixed-2018 split has the same sign but is imprecise in several columns; the continuous dose is the cleaner summary of the statutory gradient.

Table D.6: Robustness of the Exact-Cohort TCJA Comparisons

	Observed all filings	Initial filings	Supported with zeros	Drop 2017	Saturated fixed effects
	(1)	(2)	(3)	(4)	(5)
Current gap: positive minus exhausted	0.252***	0.201***	0.251***	0.304***	0.190**
	(0.083)	(0.071)	(0.081)	(0.096)	(0.074)
Fixed 2018 gap: positive minus exhausted	0.188**	0.144*	0.182**	0.213**	0.154**
	(0.088)	(0.084)	(0.085)	(0.107)	(0.071)
Fixed 2018 gap: response per 10 pp	0.127***	0.139***	0.123***	0.206***	0.077*
	(0.044)	(0.037)	(0.042)	(0.076)	(0.043)
Exact product-vintage FE	X	X	X	X	X
Equipment type × year FE	X	X	X	X	
Product × year and product × age FE					X
Observations	10,353	9,770	18,305	8,994	10,353

Notes: Each entry is a relative post-TCJA comparison within exact equipment-type × MACRS-class × vintage cohorts. Column (1) reproduces the main observed-cell sample. Column (2) retains initial filings. Column (3) defines the cohort risk set using only cohorts observed by 2017 and fills feasible absent cells with zeros. Column (4) omits 2017, which is potentially contaminated by the September 27 effective date and anticipation of Section 1031 repeal. Column (5) replaces equipment-type by year and common age effects with product-by-year and product-by-age effects. The current-gap regressions include the time-varying gap level. Standard errors clustered by vintage are in parentheses.

Table D.7 provides the formal counterpart to the age-shift panel in the main text. Following the TCJA, positive-age equipment in the UCC data is more likely to have future basis under its reconstructed schedule and has more deduction years remaining.

Table D.7: Age Composition of Equipment Filings Around the TCJA

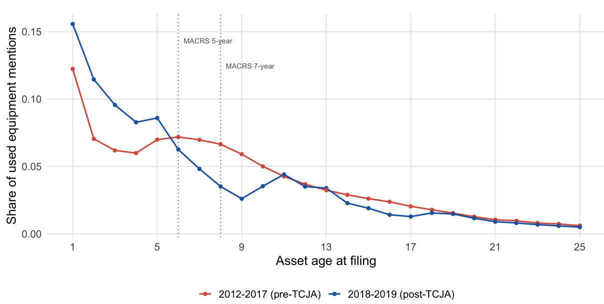
	Positive ordinary MACRS basis			Years of basis remaining
	Raw	Linear trend	Quadratic trend	Linear trend
	(1)	(2)	(3)	(4)
Used × Post-TCJA	0.096***	0.096***	0.096***	0.343*
	(0.032)	(0.032)	(0.032)	(0.185)
Macro controls		X	X	X
Product FE	X	X	X	X
Observations	129,463	129,463	129,463	129,463

Notes: Item-level linear regressions over 2012–2019. Positive Ordinary MACRS Basis indicates that the ordinary five- or seven-year schedule has basis remaining at the asset's observed age. The final column uses years until ordinary basis exhaustion, censored at zero. Macro controls include GDP growth, oil and agricultural price changes, agricultural income growth, the ten-year Treasury rate, and Texas unemployment. Standard errors clustered by equipment-type by MACRS-class cells are in parentheses. This is descriptive evidence on the composition of filings, not a separate causal design.

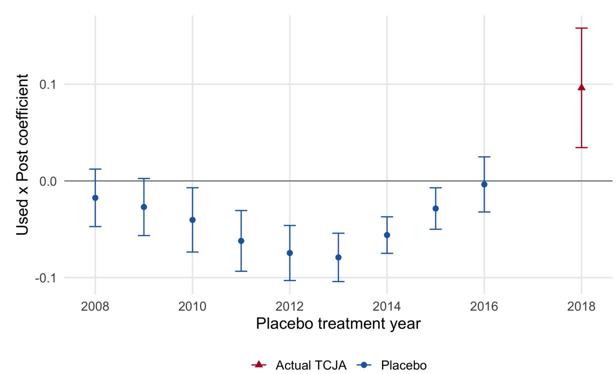
Figure D.2 shows that the post-TCJA distribution shifts toward ages with future deductions remaining, although similar movements appear in some earlier placebo windows. Because this comparison does not hold model-year composition fixed, I use it as descriptive evidence about timing rather than as a separate causal design.

Figure D.2: Age Composition of Used Equipment Around the TCJA

(a) Age distributions before and after the TCJA



(b) Placebo reform dates



Notes: Panel (a) plots the share of positive-age equipment mentions at each asset age in 2012–2017 and 2018–2019. The vertical lines mark ages 5 and 7, when future basis after the filing-year deduction is exhausted under the 5- and 7-year schedules. Panel (b) assigns the reform to each placebo year from 2008 through 2016. Every estimate uses six pre-reform years and two post-reform years, matching the 2012–2019 TCJA window. The triangle reports the actual estimate. Bars are 95% confidence intervals from standard errors clustered by equipment-type, recovery-class, and basis-method cells. Both panels are descriptive because model-year composition is not held fixed.

E Business Dynamics Statistics

Table E.1 reports summary statistics for the bonus-depreciation and TCJA samples described in the main text.

Table E.1: Summary Statistics: Business Dynamics Statistics

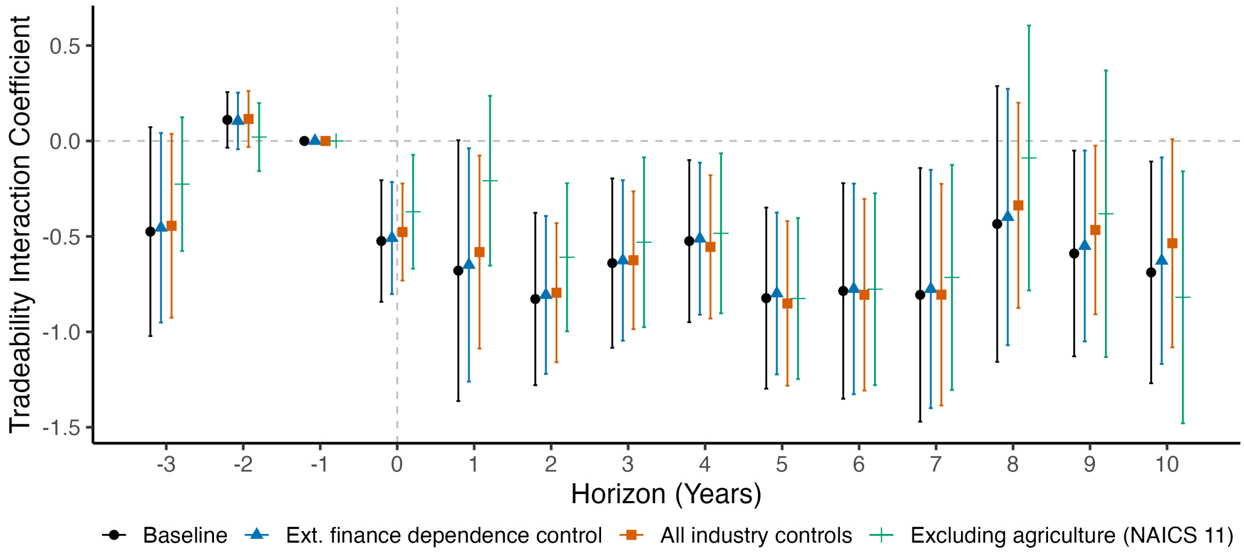
	Mean	SD
Panel A: Bonus Depreciation Sample (1996–2017)		
Entry Rate (%)	7.9	6.06
Exit Rate (%)	7.94	2.94
Z^N	0.918	0.035
PPE Recovery Rate (Kermani-Ma)	32.18	17.61
Industries	227	
Industry-Years	4,984	
Panel B: TCJA Sample (2012–2019)		
Entry Rate (%)	7.19	5.05
Exit Rate (%)	7.02	2.37
Δg_N (Demand Wedge Change)	0.032	0.004
Δg_N (Standardized)	7.308	1
Industries	201	
Industry-Years	1,608	

Notes: Data are from the Census Bureau's Business Dynamics Statistics at the 4-digit NAICS level. Entry rate is $(\text{firms}_t - \text{firms}_{t-1} + \text{deaths}_t)/\text{firms}_{t-1}$. Exit rate is firm deaths divided by lagged firm count. In Panel A, z is the present value of depreciation deductions from Zwick and Mahon (2017). In Panel B, Δg_N is the change in the demand-side tax wedge between new and used capital induced by the TCJA, computed using 2014–2016 BEA investment weights. PPE recovery rate is the industry-level liquidation value from Kermani and Ma (2022).

E.1 Bonus Depreciation

The main text shows that the entry response is larger in industries with more tradeable capital. Figure E.1 tests whether this interaction is explained by other industry characteristics or by agriculture.

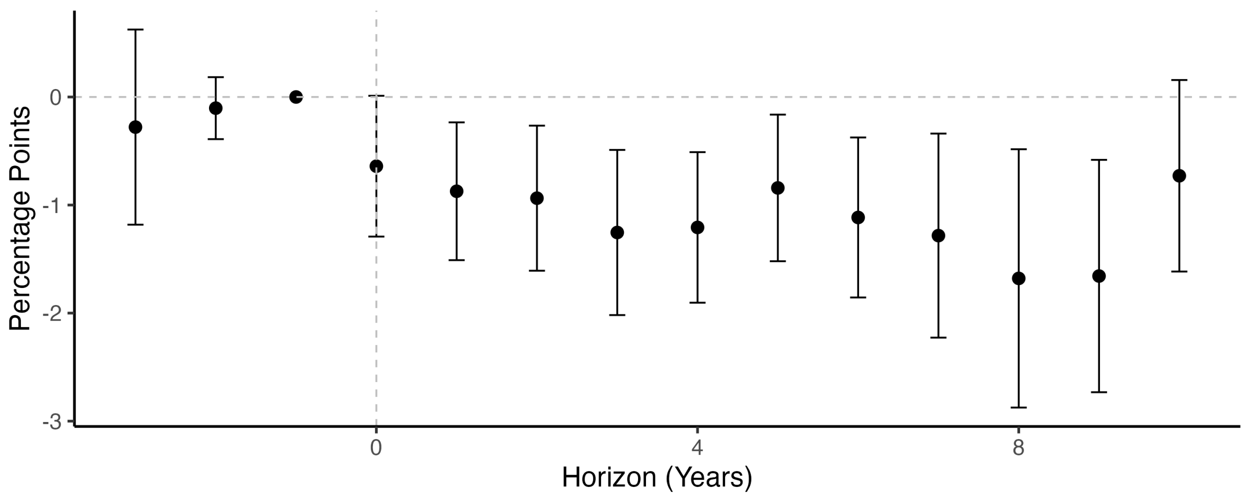
Figure E.1: The Entry–Tradeability Interaction: Robustness



Note: This figure reports the coefficient on $\tilde{z}$ interacted with the PPE recovery rate from the panel local projection in Figure 3b. The specifications move from the baseline to a control for external finance dependence, controls for all four competing characteristics, and a sample excluding agriculture (NAICS 11). The competing characteristics are external finance dependence, average firm size, capital duration, and entry cyclicality; external finance dependence is the Rajan–Zingales measure constructed from U.S. Compustat firms over 1980–2001. All specifications include $\tilde{z}$, industry and year fixed effects, and two-digit NAICS quadratic trends. Bars report 95% confidence intervals from standard errors clustered by four-digit industry; horizon -1 is the omitted period.

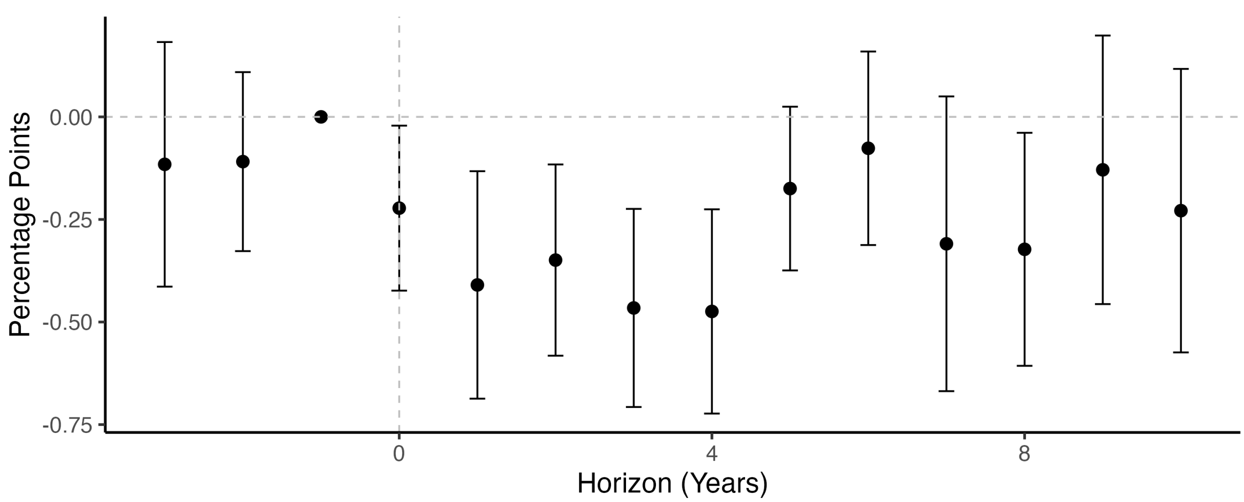
Figures E.2 and E.3 vary the entry measure. The first excludes utilities, while the second measures establishment rather than firm entry.

Figure E.2: Dynamic Effect of Bonus Depreciation on Entry (Excluding Utilities)



Note: This panel local projection uses the firm entry rate after excluding utilities. The treatment is the industry-level present value of depreciation allowances, $\tilde{z}_{N,t}$; controls are four-digit NAICS and year fixed effects and two-digit NAICS linear and quadratic trends. Bars report 95% confidence intervals from standard errors clustered by four-digit NAICS industry.

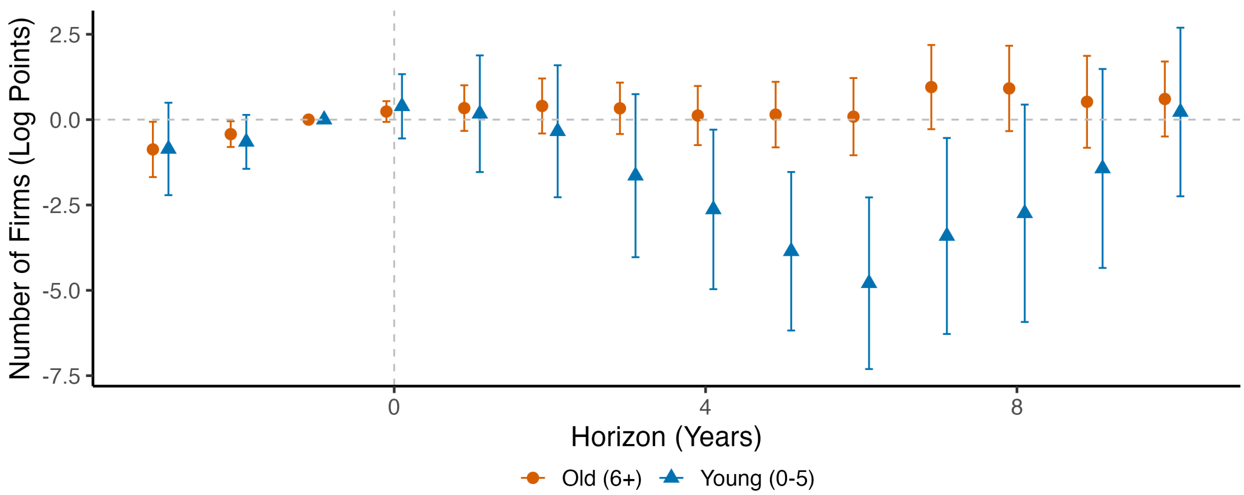
Figure E.3: Dynamic Effect of Bonus Depreciation on Establishment Entry



Note: This panel local projection uses the establishment entry rate as the outcome and the industry-level present value of depreciation allowances, $\tilde{z}_{N,t}$, as the treatment. It includes four-digit NAICS and year fixed effects and two-digit NAICS linear and quadratic trends. Bars report 95% confidence intervals from standard errors clustered by four-digit NAICS industry.

Figures E.4 and E.5 show that the response is concentrated among young firms and distinguish it from broader changes in firm turnover.

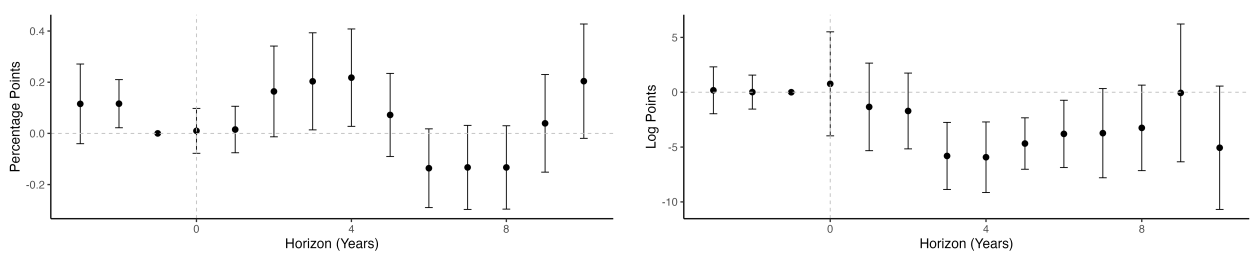
Figure E.4: Age Composition of Firms



Note: These panel local projections use the log number of firms in each age group as the outcome and the industry-level present value of depreciation allowances, $\tilde{z}_{N,t}$, as the treatment. They include four-digit NAICS and year fixed effects and two-digit NAICS linear and quadratic trends. Bars report 95% confidence intervals from standard errors clustered by four-digit NAICS industry.

Figure E.5: Bonus Depreciation, Firm Exit, and Business Dynamism

(a) Firm exit (b) Business dynamism



Notes: These panel local projections use the specification from the main entry analysis. The outcomes are the firm exit rate in panel (a) and the log sum of the firm entry and exit rates in panel (b). Both specifications include four-digit NAICS and year fixed effects and two-digit NAICS quadratic time trends. Bars report 95% confidence intervals from standard errors clustered by four-digit NAICS industry.

E.2 TCJA and Firm Entry

By extending full expensing to used purchases, the TCJA narrowed the tax disadvantage of buying used rather than new capital. I measure this change using the tax-adjusted acquisition cost of each type of capital. Let z_N^0 denote the present value of ordinary MACRS deductions for industry N, and let

$$z_N(\theta) = \theta + (1-\theta)z_N^0, \qquad p_N(\theta,\tau) = 1 - \tau z_N(\theta).$$

The pre-TCJA wedge is

$$g_N^{\text{pre}} = 1 - \frac{p_N(0.5, 0.35)}{p_N(0, 0.35)}.$$

Full expensing of both new and used purchases makes the corresponding post-TCJA wedge zero. I therefore define $\Delta g_N = g_N^{\text{pre}} - g_N^{\text{post}} = g_N^{\text{pre}}$, which is larger in industries where the reform did more to lower the relative cost of used capital. I construct z_N^0 by discounting asset-level MACRS schedules at 6%, weighting them with each BEA industry's fixed investment from 2014 through 2016, and mapping the resulting exposure to four-digit NAICS industries using the most detailed available four-, three-, or two-digit match.

Let $\widehat{\Delta g}_N$ denote this exposure after demeaning and dividing by its cross-industry standard deviation. I estimate

$$y_{N,t} = \alpha_N + \gamma_t + \sum_{s \neq 2017} \beta_s \widehat{\Delta g}_N \mathbf{1}\{t = s\} + \eta_{n(N)} t + \varepsilon_{N,t}, \tag{A.37}$$

where $\eta_{n(N)} t$ denotes two-digit NAICS linear trends. Standard errors are clustered by four-digit NAICS industry. The sample contains 201 industries from 2012 through 2019.

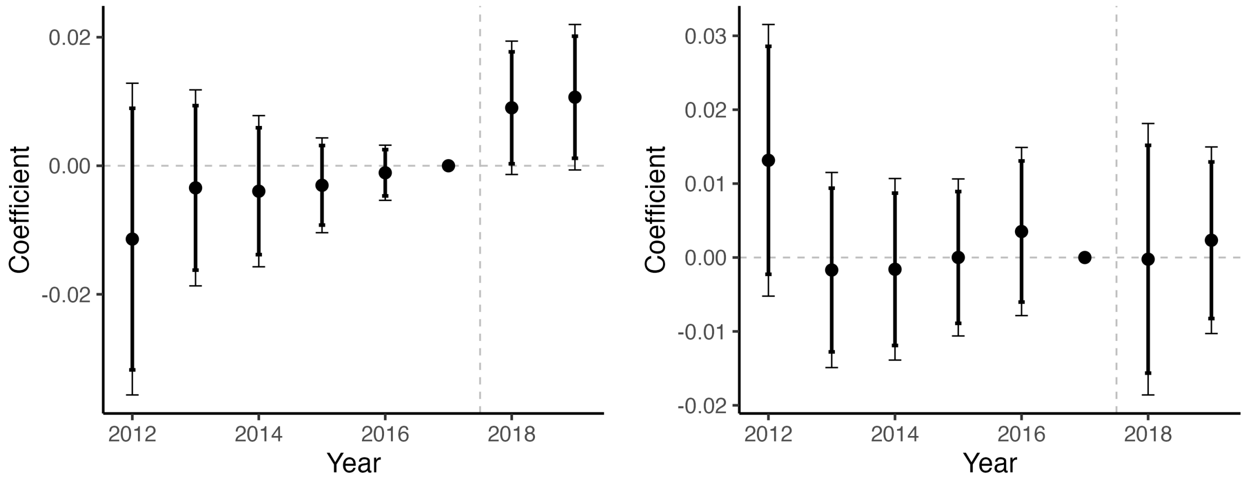
Results. Panel (a) of Figure E.6 plots β_s. The coefficients from 2013 through 2016 are close to zero; the 2012 coefficient is more negative but imprecise. They rise to 0.9 percentage points in 2018 and 1.1 percentage points in 2019 for a one-standard-deviation change in the wedge. Both post-TCJA estimates are statistically significant at the 10% level but not the 5% level. With only two post-reform years before COVID, I interpret this evidence as suggestive.

Panel (b) asks whether the response is larger in industries with more tradeable capital. On the 168-industry sample with a PPE recovery rate, I add year interactions with the demeaned recovery rate and with its interaction with $\widehat{\Delta g}_N$. The plotted interaction is scaled to a one-standard-deviation change in the wedge and a ten-percentage-point difference in the recovery rate. Its pre-TCJA coefficients are negative and converge toward zero as 2017 approaches. Because this differential pretrend undermines a parallel-trends interpretation, the post-TCJA interaction does not provide a credible separate test of the tradeability mechanism.

Figure E.6: Firm Entry Around the TCJA

(a) By pre-TCJA demand wedge exposure

(b) Interaction with the PPE recovery rate



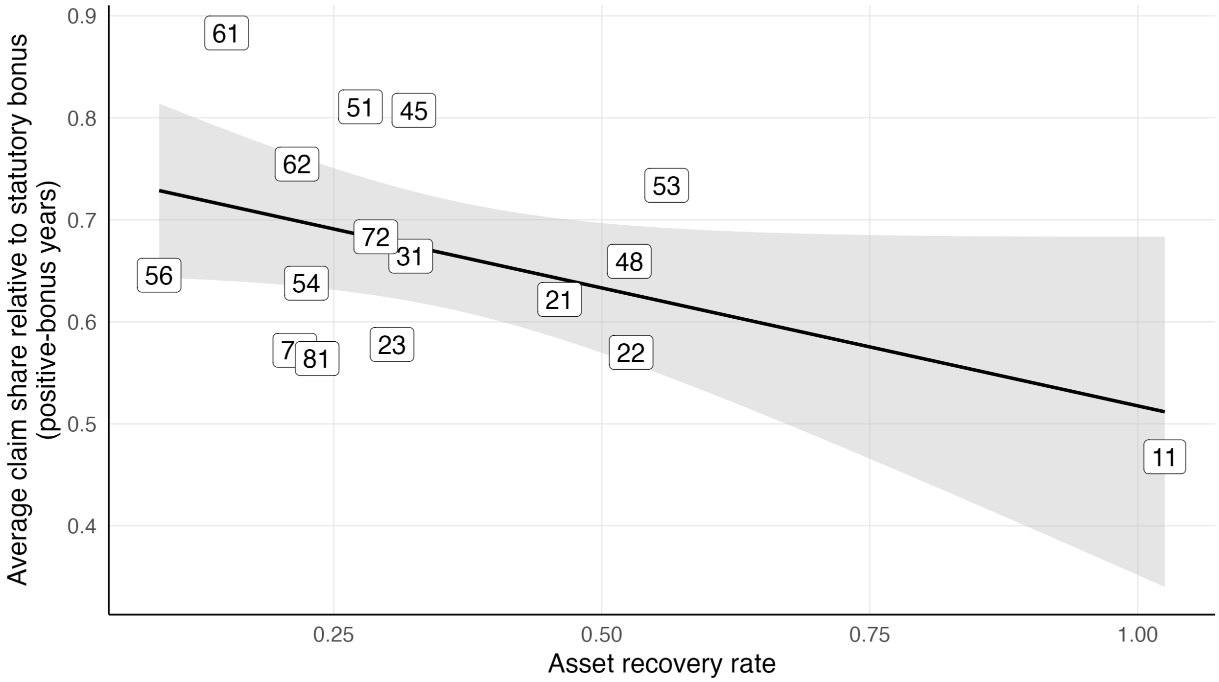
Notes: Panel (a) reports β_s from (A.37). Panel (b) reports year-specific interactions between $\widehat{\Delta g}_N$ and the demeaned PPE recovery rate from Kermani and Ma (2022); the regression also includes the corresponding year interactions with each variable separately. Both specifications include four-digit NAICS and year fixed effects and two-digit NAICS linear trends. The reference year is 2017. Thick bars report 90% confidence intervals and thin bars report 95% confidence intervals from standard errors clustered by four-digit NAICS industry.

F Statistics of Income Evidence on Bonus Claims

The public Statistics of Income tabulations report Form 4562 special depreciation allowances by two-digit industry. I divide Line 14 by Line 14 plus the reported basis for three- through twenty-year GDS property. The tabulations neither isolate basis eligible for nationwide bonus depreciation nor exclude other special allowances from Line 14, so I interpret the variable as an industry-level special-allowance claim share rather than a literal firm-level take-up rate.

Figure F.1 plots the average claim share relative to the statutory bonus rate across industries during positive-bonus years. This comparison of claiming intensity and asset tradeability is descriptive; it does not plot the fixed-effect estimates.

Figure F.1: Bonus Depreciation Claims and Asset Tradeability



Notes: Each point is a two-digit NAICS industry. The vertical axis is the industry's average special-allowance claim share relative to the statutory bonus rate during years with positive bonus depreciation. The horizontal axis is the PPE recovery rate from Kermani and Ma (2022). The fitted line is unweighted.

Table F.1 reports panel regressions of the claim share on statutory bonus rates and asset tradeability. Given the small number of industry clusters, I report exact null-imposed wild-cluster p-values. I treat these estimates as supplementary evidence on claiming behavior, not as identification of the reallocation effects in the main text.

Table F.1: Bonus Depreciation Claims and Asset Tradeability

	Full Sample		Bonus Years	Excl. Agriculture
	(1)	(2)	(3)	(4)
$\theta_t \times \ell_i$	-0.269*	-0.280*	-0.329**	-0.285
	(0.074)	(0.082)	(0.172)	(0.209)
Exact wild-cluster p-value	0.073	0.067	0.044	0.216
SOI claiming-capacity controls		X		
Industry linear trends	X	X	X	X
Year FE	X	X	X	X
Industry FE	X	X	X	X
Observations	316	298	236	295
Industry clusters	16	16	16	15

Notes: The dependent variable is the special depreciation allowance claimed on Form 4562, Line 14, divided by Line 14 plus the reported basis for three-, five-, seven-, ten-, fifteen-, and twenty-year GDS property. Line 21 is excluded because it reports depreciation claimed on listed property rather than depreciable basis; ADS property is also excluded because it is not part of the broad bonus-eligible base. Because Line 14 includes special allowances beyond the nationwide bonus policy and the public SOI tabulations do not separately identify bonus-eligible basis—including new versus ineligible used property before 2018—the outcome is an industry-level claim share rather than a literal firm-level take-up rate. The variable θ_t is the statutory bonus rate and ℓ_i is the PPE recovery rate from Kermani and Ma (2022). Column (2) controls for the NOL-to-sales ratio, the share of returns reporting net income, sales relative to capital, and sales growth. Column (3) retains only years with a positive nationwide bonus rate, and column (4) excludes agriculture. All specifications include industry and year fixed effects and industry-specific linear trends. The source window is 2000–2021; 2008 is excluded because the available tabulation does not provide usable Line 14 amounts, and industry-years with a disclosure-suppressed claim-share input are dropped. Dashes in the source tables are treated as reported zeros. Standard errors clustered by two-digit NAICS are in parentheses. Reported p-values and significance markers use an exact null-imposed Rademacher wild-cluster bootstrap over all 2^G sign assignments.