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The Effect of Corporate Taxation on Investment and Financial Policy: Evidence from the DPAD†

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This study estimates the investment, financing, and payout responses to variation in a firm's effective corporate income tax rate in the United States. I exploit quasi-experimental variation created by the Domestic Production Activities Deduction, a corporate tax expenditure created in 2005. A 1 percentage point reduction in tax rates increases investment by 4.7 percent of installed capital, increases payouts by 0.3 percent of sales, and decreases debt by 5.3 percent of total assets. These estimates suggest that lower corporate tax rates and faster accelerated depreciation each stimulate a similar increase in investment, per dollar in lost revenue. (*JEL* D22, D25, G31, G32, H25, H32)

Many economists and policy makers believe that the US corporate tax system is in serious need of reform and point to the system's 35 percent rate—the highest statutory rate among developed nations—as evidence in favor of this reform. In order to address the high rate in a way that does not have significant effects on the federal budget, many proposals have suggested revenue neutral reforms that pay for a reduced rate by broadening the corporate tax base. Despite widespread support for such proposals, relatively little empirical work has been able to directly estimate the effects of a reduction in the corporate income tax rate on business activity.

This study provides new evidence on these effects by examining the corporate investment and financial policy responses to the Domestic Production Activities Deduction (DPAD). The DPAD is a corporate tax provision that allows firms to deduct a percentage of their domestic manufacturing income from their taxable income. In 2005, when the DPAD was implemented, firms could deduct 3 percent of manufacturing income. This rate was scaled to 6 percent in 2007 and 9 percent in 2010, where it remains today. As a result of the policy, after 2010, firms that derive all of their income from domestic manufacturing activities and face the top statutory corporate income tax rate have a 3.15 ($= 0.09 \times 35$ percent) percentage point lower effective tax rate than firms with no domestic manufacturing activities. This variation in tax rates across firms presents a novel opportunity to understand how a reduction in the corporate income tax rate will affect corporate behavior and the economy.

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I implement a difference-in-differences empirical design that exploits industry and firm-size variation in the percentage of income that is eligible for the DPAD. Firms belonging to industries that derive a large portion of income from domestic manufacturing activities (such as construction and agricultural firms) see a significant reduction in their average effective corporate income tax rate while firms residing in industries that are not domestic manufacturing intensive (such as real estate and transportation) are left essentially unaffected by the policy. The effect of the policy is also more concentrated among larger firms that are more likely to claim the deduction.

To construct this industry and firm-size variation, I use data provided by the IRS Statistics of Income (SOI) Division. The SOI publishes the aggregate annual dollar values of the DPAD and Net Taxable Income for corporations in 75 unique industries and all businesses in 12 asset classes (firm size bins). I use these numbers to calculate the percentage of income eligible for the DPAD within each industry and firm-size grouping. This variation in treatment intensity combines with temporal variation in the deduction rate to create plausibly exogenous variation in effective tax rates.

I find that the DPAD has a large effect on corporate behavior. A 1 percentage point reduction in the effective corporate income tax rate via the DPAD increases investment by 4.7 percent of installed capital, increases payouts by 0.3 percent of revenues, and decreases debt usage by 5.3 percent of total assets. The results also indicate that the DPAD does not increase taxable income per dollar of total assets and, as a result, does not yield higher tax revenues.

These results suggest that a 1 percentage point reduction in the corporate tax rate is 64 percent more effective at stimulating corporate investment than a 1 percentage point reduction in investment costs via accelerated depreciation policies. However, because corporate taxable income is 59 percent larger than corporate investment spending, the present value of government revenue sacrificed to achieve a 1 percentage point reduction in tax rates is, symmetrically, 59 percent larger than the present value of government revenue lost to achieve a 1 percentage point reduction in investment costs. As a result, a dollar spent by the government stimulates virtually the same amount of investment whether it is used to reduce corporate tax rates or accelerate depreciation expenses. Put differently, financing a reduced tax rate by eliminating accelerated depreciation has only a modest 5 percent impact on investment, suggesting revenue-neutral tax reforms of this nature are nearly investment neutral. This finding has both historic precedent and present relevance. The Tax Reform Act of 1986—the model "low-rate, broad-base" corporate tax reform—had a negligible effect on business investment (Auerbach and Slemrod 1997), yet most modern corporate reforms have lowered rates while eliminating deductions, often in the hopes of achieving revenue neutrality (Devereux, Griffith, and Klemm 2002; Kawano and Slemrod 2016).

Although swapping accelerated depreciation for lower rates would not dramatically affect investment, the results presented here suggest it would increase payouts and decrease the incentive to finance investment with debt, two responses that could have positive consequences for the economy as a whole if principle-agent problems within corporations are severe.

The key threat to this study's empirical design is that other time-varying, industry-firm-size shocks may coincide with the DPAD. Throughout the paper I work to address this concern, providing several reasons that this threat—although real—is unjustified. First, a graphical implementation of the difference-in-differences empirical design shows that the parallel trends assumption holds in the five years prior to DPAD enactment. Second, using a series of 2,000 block permutation tests, I confirm that when the policy is implemented in an alternative year or treatment is assigned to different industries, the baseline results do not hold. The block permutation tests allay concerns that differences across industries in response to business cycles are responsible for the estimated effects. The permutation tests simultaneously demonstrate that the clustering procedure used throughout the analysis produces standard errors that are not artificially small as a result of serially correlated data. Third and finally, based on several tests, I confirm that the response to the DPAD is not driven by two contemporaneous tax policies: bonus depreciation and the Extraterritorial Income Exclusion (ETI).

Considered narrowly, this study identifies the effects of the DPAD using a well-identified empirical methodology. To date, Blouin, Krull, and Schwab (2014) and Lester (2015) are the only papers on this subject. Both examine the investment effect of the DPAD using a subsample of firms that elect to disclose the deduction on their financial statements.

Considered more broadly, by providing novel estimates of responses to quasi-experimental exogenous variation in effective corporate income tax rates, this paper enhances to our understanding of how business activities respond to corporate taxation and adds to the significant theoretical and empirical efforts that have been made in this area. The study of the effect of corporate taxation on investment is highlighted by Hall and Jorgenson (1967), Summers (1981), Cummins et al. (1994), Goolsbee (1998), House and Shapiro (2008), Djankov et al. (2010), Edgerton (2010) and Zwick and Mahon (2017); the effects on payouts by Auerbach (1979), Bradford (1981), Poterba and Summers (1985), Chetty and Saez (2005), and Yagan (2015); the effects on capital structure by King (1977), MacKie-Mason (1990), and Graham (1996); the effects on taxable income is highlighted by Gruber and Rauh (2007), Devereux, Liu, and Loretz (2014), and Patel, Seegert, and Smith (2016).

I. The Domestic Production Activities Deduction

During the years 1971–2004, the United States utilized three successive tax incentives—the Domestic International Sales Corporation (DISC) rules (in place 1971–1984), Foreign Sales Corporation (FSC) rules (1984–2000), and the ETI (2000–2004)—to promote the worldwide competitiveness of domestic US exporters. These incentives allowed firms to defer, exempt, or deduct a percentage of export income from US taxation.[1] The World Trade Organization (WTO) ruled that

[1] DISC allowed firms to defer US taxation on up to 50 percent of export income. The deferred amount was subject only to shareholder taxes upon distribution. In the event that the export income was reinvested abroad, US taxation on these earnings was permanently deferred. FSC rules allowed foreign subsidiaries of US exporters to repatriate export income without triggering US tax liability. The ETI allowed exporters to deduct 15 percent of export income from their US taxable income (Lester 2015).

all three were illegal export incentives and in 2004, began levying retaliatory customs penalties on US exports.[2]

In an effort to stop the penalties and introduce a revenue neutral and legal alternative to the ETI, the American Jobs Creation Act of 2004 repealed the export incentive and introduced the DPAD.[3] The DPAD allows firms to deduct a percentage of Qualified Production Activities Income (QPAI) from their taxable income. QPAI is calculated as revenues from the sales of domestically produced goods less the cost of goods sold attributable to domestic production and other expenses related to domestic production including financing costs. A firm's DPAD may not exceed 50 percent of its W-2 wages and may not exceed the firm's gross taxable income. Section 199 of the US Tax Code details the specifics of the deduction. Taxpayers claim the deduction using IRS Form 8903. Because the DPAD is based on domestic and not foreign income, it has a broader base and applies to more firms than the ETI and is not likely to be challenged as an export subsidy.

As detailed in Table 1, the DPAD was phased in during the years 2005–2010.[4] The deduction was implemented at a rate of 3 percent in 2005, was scaled to 6 percent in 2007, and increased to its maximum rate of 9 percent in 2010.[5] Assuming firms faced the maximum statutory corporate tax rate of 35 percent, once fully phased in, the DPAD decreased the effective tax rate on QPAI by 3.15 ($= 0.09 \times 35$) percentage points. How much the DPAD decreases the effective tax rate for a firm depends on the percentage of income defined as QPAI. In 2010, a firm that defined 75 percent of income as QPAI received a 2.3625 percentage point reduction in their effective tax rate via the DPAD, whereas a firm that derives only 25 percent of their income from qualified production activities received a break of only 0.7875 percentage points. This difference in the effective tax rates generated by the DPAD is the heart of the identification strategy used to estimate the investment and financial effects of the policy.

Not only does the potential 3.15 percentage point tax rate reduction provide a nonnegligible break from the perspective of individual establishments, but the policy also constitutes a significant tax expenditure at the national level. The last column of Table 1 lists DPAD tax expenditure assuming a 35 percent corporate tax rate on all income. In 2010, when the DPAD reached 9 percent, corporations were able to deduct more than \$24 billion from their taxable income at a cost of approximately \$8.5 billion to US government. By 2012, tax expenditures on the DPAD topped \$11 billion. The US Government Accountability Office estimates that, since 2010,

[2] In 1984, the General Agreement on Tariffs and Trade (GATT) ruled that DISC constituted an illegal export subsidy. Congress replaced the DISC rules with the FSC regime which in 2000 was also deemed to be an illegal export subsidy, this time by the World Trade Organization (WTO), the modern incarnation of GATT. Again, Congress tried to subvert the international ruling by replacing the FSC regime with the ETI. Only two years later, in 2002, the WTO found that the ETI, too, was an illegal export incentive.

[3] AJCA 2004 also introduced the 2004 tax holiday on repatriated earnings. This policy was designed to work in tandem with the DPAD to increase domestic investment. In Section VI, estimates are performed on only domestic firms which were unaffected by the repatriation holiday. Section VII explores whether firms that responded to the repatriation holiday were differentially responsive to the DPAD.

[4] Lester and Rector (2016) provides a nice overview of the DPAD and explores the companies that utilized the deduction.

[5] For oil-related QPAI, the maximum rate is 6 percent.

Table 1—DPAD Phase-In and Expenditure

	DPAD rate (percent)	Max CIT decrease (percent)	Deductions ($ billions)	Tax expenditure ($ billions)
2005	3.00	1.05	9.332	3.266
2006	3.00	1.05	11.106	3.887
2007	6.00	2.10	21.058	7.370
2008	6.00	2.10	18.374	6.320
2009	6.00	2.10	14.198	4.970
2010	9.00	3.15	24.365	8.528
2011	9.00	3.15	27.388	9.586
2012	9.00	3.15	31.966	11.188

Notes: Table 1 lists the DPAD rate (from IRS Form 8903), the maximum corporate income tax rate deduction resulting from the DPAD ($= 0.35 \times$ DPAD rate), federal DPAD tax deductions (from IRS Statistics of Income Division), and tax expenditures for all businesses during the years 2005 to 2012 in billions of dollars ($=$ Deductions $\times$ 0.35). In calculating tax expenditure and the max CIT decrease, the corporate statutory rate is assumed to be 35 percent for all firms.

the DPAD has been the third largest corporate tax expenditure behind accelerated depreciation and deferral of income from controlled foreign corporations.

II. Modeling Investment and Financing Responses to the DPAD

To understand how the DPAD jointly affects corporate investment and financing decisions, I add the DPAD to a two-period representative firm model in the spirit of Poterba and Summers (1985). A firm starts period 1 with earnings, R_0, and must decide how much to invest in period 1 to maximize the present value of after-tax dividends in periods 1 and 2 net of equity issuances.[6] The maximization problem can be written as

$$\max_I \,(1 - \tau_d)\left[D_1(I) + \frac{D_2(I)}{1+r}\right] - E, \tag{1}$$

where I is total investment, D_1 and D_2 are dividend payments in periods 1 and 2 that depend on the level of investment, r is the risk-adjusted rate of return demanded by investors, E is the amount of new equity issued in period 1, and τ_d is the tax rate on dividend payments. The firm finances investment through a combination of three methods: (i) internally generated funds, G, (ii) newly issued equity, E, and/or (iii) debt, B. Total investment, I, is therefore equal to the sum $G + E + B$.

The three sources of finance differ in their costs to investors. Internally generated funds cost shareholders period 1 dividends, which implies $D_1 = R_0 - G$. To finance an investment with equity, shareholders invest E in period 1 and receive E as an untaxed dividend in the next period. Thus, equity costs investors nondeductible costs $rE/(1+r)$. The cost of debt financed investment is the tax deductible borrowing cost, rB.

[6] The firm could also repurchase shares, the gains on which would be taxed at the capital gains tax rate. Changing dividends to repurchases does not change the key results of the model.

Investment generates pretax net revenue in period 2 according to the concave production function $\Pi(I)$. The investment depreciates at rate δ. The return on the investment net of depreciation and borrowing costs is taxed at the DPAD-adjusted corporate income tax rate, $\tau_c(1-d)$, where d is equal to the DPAD rate for domestic manufacturing firms and 0 for firms do not generate income via domestic manufacturing activities.[7]

Understanding the potential sources of financing, their costs, and the firm's production functions, the maximand can be rewritten as

$$\max_I (1-\tau_d)\left[[R_0 - G] + \frac{(1-\tau_c(1-d))\,[\Pi(I) - \delta(I) - rB] + G}{1+r}\right] - \frac{rE}{1+r}$$

and first-order conditions for each of the three financing strategies are

$$(2) \qquad \Pi'(G) = \frac{r}{1-\tau_c(1-d)} + \delta,$$

$$(3) \qquad \Pi'(E) = \frac{r}{(1-\tau_d)(1-\tau_c(1-d))} + \delta, \text{ and}$$

$$(4) \qquad \Pi'(B) = r + \delta.$$

The partial derivative of each type of financing method with respect to d describes the effect of the DPAD.[8] When the marginal source of finance is either internally generated funds or new equity, $\partial I/\partial d > 0$, but when the marginal source of finance is debt, $\partial I/\partial d = 0$. The intuition is that the DPAD actually increases the cost of debt-financed investment because the borrowing costs are now deducted at the lower DPAD adjusted tax rate. The increased borrowing costs exactly offset the increases in after-tax net revenue generated by the policy.

Two primary empirically testable hypotheses emerge from the model's comparative statics.

HYPOTHESIS 1: *All else equal, domestic manufacturing firms increase investment relative to non-manufacturing firms when the DPAD is implemented and scaled.*

HYPOTHESIS 2: *All else equal, domestic manufacturing firms will increase new equity issuances and reinvestment of internally generated funds while decreasing debt financing relative to nonmanufacturing firms when the DPAD is implemented and scaled.*

[7] To keep the model and its intuition simple, investment is assumed to be depreciated for tax purposes at the economic depreciation rate, δ. Online Appendix A presents an extension to the model in which investments are depreciated at an accelerated rate for tax purposes. The extension shows that the DPAD can blunt the effect of accelerated depreciation policies, but under realistic parameterizations, the blunting does not alter the hypotheses generated by the simplified model.

[8] FOC (2) corresponds to the "new view" or "trapped equity view" of dividend taxation (King 1977, Auerbach 1979, Bradford 1981). FOC (3) corresponds to the "traditional view" of dividend taxation (Harberger 1962, Feldstein 1970, Poterba and Summers 1985).

In addition to the two primary hypotheses, I empirically test several other predictions. To start, because the DPAD is a proportional reduction in a firm's marginal tax rate, the investment and financing effects of the DPAD should be stronger for firms that face higher marginal tax rates. Tests of heterogeneity with respect to marginal tax rates are performed in Section VI.

While the model can predict the basic investment and financing responses to the DPAD, it lacks the sophistication to accurately predict how payouts should respond. In the model, firms that invest with internally generated funds may decrease dividend payments in response to the policy. In reality, R_0 is not exogenous but may, itself, increase as the DPAD is scaled. In addition, firms are penalized for decreasing dividends once initiated and may be constrained by agency conflicts to repurchase shares only when the market is in an upswing (Farre-Mensa, Michaely, and Schmalz 2014). Thus, while the payout response to the DPAD is of great interest and will be tested empirically, it is hard to predict.

There are two additional ways in which firms may respond to the DPAD that are absent from the model. First, if firms face some convex and nondeductible costs of tax avoidance, they may increase their taxable income in response to the DPAD. Second, firms may increase the percentage of income they claim as QPAI either through reclassification or through real changes in their production function. Empirically testing the taxable income response will rely on the same empirical framework as the tests for investment, financing, and payouts (described in Subsection IV). While the analysis in Section VI addresses the potential endogeneity of QPAI with respect to investment activity, directly testing for the reclassification of investment induced changes in production functions of the policy, on the other hand, requires a wholly different framework and is left for future work.

III. Data and Descriptive Statistics

A. *QPAI Percent and DPAD Treatment*

The model and resulting hypotheses compare the behavior of domestic manufacturing and non-manufacturing firms. In practice, only a portion of taxable income qualifies for the deduction even for firms in manufacturing industries. Therefore, I test the hypotheses empirically by calculating *QPAI Percent*, a continuous measure of the percent of income eligible for the deduction, using information provided by the IRS Statistics of Income (SOI) division.[9] For each of approximately 75 IRS industries, SOI provides total Income Subject to Tax and total Domestic Production Activities Deduction. Dividing total Domestic Production Activities Deduction by the DPAD rate yields total Qualified Production Activities Income. Dividing this amount by total Income Subject to Tax plus total Domestic Production Activities Deduction generates a precursor to *QPAI Percent*, which varies across industries in each year 2005–2012.

I rescale the industry-level precursor to account for differences in DPAD usage across firm-size bins. Using SOI Corporate Source Book data aggregated by total

[9] Online Appendix B contains a more detailed discussion of the construction of *QPAI Percent* and other variables used in the analysis.

asset value, I create asset-class measures of *QPAI Percent* following the same calculation described above. Then, I divide these asset-class *QPAI Percent* measures by the average *QPAI Percent* observed in each year, creating 12 asset-class multipliers that vary over time. The multipliers describe how much more or less firms in an asset class make use of the DPAD than the average firm. The industry-level QPAI precursor is then cross multiplied with these asset-class multipliers to generate the final *QPAI Percent* variable. *QPAI Percent* varies across approximately 900 $(= 75 \times 12)$ industry-size bins and over the years 2005–2012. *QPAI Percent* is matched to firms in the COMPUSTAT database using 4-digit NAICS codes, which closely correspond to IRS industry definitions, and balance sheet measures of total assets. Figure 1 displays averages of *QPAI Percent* over time, across IRS sectors, and across asset-classes.

Following the procedure described above, *QPAI Percent* is the same for multinational and domestic firms in the same industry-size-year cell. A concern is that because COMPUSTAT reports worldwide accounting data, even if the domestic activities of multinationals may be responsive to the policy, worldwide behavior may appear unaltered. To address this concern, the effects of the DPAD are estimated among domestic firms only in Table 4, and the effect of the DPAD on effective tax rates is estimated separately for multinationals (Table 5) to confirm that no significant sources of measurement error are present in *QPAI Percent*.

QPAI Percent is multiplied by the statutory corporate income tax rate and the DPAD rate (d in the model) to generate *DPAD*. The *DPAD* variable is equal to the percentage point reduction in effective tax rates a firm receives from the deduction. The *DPAD* variable can be interpreted as the interaction between treatment and intensity where treatment is the DPAD rate times the corporate income tax rate, which escalates from 0 to 3.15 during the years 2004 to 2010 and intensity measured by *QPAI Percent*, which varies by industry, firm size, and over time.

Descriptive statistics for *QPAI Percent*, *DPAD*, and other tax policy variables are presented in Table 2. Over the sample period 2005–2012, the average value of the *DPAD* variable is 0.944 meaning that the DPAD reduces a firm's effective marginal tax rate by 0.944 percentage points. Once the policy is fully phased-in, in years 2010 through 2012, the average firm receives a 1.432 percentage point reduction in their effective tax rate via the DPAD. The DPAD reduced the seventy-fifth percentile firm's effective tax rate by 2.29 percentage points.

Adjusted DPAD is an alternate measure of DPAD benefit. As mentioned in Section I, firms with no taxable income in a given year do not receive any monetary benefit from the deduction. *Adjusted DPAD* accounts for this by setting the unadjusted *DPAD* variable equal to zero for firms that report zero or negative taxable income (as defined below). The majority of the analysis relies on the unadjusted *DPAD* variable, which treats firms as exposed to the DPAD if they are currently receiving relief from the deduction or will receive some benefits when and if they are earning positive taxable income in the future.

B. *Other Tax Policy Variables*

As noted, a threat to the identification strategy is that other contemporaneous tax policies covary with the DPAD. The first step in addressing this concern is to

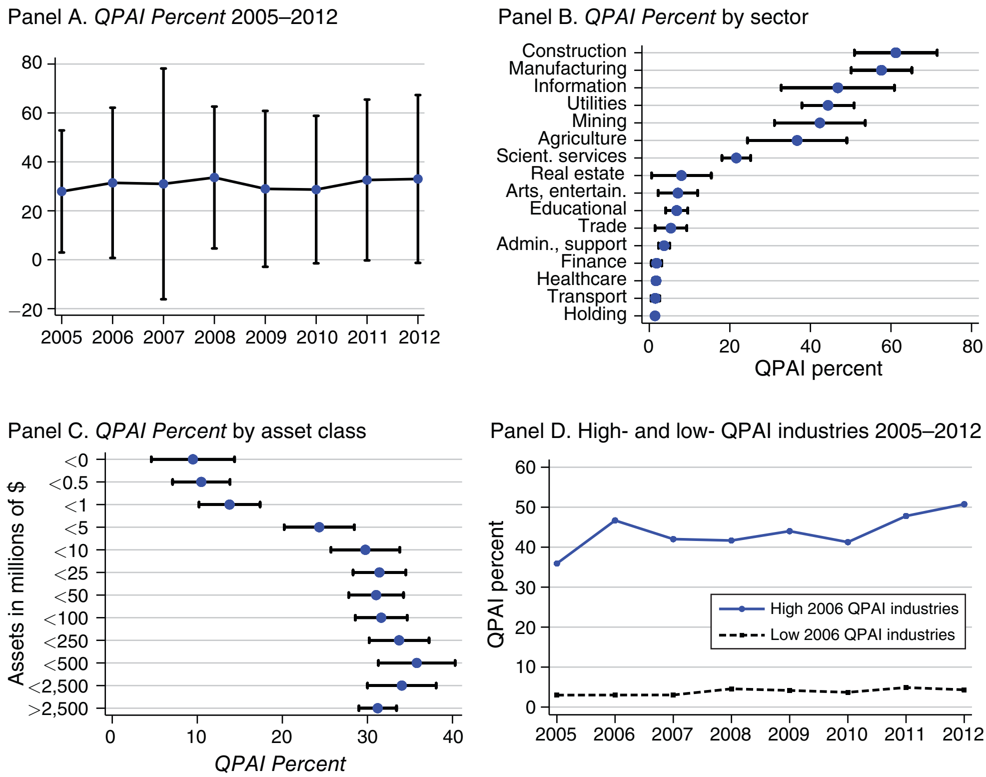

Figure 1. *QPAI Percent*

Notes: This figure describes temporal, industry-level, and asset-class variation in *QPAI Percent*, the percentage of taxable income classified as Qualified Production Activities Income. *QPAI Percent* is constructed for industries and firm-size groups using data from IRS SOI Tax Stats Corporation Tax Statistics table 17 and Corporate Source Book section III table 1. *QPAI Percent* is calculated as "Domestic Production Activities Deduction" divided by the DPAD rate divided by the sum of income subject to tax and domestic production activities deduction. Panel A plots mean *QPAI Percent* and 1 standard deviation intervals for C-Corps during the years 2005 to 2012. Panel B presents mean *QPAI Percent* and 1 standard deviation intervals for C-Corps for each of the 16 IRS sectors. Panel C presents mean *QPAI Percent* and 1 standard deviation intervals for all corporations for 12 IRS-defined assets classes. Panel D presents mean *QPAI Percent* for C-Corps in high 2006 QPAI Industries and C-Corps in low 2006 QPAI Industries during the years 2005 to 2012. High (low) 2006 QPAI industries are defined as those in the top (bottom) half of the 2006 QPAI distribution; the median industry-level QPAI in 2006 was 8 percent.

carefully construct variables that capture the effect of the two most concerning policies, the ETI, which the DPAD replaced, and bonus depreciation, a federal investment tax incentive that has been in use in the United States since 2001. The policy encourages investment by accelerating the deduction of newly installed capital from taxable income. The acceleration decreases the after-tax present value cost of any given investment. Bonus depreciation was set to 30 percent in 2001 and 2002; 50 percent in 2003, 2004, 2008–2010, and 2012; and 100 percent in 2011. In all other sample years the bonus was set to 0 percent.

ETI is constructed in a manner similar to the *DPAD* variable. *ETI* varies at the industry-level based on export intensity (data from USA Trade Online) and over

TABLE 2—TAX POLICY VARIABLE DESCRIPTIVE STATISTICS

	Mean	Standard deviation	25th percentile	75th percentile	Observations
Tax policy variables					
DPAD	0.381	0.683	0.000	0.555	90,398
post 2005	0.944	0.790	0.327	1.408	36,488
post 2010	1.432	0.963	0.613	2.294	12,680
Adjusted DPAD	0.159	0.493	0.000	0.000	90,398
post 2005	0.393	0.714	0.000	0.534	36,488
post 2010	0.623	0.986	0.000	0.952	12,680
ETI	0.151	0.396	0.000	0.000	90,398
2000–2004	0.468	0.583	0.000	0.970	29,100
BONUS	0.905	1.163	0.000	1.702	90,398
2008–2010	1.869	0.787	1.331	2.056	13,233

Notes: Table 2 presents descriptive statistics for the tax policy variables used in the empirical analysis. The data consist of firm-year observations that had non-missing *Investment*, *Debt*, *HP Index*, *Marginal Q*, *Cash Flow*, and NAICS industry (definition in Table 3). *DPAD* represents the percentage point reduction in effective tax rates a firm receives from the *DPAD*. *DPAD* = industry *QPAI Percent* × (asset class *QPAI Percent*/Mean Asset-Class *QPAI Percent*) × τ_c × the *DPAD* rate. *QPAI Percent* is calculated as described in the Figure 1 notes. *Adjusted DPAD* = *DPAD* × an indicator equal to 1 when taxable income > 0. *ETI* represents the percentage point reduction in effective tax rates a firm receives from the *ETI*. *ETI* = industry gross export receipts from USA Trade Online divided by industry-level total receipts from IRS SOI Tax Stats Corporation Tax Statistics × τ_c × the *ETI* rate (0.15 in years 2000–2004, 0 in all other years). *BONUS* measures the percentage point reduction in investment prices due to bonus depreciation. $BONUS = (z - z_0)\tau_c(1 - DPAD/100)$. z_0 is the industry-level present value of tax deductions per dollar of investment under MACRS rules as calculated using BEA capital flow data, IRS Publication 946 and assuming a 7 percent discount rate. $z = b + (1 - b)z_0$, where b is the "bonus percentage" that may be deducted in each year. *DPAD* is defined above. In all calculations, $\tau_c = 35\%$.

time due to the timing of the policy. *ETI* measures the percentage point reduction in corporate income tax rates due to the export incentive. When the ETI was in effect, during the years 2000–2004, the policy reduced the average firm's effective corporate income tax rate by 0.47 percentage points.

BONUS measures the percentage point reduction in investment prices due to *BONUS* depreciation and is constructed following the procedure used in Cummins et al. (1994), Desai and Goolsbee (2004), House and Shapiro (2008), Edgerton (2010), and Zwick and Mahon (2017). *BONUS* varies in three ways: (i) across industries due to how quickly firms can deduct capital investments from taxable income in the absence of bonus, (ii) across time due to changes in bonus depreciation generosity over time, and (iii) due to variation in DPAD-adjusted corporate income tax rates due to bonus depreciation. The intuition behind the third source of variation is that bonus depreciation has a larger effect at higher corporate tax rates and the DPAD reduced these rates. More on this interaction is discussed in online Appendix C. *BONUS* is equal to 1.87 for the average firm during the years 2008–2010, meaning bonus depreciation decreased investment prices for the average firm by 1.87 percentage points.

C. *Outcome*, *Control*, *and Heterogeneity Variables*

The empirical analysis focuses on four outcomes derived from firm-level COMPUSTAT data: *Investment, Debt, Payouts*, and *Taxable Income*. *Investment* is defined as capital expenditure per dollar of lagged net property plant and equipment (Cummins et al. 1994; Desai and Goolsbee 2004; Edgerton 2010). *Debt* is defined as total liabilities per dollar of total assets. *Payouts* is equal to total dividends plus share repurchases per dollar of lagged revenue where share repurchases are equal to the nonnegative annual dollar changes in treasury stock. (Blouin, Raedy, and Shackelford 2011; Edgerton 2013; Yagan 2015). *Taxable Income* is defined as pre-tax book income minus deferred tax expense divided by the marginal tax rate scaled by the lagged value of total assets (Stickney and McGee 1983; Gruber and Rauh 2007). *Taxable Income* is reported and used in the analysis only when firms report positive pretax income.

This debt measure is often referred to as the "debt ratio." The debt ratio is used here because it nicely captures all potential financing responses to the DPAD. If firms increase debt usage in response to the DPAD, *Debt* increases. On the other hand, if, as predicted, firms respond to the DPAD by investing with internally generated funds or new equity, *Debt* will decrease. In further analysis, *Debt* is replaced with finer measures of financing. *New Equity* is equal to the change in book equity minus the change in retained earnings scaled by lagged total assets. *New Debt* is equal to the sum of changes in long-term and short-term debt scaled by lagged total assets. *Change in RE* is equal to the net change in retained earnings scaled by lagged total assets. All three measures follow Baker and Wurgler (2002).

In Subsection VI, the outcome variables are replaced with *Cash ETR*, a measure of the cash effective tax rate, to verify that the DPAD treatment is accurately measured. *Cash ETR* is defined as cash taxes paid divided by pretax book income before special items (Dyreng, Hanlon, and Maydew 2010).

Firm-level control variables constructed from COMPUSTAT data are added to each regression to control for financial constraints, cash flows, and investment opportunities. Section VII explores potential heterogeneous effects of the *DPAD* across tax status, size, age, cash flow, foreign presence and response to the 2004 repatriation holiday. Details on control and heterogeneity variables are included in the Table 3 notes and in online Appendix B. Descriptive statistics for all outcome, control, and heterogeneity variables are presented in Table 3.

IV. Estimating Strategy

The DPAD allows firms to deduct a percentage of income derived from qualified production activities from their taxable income. The identification strategy builds on the idea that firms in certain industries and certain size-bins benefited more from the DPAD because a larger percentage of their income is eligible for the deduction. This cross-sectional variation permits within-year comparison of outcome variables for firms in different industry-size groups. The policy, itself, provides temporal variation as the DPAD rate increases from 0 to 3 to 6 to 9 percent during the years 2005–2010. Thus, the policy varies at the industry-by-size-by-year level and the key identifying assumption behind the empirical estimation of the effects of the DPAD is that this policy variation is independent of other industry-by-size-by-year shocks. A litany of tests validate this assumption.

Table 3—Additional Descriptive Statistics

	Mean	Standard deviation	25th percentile	75th percentile	Observations
Outcome variables					
Investment	0.444	0.746	0.105	0.448	90,398
Debt	0.604	0.600	0.285	0.694	90,398
Payouts	0.023	0.064	0.000	0.014	86,949
Taxable income	0.040	0.198	−0.021	0.130	51,391
New equity	−0.030	0.884	−0.203	0.203	88,877
New debt	0.046	0.234	−0.026	0.053	90,322
Change in RE	−0.216	0.702	−0.179	0.063	88,950
Cash ETR	0.118	0.228	0.000	0.246	90,370
Control and heterogeneity variables					
HP index	−4.029	1.925	−5.455	−2.753	90,398
Cash flow	−6.000	35.184	−0.601	0.644	90,398
Marginal Q	0.036	0.111	0.011	0.026	90,398
Marginal tax rate	0.209	0.105	0.105	0.310	75,387
Revenue ($ mill)	24.043	124.029	0.210	8.193	90,398
Age	12.689	11.481	4.000	18.000	90,398
Foreign ops.	0.538	0.499	0.000	1.000	90,398
2004 Repatriator	0.015	0.120	0.000	0.000	90,398

Notes: Table 3 presents descriptive statistics for outcome, control, and heterogeneity variables used in the empirical analysis. The data consist of firm-year observations that had non-missing *Investment*, *Debt*, *HP Index*, *Marginal Q*, *Cash Flow*, and NAICS industry. All outcome variables are constructed using COMPUSTAT data except when noted. *Investment* = capital expenditure divided by lagged property plant and equipment (net). *Debt* = total liabilities divided by total assets. *Payouts* = total dividends plus share repurchases divided by lagged total revenue where share repurchases = nonnegative annual dollar changes in treasury stock. *Taxable Income* = pretax book income minus deferred tax expense divided by the marginal tax rate scaled by the lagged value of total assets. *Taxable Income* is reported and used in the analysis only when firms report positive pretax income. *New Equity* = the change in book equity minus the change in retained earnings divided by lagged total assets. *New Debt* = the sum of changes in long-term and short-term debt scaled by lagged total assets. *Change in RE* = the net change in retained earnings divided by lagged total assets. *Cash ETR* is defined as cash taxes paid divided by pretax book income before special items. *HP Index* measures financial constraint and is equal to $-0.737 \times$ size $+ 0.043 \times$ size$^2 - 0.04 \times$ age where size is the minimum of total assets in 2004 dollars and \$4.5 billion, and age is the minimum of the number of years a firm has been in the COMPUSTAT database and 37. *Cash flow* is measured as income before extraordinary items plus depreciation and amortization divided by lagged property, plant, and equipment. *Marginal Q* proxies investment opportunities as the market value of equity plus the book value of debt divided by the book value of the firm's total assets. *Marginal tax rate* is the Blouin, Core, and Guay (2010) simulated marginal tax rate after interest deductions (only available for the years 2000–2010). Revenue = sales in 2010 dollars (millions). *Age* is the number of years a firm has been in the COMPUSTAT database. *Foreign Ops*. is an indicator equal to 1 if the firm reported nonzero foreign income during the years 2006–2010. Repatriate is an indicator equal to 1 if the firm repatriated foreign income in response to the 2004 repatriation tax holiday and 0 if the firm reported foreign income but did not repatriate (from Bradley 2013).

A differences-in-differences (DD) estimation strategy follows naturally from the industry-by-size-by-year DPAD policy variation. The DD strategy is implemented using the regression framework

$$Outcome_{i,t} = \beta_0 + \beta_1 DPAD_{j,s,t} + \gamma \mathbf{X}_{i,t} + \eta_i + \gamma_t + \epsilon_{it}, \tag{5}$$

where i indexes firms, j indexes industries, s indexes size bins, and t indexes time; η and γ are firm and year fixed effects and $\mathbf{X}_{i,t}$ is a vector of control variables observed at the firm-year level. In this DD specification, β_1 is the treatment effect and describes the increase in a given outcome variable that results from a 1 percentage point reduction in a firm's effective income tax rate generated by the *DPAD*.

To see why β_1 is a DD estimate, recall that the *DPAD* variable is equal to *QPAI Percent* times the DPAD rate times the corporate income tax rate. The DPAD rate

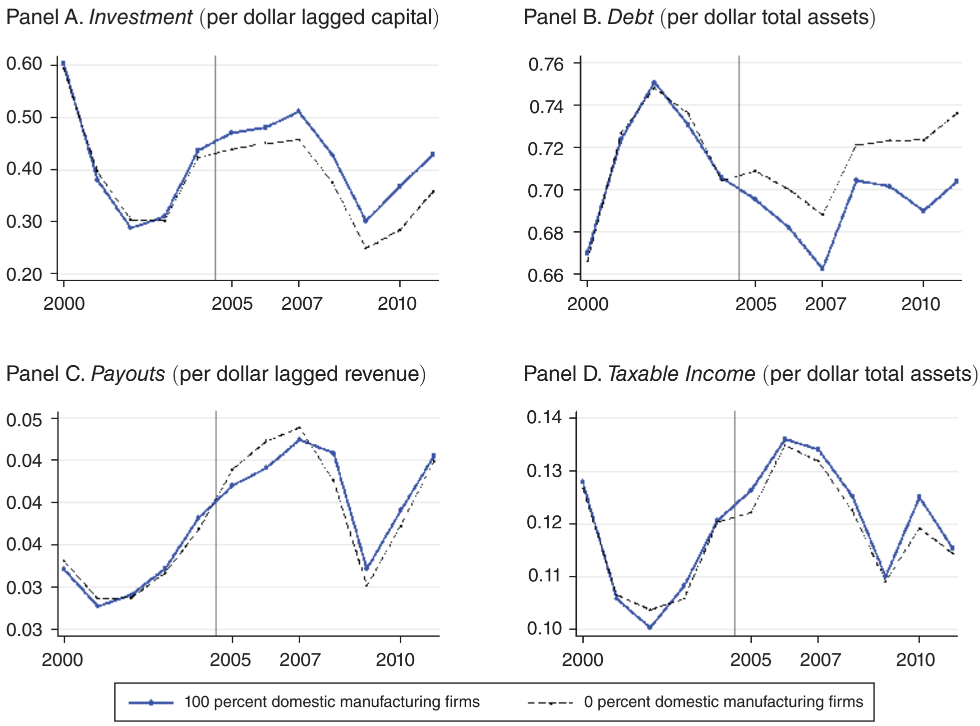

Figure 2. Effects of the DPAD on Corporate Activities

Notes: This figure presents a visual implementation of the differences-in-differences (DD) research design described in Section IV for each of the four outcome variables investigated in the primary empirical analysis. To create each plot, first *QPAI Percent* is averaged for each industry-size group over the years 2005–2012. Then, according to estimating equation (6), the outcome variable is regressed on the averaged QPAI treatment interacted with year dummies as well as the baseline set of controls (Series (1) from Table 4). These coefficients are combined with secular trends in the outcome variables using the following two-step procedure. First, the magnitude of the average coefficient in years 2000–2004 $\left(\left[\sum_{t=2000}^{2004} \beta_t\right]/5\right)$ is subtracted from each coefficient in order to eliminate differences in outcome levels prior to *DPAD* treatment. Second, for each year, 0.5 times the coefficient is added to the average outcome value to create the "100 percent domestic manufacturing firms" series and 0.5 times the coefficient is subtracted to create the "0 percent domestic manufacturing firms" series. Comparing the vertical distance between the two series as the DPAD is implemented and scaled relative to the vertical distances prior to 2005 provides a graphical approximation of the DD empirical approach.

times the corporate income describes the "treatment" and *QPAI Percent* describes the treatment's intensity. Thus, β_1 is estimated by comparing the outcomes for firms in high *QPAI Percent* industry-size cells to the same outcomes of firms in low *QPAI Percent* industry-size cells as the policy is implemented and scaled.

V. The Effect of the *DPAD* on Corporate Activities

A. *Graphical Results*

Figure 2 presents a semiparametric visual implementation of the DD estimation strategy. To create each DD plot, first *QPAI Percent* is averaged for each industry-size group over the years 2005–2012. The outcome variable is then regressed on this averaged QPAI treatment (denoted by the absence of a time index) interacted with year dummies as well as the baseline set of controls:

$$(6)\quad Outcome_{i,t} = \beta_0 + \sum_{t=2000}^{2012} \beta_t \left[QPAIPercent_{j,s} \times \mathbf{1}[Year_t]\right] + \gamma \mathbf{X}_{i,t} + \eta_i + \gamma_t + \epsilon_{it}.$$

Coefficients $\beta_{2000} - \beta_{2011}$ generated by this specification are the empirically estimated differences in the outcome variable between 100 percent QPAI firms and 0 percent QPAI firms in each year 2000–2011.[10] These coefficients are combined with secular trends in the outcome variables using the following two-step procedure. First, the magnitude of the average coefficient in years 2000–2004 $\left(\left[\sum_{t=2000}^{2004} \beta_t\right]/5\right)$ is subtracted from each coefficient in order to eliminate differences in outcome levels prior to DPAD treatment. Second, for each year, 0.5 times the coefficient is added to the average outcome value to create the "100 percent Domestic Manufacturing Firms" series and 0.5 times the coefficient is subtracted to create the "0 percent Domestic Manufacturing Firms" series. The resulting plots show both the time trend in the outcome variable (the equal weighted average of the 100 percent and 0 percent points in each year) and the coefficients from the semiparametric specification (the vertical distance between the two series).

Comparing the vertical distance between the two series as the DPAD is implemented and scaled relative to the vertical distances prior to 2005 provides a graphical approximation of the DD empirical approach.[11] Panels A and B show a sharp divergence in investment and financing behavior between 100 percent domestic manufacturing and 0 percent firms beginning in 2005. In support of Hypotheses 1 and 2, *Investment* by domestic manufacturing firms increases relative to other firms and debt usage by 100 Percent Firms decreases relative to 0 Percent Firms. Further validating the hypotheses, the differences in investment and financing behaviors are statistically significant at the 90 percent level in all years after 2006, and these differences grow as the DPAD rate increases from 0 to 3 to 6 to 9 percent in years 2005–2010.

The visual results are not as clear and certainly smaller in magnitude for *Payouts* (panel C) and *Taxable Income* (panel D). *Payouts* by 100 percent domestic manufacturing firms are depressed relative to *Payouts* by 0 percent firms in years 2005–2007. This trend reverses during the years 2008–2010 (payouts are statistically smaller at the 90 percent level only in 2006 and larger only in 2008). In 2011, payouts are approximately equal between the two groups. This behavior is consistent with domestic manufacturing firms decreasing payouts in the early years of the deduction in order to increase investment then increasing payouts as the income effects of the policy increase. This behavior is also consistent with domestic manufacturing firms not having to decrease payouts during the financial downturn in 2008–2010 due to the extra cash flows generated by the DPAD.

[10] β_{2012} is not estimated due to multicollinearity.

[11] Online Appendix D provides corresponding visuals in which the transformed coefficients and corresponding confidence internals are graphed prior to adding the time trends in the outcome variables in the style of Autor (2003).

Taxable Income seems to slightly increase for the 100 percent domestic manufacturing firms relative to 0 percent firms in years 2008–2011. However, in no year during the panel is the interaction coefficient statistically different from zero with 90 percent confidence indicating that firms did not seem to increase their taxable income in response to the DPAD.

In sum, the visual evidence suggests that, consistent with Hypotheses 1 and 2, firms increased *Investment* in response to the DPAD and did not finance this investment using new debt. *Payouts* may have increased due to the DPAD especially during 2008–2010. Firms do not seem to report more taxable income in response to the DPAD. Critically, across all four outcome variables, there is no divergence in corporate behavior between domestic manufacturing and other firms during the five years prior to DPAD implementation. This visual evidence (i) suggests that differential trends across groups in the pre-period are not responsible for the estimated effects of the policy, (ii) provides a visual placebo that indicates no false positives, and (iii) suggests that bonus depreciation, which was first implemented in 2001 and increased in 2003, did not differentially affect either group.

B. *Empirical Results*

Table 4 presents *DPAD*, *BONUS*, and *ETI* coefficients from regressions in the form of equation (5) for all four primary outcomes, *Investment*, *Debt*, *Payouts*, and *Taxable Income*. Consistent with the visual evidence and Hypotheses 1 and 2, the empirical results demonstrate large *Investment* increases and *Debt* decreases in response to the DPAD. *Payouts* are estimated to increase in response to the *DPAD* but the magnitude of the increase is sensitive to the specification and is not always statistically different from zero. *Taxable Income* is responsive to the *DPAD* only when the policy is measured using the *Adjusted DPAD* variable.

In all Table 4 specifications, the outcome variable is regressed on *DPAD*, *BONUS*, *ETI*, firm and year fixed effects, and controls for financial distress, cash flow, and investment opportunities. The standard errors in each regression as well as the standard errors throughout the paper are clustered at the IRS industry level.[12] The second specification in each panel, (2a)–(2d), limits the analysis to domestic firms. The third specification in each panel, (3a)–(3d), uses the *Adjusted DPAD* variable. I consider series (1) specifications the baseline form upon which most other analyses throughout the paper are based.

Specification (1a), reports a semi-elasticity of 0.0473 of *Investment* with respect to *DPAD*. The estimate suggests that firms increase capital expenditure by 4.73 percent of installed capital when they face a 1 percentage point reduction in the effective corporate income tax rate generated by the DPAD. A more comprehensive way to measure the effect of the policy is to calculate $\mathcal{E}_{DPAD}$, the elasticity of investment with respect to the net of DPAD-adjusted effective corporate income tax rate.

[12] Bertrand, Duflo, and Mullainathan (2004) suggests that DD estimates in which standard errors are not clustered at the level of treatment exhibit artificially precise estimates. The treatment level here is industry-size groups. However, because firms change size during the sample frame, firms move across clusters and clustering at this level is infeasible. Following Cameron and Miller (2015), the estimates are clustered at the industry-level instead as clustering on larger groups provides more conservative standard error estimates.

Table 4—Effects of the DPAD

Dependent variable	*Panel A. Investment*			*Panel B. Debt*		
	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)
DPAD	0.0473	0.0598	0.0697	−0.0531	−0.0756	−0.0721
	(0.0165)	(0.0149)	(0.0144)	(0.0160)	(0.0174)	(0.0144)
BONUS	0.0290	0.0267	0.0290	−0.0077	−0.0143	−0.0072
	(0.0117)	(0.0120)	(0.0117)	(0.0058)	(0.0070)	(0.0060)
ETI	0.0557	0.0530	0.0540	−0.0135	−0.0396	−0.0106
	(0.0204)	(0.0358)	(0.0200)	(0.0109)	(0.0195)	(0.0102)
Domestic		✓			✓	
Adjusted *DPAD*			✓			✓
Firm-years	90,398	41,788	90,398	90,398	41,788	90,398
Firms	12,443	4,731	12,443	12,443	4,731	12,443
Dependent variable mean	0.470	0.434	0.401	0.592	0.621	0.492
	6.538	8.958	9.577	−5.832	−7.911	−7.917

Dependent variable	*Panel C. Payouts*			*Panel D. Taxable Income*		
	(1c)	(2c)	(3c)	(1d)	(2d)	(3d)
DPAD	0.0029	0.0017	0.0059	0.0003	0.0008	0.0172
	(0.0014)	(0.0016)	(0.0010)	(0.0030)	(0.0039)	(0.0036)
BONUS	−0.0004	−0.0001	−0.0003	0.0008	0.0008	0.0028
	(0.0008)	(0.0011)	(0.0008)	(0.0013)	(0.0020)	(0.0013)
ETI	0.0012	0.0018	0.0013	−0.0002	−0.0002	0.0049
	(0.0008)	(0.0010)	(0.0008)	(0.0045)	(0.0043)	(0.0049)
Domestic		✓			✓	
Adjusted *DPAD*			✓			✓
Firm-years	86,949	39,202	86,949	51,368	21,758	51,368
Firms	12,069	4,475	12,069	9,026	3,386	9,026
Dependent variable mean	0.019	0.022	0.019	0.122	0.116	0.130
Implied $\mathcal{E}_{DPAD}$	10.11	5.19	20.185	0.182	0.431	8.575

Notes: This table reports estimates of the effect of the *DPAD* on corporate behavior. Following estimating equation (5), all columns display the *DPAD* coefficient from a regression of the outcome on *DPAD*, year and firm fixed effects, as well as *BONUS*, *ETI*, *Cash Flow*, *Marginal Q*, and *HP Index* controls. The second specifications in each panel limits the analysis to firms with no reported foreign income. The third specification in each panel replaces *DPAD* with *Adjusted DPAD*. Implied $\mathcal{E}_{DPAD}$ is the elasticity of the outcome variable with respect to one-minus-the-top-statutory-corporate-income-tax-rate on domestic manufacturing income. Implied $\mathcal{E}_{DPAD}$ is calculated as the estimated *DPAD* effect divided by the mean of the outcome prior to *DPAD* implementation, divided by the percentage change in one-minus-the-top-statutory-corporate-income-tax-rate on domestic manufacturing income (assuming the DPAD decreased the top rate from 35 percent to 31.85 percent). Standard errors are presented in parentheses and are clustered at the industry level.

During the sample period, the average firm invested \$0.47 per dollar of installed capital prior to DPAD implementation, thus a 1 percentage point increase in *DPAD* increases investment by 10.06 percent. At a 35 percent corporate income tax rate, the same 1 percentage point increase in the *DPAD* increases 1 minus the effective tax rate from 0.65 to 0.66 or by 1.538 percent. Thus, the elasticity of investment with respect to the net of tax rate is 6.538 ($= 10.06/1.538$).[13]

[13] The *DPAD* coefficient represents the effect of the DPAD when *BONUS* depreciation is set to zero. Because *BONUS* is a function of *DPAD*, the effect of the *DPAD* at varying *BONUS* levels depends on the *BONUS* coefficient. Online Appendix C presents empirical estimates of the effect of the DPAD at varying levels of DPAD. In sum, the

Specification (1b) results show *Debt* decreases by 5.31 percent of total assets in response to a 1 percentage point increase in *DPAD*. The corresponding elasticity is equal to −5.832. Together, the (1b) and (2b) results indicate that firms increase investment in response to the policy and finance that investment with retained earnings or new equity. These results are consistent with Hypotheses 1 and 2 and suggest that the DPAD, and corporate tax rate cuts more generally, are effective tools to stimulate investment and decrease leverage. That both hypotheses are supported in the data provides extra confirmation that the estimated effects are due to the policy. As the simple model suggests, there is no incentive to respond to the DPAD with debt financed investment. Thus, if Hypothesis 1 was supported but 2 was rejected, there would be some concern that the empirical design is invalid.[14]

Baseline estimates suggest the DPAD also increases *Payouts* but does not have an effect on *Taxable Income*. Specification (1c) results imply that a 1 percentage point increase in the *DPAD* raises payouts by 0.3 percent of lagged revenue. This relatively small but statistically significant effect may be due to depressed *Payouts* by manufacturing firms in 2005–2007 but increased *Payouts* in years 2008–2010, as suggested by Figure 2, panel C.

Baseline estimates also show that bonus depreciation and the ETI affect investment but do not impact firms' financial structure, payouts, or taxable income. From Specification (1a), a 1 percentage point decrease in the present value cost of investment due to bonus depreciation is approximately 61 percent as effective at stimulating investment relative to the 1 percentage point reduction in the corporate income tax rate due to *DPAD*. On the other hand, a 1 percentage point reduction in corporate taxes due to *ETI* is approximately 18 percent more effective than a cut due to *DPAD*. Here, *t*-tests cannot reject that *DPAD* and *BONUS* coefficients ($p = 0.3918$) and that *DPAD* and *ETI* coefficients are equal ($p = 0.7014$). Further discussion of the relative costs and benefits of *BONUS* and *DPAD* on investment are reserved for Section VIII. Section VIIIA compares baseline estimates to prior work.

Specifications (2a)–(2d) limit the analysis to firms that report no foreign pretax income during the years 2006–2012. *Investment*, *Debt*, and *Taxable Income* results remain stable, but *Payout* results are smaller and no longer statistically significant. These changes are consistent with some portion of estimated payout response to *DPAD* resulting from the 2004 tax holiday on repatriated earnings. Although the payout response differs between full sample and domestic estimates, the *Investment* and *Debt* responses are larger, suggesting that the 2004 repatriation is not responsible for the estimated response of these variables to *DPAD*.

Specifications (3a)–(3d) revert to the full sample but now use the *Adjusted DPAD* variable. In response to *Adjusted DPAD*, *Investment* increases by 47.3 percent more and *Debt* decreases by 35.8 percent more than in Specifications (1a) and (1b). *Payouts* are more than twice as responsive to *Adjusted DPAD* and *Taxable Income*

DPAD is more than 90 percent as effective as baseline estimates suggest even when *BONUS* is set to 100 percent and investment can be immediately expensed.

[14] Online Appendix G shows that this debt ratio response was driven by an increase in equity issuance across all firms and by an increase in retained earnings by firms with positive pretax income.

increases by 0.0172 or by 13 percent per percentage point reduction in the corporate tax rate. To interpret these results, consider that the difference between the two *DPAD* variables is that the *Adjusted DPAD* considers firms with no taxable income untreated by the *DPAD,* even if they belong to a high *QPAI Percent* industry. As a result, firms that are treated in Specifications (3a)–(3d) are both incentivized to make more investments financed by new equity or retained earnings and are receiving higher after-tax income with which to make investment or increase payouts. This *Adjusted DPAD* analysis suggests that the income effects of the policy are substantial across all four margins of response, but, as one might expect, are most important in determining *Payout* and *Taxable Income* outcomes.

Overall, the baseline empirical results as well as those limited to domestic firms and those using the *adjusted DPAD* variable show that the DPAD, and corporate tax rate cuts more generally, have a large impact on the investment and financing activities of firms. Considering that once fully phased in, the DPAD decreased the effective tax rate of the average firm in the sample by 1.43 percentage points, the baseline estimates suggest that the DPAD increased *Investment* by 14.4 percent, decreased *Debt* by 17.3 percent and increased *Payouts* by 20.6 percent. In the following section, these striking results are subjected to scrutiny via a series of robustness tests, placebo tests, and checks on the internal validity of the empirical approach.

VI. Robustness, Placebo Tests, and Internal Validity Confirmation

A. *Robustness Tests*

Several robustness checks are included in online Appendix E. First, Specifications (1a)–(1d) of online Appendix Table A2 reports estimates of *DPAD* when *BONUS* and *ETI* controls are not included in the regression. Excluding *BONUS* and *ETI* downward biases the *Investment* result but does not affect the *Debt* or *Payouts* responses.

Second, in Specifications (2a)–(2d) of online Appendix Table A2, *DPAD* as measured in 2006, is used as an instrument for *DPAD* in subsequent years in a two-stage least-squares regression framework.[15] This specification eliminates the potential endogeneity of the *DPAD* treatment to prior changes in investment behavior. While the *Investment* and *Debt* responses are stable, the *Payouts* response is smaller and no longer statistically significant suggesting that, consistent with the visual evidence presented in panel C of Figure 2, there may have been a more complex dynamic *Payouts* response predicated on increasing QPAI over time.

Third, Specification (3a)–(3d) of online Appendix Table A2 introduce industry and asset-class linear time trends. With the trends included, the effect of *DPAD* on *Investment* increases by about 62.5 percent, the effect on *Payouts* decreases by about 38 percent, and the effect on *Debt* halves while the effect on *Taxable Income* remains statistically indistinguishable from 0. The changes in estimated magnitudes suggest that secular trends in stimuli such as investment good prices may affect firm

[15] I use 2006 *DPAD* instead of 2005 because there was some policy uncertainty when the *DPAD* was first rolled out in mid-2005.

behaviors differently across manufacturing and non-manufacturing industries and asset classes, but that these secular trends are not responsible for majority of the estimated effects of the DPAD.[16]

Fourth, Specifications (1a)–(1d) of online Appendix Table A3 limits the analysis to firms with December fiscal year ends. Because these firms end their fiscal year on December 31, their financial statement data lines up exactly with the implementation of and increases in the *DPAD*. Across all four panels, the point estimates and standard errors are unchanged despite a significant decrease in sample size. Thus, as expected, when (slightly) mismatched data is excluded, the precision of estimates increases. Fifth, in Specifications (2a)–(2d) of the same table, the analysis is limited to a balanced panel of firms during the years 2000–2012. Point estimates are similar for all four outcomes suggesting that the changing composition of the sample does not significantly affect estimated response magnitudes. Sixth and finally, Specifications (3a)–(3d) of online Appendix Table A3 uses the *DPAD* variable prior to asset-class weighting. Point estimates are statistically significant but considerably smaller, suggesting that, as expected, there is less measurement error in the treatment when it is scaled by asset-class multipliers.

B. *Block Permutation Tests*

To provide a comprehensive series of placebo tests and simultaneously allay concerns that the difference-in-differences estimation strategy may overreject the null hypothesis when error terms are serially correlated (Bertrand, Duflo, and Mullainathan 2004), I implement a block permutation test similar to those used in Chetty, Looney, and Kroft (2009) and Zidar (2015). To begin the procedure, I un-weight the *DPAD* treatment using the asset-class multipliers described in Section III. Each permutation is performed by randomly selecting a placebo implementation year between 2000 and 2005. Then, each industry is randomly assigned—without replacement—another industry's actual unweighted *DPAD* treatment from the years 2005–2012 to begin in the placebo implementation year. Once the placebo *DPAD* has been assigned, I re-weight using the asset-class multipliers. Thus, while the implementation year is chosen at random and the unweighted *DPAD* treatments are block permuted, asset class weights are left unchanged. This biases the results of the permutation test *towards* the actual effect sizes. The baseline regression, Specification (1) from Table 4, is then re-estimated for each of the four primary outcomes of interest using the placebo treatment. Point estimates are recorded and the procedure is repeated another 1,999 times to produce the plots in Figure 3.

Each of the four panels in Figure 3 displays an empirical CDF of the 2,000 placebo coefficients. No parametric smoothing is applied; the CDF looks smooth because of the large number of points used to construct it. The vertical black line is the baseline effect size. For *Investment*, 6 out of the 2,000 placebo coefficients are larger than the estimated effect suggesting a nonparametric p-value of 0.003. For

[16] I prefer the baseline results to these estimates because as the DPAD rate increased three times over a five-year period, responses within industry-size cells should have an approximately linear shape during a large portion of the sample period.

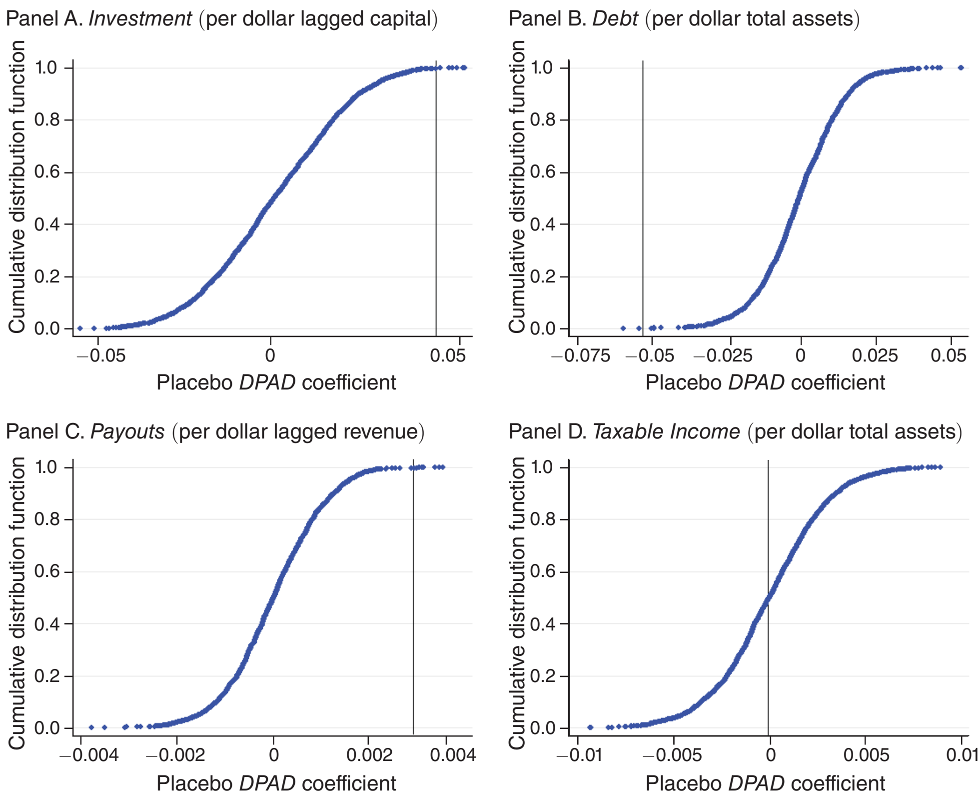

Figure 3. Permutation Tests

Notes: Panels A–D plot the empirical distributions of placebo effects for each of the four primary outcome variables of interest. Each cumulative distribution function is constructed by regressing the outcome variable on 2,000 randomly assigned *DPAD* treatments and controls as in specifications (1a)–(1d) from Table 4. To create the random treatments, first a placebo year from the years 2000–2005 is chosen. Then each industry is assigned another industry's actual *DPAD* treatment to begin in the placebo year. The treatment is then scaled using asset class weights as discussed in Section III. No parametric smoothing is applied: the cumulative distribution function appears smooth because of the large number of points used to construct it. The vertical lines show the treatment effect estimate reported in Table 4. In panel A, 6 out of the 2,000 (0.3 percent) of placebo coefficients are larger than the estimated effect. In panel B, 2 out of the 2,000 (0.1 percent) of placebo coefficients are smaller than the estimated effect. In panel C, 8 out of the 2,000 (0.4 percent) of placebo coefficients are larger than the estimated effect. In panel D, 980 out of the 2,000 (49.0 percent) of placebo coefficients are smaller than the estimated effect.

Debt, 2 out of the 2,000 placebos are smaller suggesting $p = 0.001$. For *Payouts*, only 8 out of the 2,000 were larger, suggesting $p = 0.004$. The nonparametric test clearly shows that the effect of the *DPAD* on *Taxable Income* is statistically insignificant; 980 coefficients were smaller than the estimated effects while 1,023 were larger. In sum, the nonparametric p-values are very similar to those in the baseline regressions suggesting that (i) clustering at the industry-level nicely addresses serial correlation concerns and (ii) that random differences in industry-level time-trends are unlikely to generate the estimated *DPAD* effects.[17]

[17] Online Appendix A4 provides a more specific placebo test addressing whether industry-level differences in responses to the business cycle generate the estimated *DPAD* effects.

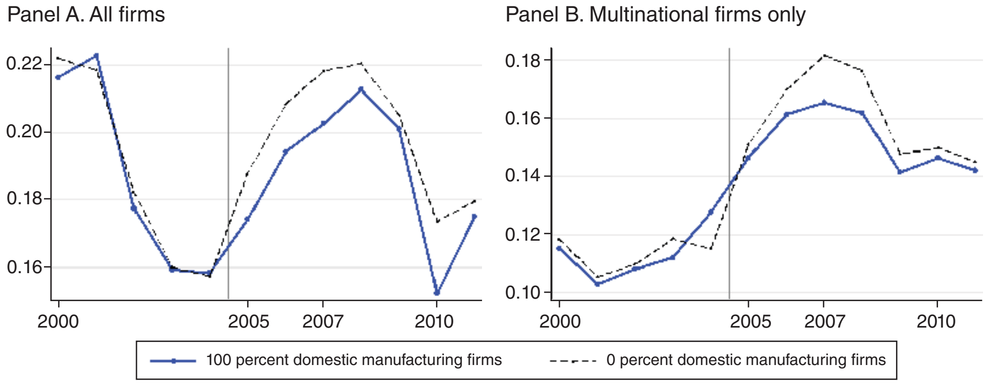

Figure 4. Effect of Tax Policies on Cash ETRs

Notes: This figure reproduces the semi-parametric difference-in-differences tests from Figure 2, but replaces the dependent variable with *Cash ETR*. Panel A focuses on all firms with positive taxable income. Panel B limits the analysis to multinational firms—those reporting pretax foreign income in years 2006–2012.

C. *The Effect of DPAD, BONUS, and ETI on Effective Tax Rates*

If the *DPAD* treatment is precisely measured, then a one unit increase in the treatment should cause a firm's effective tax rate (that is, their average tax rate) to decrease by 1 percentage point. The same is true of *ETI* but not *BONUS* as accelerated depreciation policies decrease the effective tax rate on investment, not income. I test whether *DPAD* and *ETI* decrease effective tax rates empirically by using *Cash ETR* as the outcome and repeating the baseline difference-in-differences analysis. Figure 4 presents the visual implementation and Table 5 presents the empirical results. Panel B and Specification (2) limit the analysis to multinational firms to address *DPAD* measurement concerns when firms operate internationally.

Panels A and B of Figure 4 show that *Cash ETR*s moved together for 100 percent domestic manufacturing and 0 percent firms prior to 2005. After 2005, the tax rate for 100 percent domestic manufacturing firms decreases relative to the same rates in the 0 percent firms confirming that *DPAD* affects effective tax rates in the expected direction.

Specification (1) shows that a one unit increase in *DPAD* decreases a firm's *Cash ETR* by 1.11 percentage points while a one unit decrease in *ETI* decreases a firm's rate by 0.91 percentage points. In Specification (2), point estimates suggest a 0.95 percentage point decrease due to *DPAD* and a 1.00 percentage point decrease due to *ETI*.

If the treatments were measured perfectly, then the *DPAD* and *ETI* coefficients would equal −0.01. The corresponding *p*-values from *t*-tests comparing each coefficient to −0.01 show that none of the estimated *DPAD* and *ETI* responses are statistically different from a 1 percentage point decrease. These results confirm that the *DPAD* and *ETI* variables are precisely measured and reinforce the internal validity of the analysis.

Table 5—The Empirical Effect of the *DPAD* on Tax Rates

Specification	(1) All firms		(2) Multinationals only	
	Cash ETR	p-value ($\beta = 1$)	Cash ETR	p-value ($\beta = 1$)
DPAD	−0.0111	0.7376	−0.0095	0.9088
	(0.0034)		(0.0048)	
BONUS	0.0041	0.0000	0.0075	0.0000
	(0.0026)		(0.0038)	
ETI	−0.0091	0.8341	−0.0100	0.9997
	(0.0042)		(0.0053)	
Firms	9,026		5,640	
Firm × years	51,368		29,610	

Notes: This table reports estimates of the effect of the DPAD on cash effective tax rates. All regressions following from estimating equation (5) and regress *Cash ETR* on *DPAD*, *BONUS*, *ETI*, firm and year fixed effects, as well as controls for *Cash Flow*, *Marginal Q*, the *HP Index*. Specification (1) focuses on all firms with positive taxable income. Specification (2) limits the analysis to multinational firms—those reporting pretax foreign income in years 2006–2012. Standard errors are presented in parentheses and are clustered at the industry level. p-values from t-tests comparing each coefficient to -0.01 are presented alongside the estimates.

D. *The Effect of Contemporaneous Tax Policies on DPAD Estimates*

Online Appendix I demonstrates that industries that are domestic manufacturing intensive are those with the shortest asset lives, meaning *DPAD* and *BONUS* are negatively correlated. The correlation between the *DPAD* and *BONUS* presents a threat to the empirical identification strategy because in 2005, just as the DPAD was implemented, bonus was turned off. As bonus helped firms that are not manufacturers, the elimination of bonus could have buoyed the investment behaviors of manufacturing firms relative to non-manufacturing firms generating the DPAD effects. On the flip side, the fact that bonus helped non-manufacturing firms during the years 2008–2012 suggests that bonus could be depressing the DPAD effects.

Online Appendix I also demonstrates that *DPAD* and *ETI* are positively correlated; domestic manufacturing intensive industries are also, on average, export intensive. Like bonus, the ETI was repealed at the end of 2004, as the DPAD was implemented. In contrast to potential effects of the 2004 bonus elimination, if the ETI affected corporate behaviors in a way similar to the DPAD, meaning its repeal would mitigate the estimated DPAD impact.

I now present six pieces of evidence indicating that, even in light of the correlations discussed above, the ETI and/or bonus are not responsible for the estimated DPAD effects:

(i) As previously noted, the visual evidence presented in Figure 2 shows no divergence in any of the four outcome variable pre-trends between manufacturing and non-manufacturing firms during the years 2001–2003, those years when bonus was enacted at 30 percent and scaled to 50 percent.

(ii) Baseline estimates of the effect of the *DPAD* on corporate outcomes remain unchanged or, in the case of *Investment*, *increase* when *BONUS* and *ETI* variables are added to the regressions as controls. This indicates that, as discussed above, bonus and ETI are more likely to undermine rather than enhance the estimated *DPAD* effects.

(iii) The debt ratio results cannot be explained by bonus. There is no theoretical reason that firms would alter their financing strategy in response to bonus. But this study finds that firms decrease their debt ratio via new equity issuance (reported in online Appendix G) in response to the DPAD.

(iv) Point estimates are stable when the analysis time frame is limited to the years 2007–2012 (online Appendix Table A7 Specifications (1a)–(1d)). As this time frame begins in 2007, it eliminates the possibility the *DPAD* estimates are confounded by the 2004 repeal of ETI or bonus. During this time frame, *DPAD* estimates are largely unchanged. If anything, the *Investment* and *Payout* effects are larger.

(v) When the analysis is limited to years 1996–2007 to eliminate the effects of the second episode of bonus (online Appendix A7 Specifications (2a)–(2d)). Point estimates for *Investment* and *Debt* continue to suggest large *DPAD* effects (the *Investment* effect is no longer significant likely due to the smaller sample). The *Payouts* effect is much smaller. This change in estimates could be due to the presence of bonus in 2008, but, on the contrary, Zwick and Mahon (2017) shows that bonus, unlike the DPAD seems to decrease payout behaviors.

(vi) When the analysis is limited to firms in industries that are least affected by bonus depreciation (online Appendix Table A7 Specifications (3a)–(3d)), the effects of *DPAD* among this non-bonus sample are similar to the baseline effects.

Based on these six pieces of evidence, I conclude that bonus depreciation and the ETI do not affect the estimated impact of the DPAD on corporate behavior in any substantial way.

VII. Heterogeneous Reponses to the *DPAD*

Heterogeneous responses to the *DPAD* are explored in Table 6. The coefficient in each cell is the *DPAD* interaction coefficient from a regression of the outcome on *DPAD*, *DPAD* interacted with an heterogeneity indicator, year and firm fixed effects, as well as *BONUS*, *ETI*, *Cash Flow*, *Marginal Q*, and *HP Index* controls. In the first four rows, the heterogeneity indicator is equal to 1 if the firm is in the top quartile of the trait of interest and equal to 0 if the firm is in the bottom quartile. The traits of interest in these rows are the Blouin, Core, and Guay (2010) simulated *Marginal Tax Rates*, *Firm Revenue*, *Firm Age*, and *Cash Flow*. Here *Revenue* and *Age* proxy for firm size and access to financing (Hadlock and Pierce 2010). Among each of these groups, the top quartile is predicted to be more responsive to *DPAD*. In the bottom row, the heterogeneity indicator is equal to 1 if the firm has foreign operations and

TABLE 6—HETEROGENEITY OF RESPONSE

Dependent variable	Investment (1)	Debt (2)	Payouts (3)	Taxable income (4)
DPAD				
× High *Marginal Tax Rate*	0.0998	−0.1182	0.0056	0.1561
	(0.0438)	(0.0403)	(0.0022)	(0.0100)
× Lag *Revenue*	0.0980	−0.1379	0.0045	0.1571
	(0.0497)	(0.0317)	(0.0020)	(0.0128)
× High *Firm Age*	0.3390	−0.1327	0.0065	0.2197
	(0.0361)	(0.0140)	(0.0034)	(0.0166)
× High *Cash Flow*	0.0260	−0.0792	0.0086	0.1710
	(0.0261)	(0.0244)	(0.0019)	(0.0084)
× Repatriate	0.0927	−0.0369	0.0041	−0.0038
	(0.0128)	(0.0147)	(0.0021)	(0.0041)

Notes: Each cell of Table 6 reports an estimate of the *DPAD* interaction coefficient from a regression of the outcome on *DPAD*, *DPAD* interacted with an heterogeneity indicator, year and firm fixed effects, as well as *BONUS*, *ETI*, *Cash Flow*, *Marginal Q*, and *HP Index* controls. Heterogeneity indicators vary across rows and are noted in the left-most column. High *Marginal Tax Rate* is the Row 1 heterogeneity indicator and is equal to 1 if a firm is in the top quartile of *Marginal Tax Rate* and 0 if it is in the bottom quartile. Lag *Revenue* is equal to 1 if a firm is in the top quartile of lagged *Revenue* and 0 if it is in the bottom quartile. High *Firm Age* is equal to 1 if a firm is in the top quartile of age and 0 if it is in the bottom quartile. High *Cash Flow* is equal to 1 if a firm is in the top quartile of cash flow and 0 if it is in the bottom quartile. *Repatriate* is a simple indicator for whether the firm chose to repatriate dividends in response to the 2004 repatriation tax holiday (derived from 2004 Repatriator). Standard errors are presented in parentheses and are clustered at the industry level.

repatriated funds in response to the 2004 tax holiday, and is equal to 0 if the firm has foreign operations and did not repatriate.

The first four rows of Table 6 indicate that the effects of the DPAD are concentrated among older, larger, and more liquid firms that face high marginal tax rates and should be more responsive to the DPAD. The only exception is that firms with extra cash flows are not more responsive on the investment margin. The *Marginal Tax Rate* result is particularly interesting as the simple model predicted that *Investment* and *Debt* responses would be concentrated among firms with high *Marginal Tax Rates*. This result further supports Hypotheses 1 and 2.

A second interesting result is that *Taxable Income*, which in the full sample is unresponsive to *DPAD*, is much more responsive to the policy when firms are older, larger, more liquid, and face higher marginal tax rates. The magnitudes indicate that these firms increase their *Taxable Income* in response to *DPAD* by between 15 and 22 percent of lagged assets more than firms that are younger, smaller, less liquid, and face lower marginal tax rates. Thus, although for the entire sample, the elasticity of *Taxable Income* with respect to the effective corporate income tax rate is 0, at least for some groups, the elasticity is high.

Turning to the last row, repatriating firms are more responsive in terms of *Investing*, *Debt*, and *Payouts* but did not alter total income. Consistent with Blouin, Krull, and Schwab (2014), these findings indicate that the DPAD was successful at inducing repatriating firms to make domestic investments with repatriated funds and not just distribute them to shareholders. Importantly, this result does not contrast Dharmapala, Foley, and Forbes (2011), which found no average investment effect for repatriating firms. Although the average firm may use the repatriated funds to pay dividends instead of invest, the results here suggest that what little investment response there might have been was concentrated amongst firms in manufacturing intensive industries that most benefited from the DPAD.

VIII. Discussion

A. *Comparison of Results to Previous Work*

Investment Response.—The closest estimates of the impact of the DPAD on investment come from Lester (2015), which finds that DPAD reporting firms increased domestic investment by 3.19 cents per dollar of installed capital for each 1 percentage point DPAD reduction they receive. I find that domestic investment increased by 5.98 cents per dollar of installed capital (Specification (2a) from Table 4). Both studies show a significant domestic investment response to the policy. The difference in magnitudes is most likely attributable to the Lester methodology, which compares DPAD reporting firms to firms that did not report the DPAD. If DPAD non-reporting firms benefited from the policy but did not report it on their Form 10-K, the Lester (2015) methodology would understate the impact of the policy.

Zwick and Mahon (2017) provides the most recent estimates of the effect of bonus on investment. The Zwick and Mahon (2017) elasticity of *Investment* with respect to the net of tax rate ($\mathcal{E}_{BONUS}$) is 3.96, which is remarkably close to the 3.977 value of $\mathcal{E}_{BONUS}$ derived from Specification (1a) in Table 4. The Zwick and Mahon (2017) estimated investment response among large firms is in the range of Hassett and Hubbard (2002) and similar to Desai and Goolsbee (2004), Edgerton (2010), and Ohrn (2017). Thus, the elasticity that I find is similar, as well.

Financing Response.—De Mooij (2011) performs a meta-analysis of results from papers that investigate the effect of corporate tax rates on debt ratios and finds that a 1 percentage point higher tax rate typically increases the debt-asset ratio by between 0.17 and 0.28. The *DPAD* estimates are comparatively low, suggesting a 1 percentage point increase in effective tax rates increases the debt-asset ratio by 0.0531 for all firms and by 0.0756 for US domestic firms. One explanation for the discrepancy is that most studies that estimate tax induced debt bias rely on cross-country variation or variation in simulated MTRs based on past profitability. These measures may be endogenous to debt choice at the macro or micro level. Alternatively, debt ratios may take time to adjust and the *DPAD* estimates may represent only short-run responses.

Payouts Response.—Yagan (2015) finds the elasticity of *Payouts* with respect to the cost of equity is between 3.2 and 6.3. where the cost of equity is defined as

$$\frac{r}{(1-\tau_c)[p(1-\tau_d)+(1-p)(1-\tau_{cg})]}.$$

The equivalent *DPAD Payout* elasticity with respect to the cost of equity finance is between 4.6 and 10 and in a similar range to the Yagan (2015) estimates.

Interestingly, traditional view investment models, in which a firm's marginal source of finance is new equity, suggest that firms (i) should never issue equity and payout earnings simultaneously and (ii) should not increase payouts in response to decreases in the cost of equity capital; firms do both in response to the DPAD. However, based on estimates and discussion presented in online Appendix G, the equity response is much larger than the payout response and, on net, firms seem to mostly follow the predictions of neoclassical investment theory in response to the DPAD.

Taxable Income Response.—Devereux, Liu, and Loretz (2014) and Patel, Seegert, and Smith (2016) find that taxable income is responsive to kinks and notches in the tax schedule, even in the short run. Gruber and Rauh (2007) find that taxable income is responsive to long run variation in user costs. In contrast, I find that taxable income is not responsive to the *DPAD* for the average firm. The discrepancy again indicates that the *DPAD* estimates may represent only short-run responses.

B. *Broaden the Base or Cut the Rate?*

Because this study simultaneously estimates the effects of the DPAD and bonus depreciation, a comparison of the two corporate stimulus options can be accomplished with internal results entirely. While firms respond to the DPAD by increasing *Investment* and *Payouts* and decreasing *Debt*, the same sample of firms responds to *BONUS* only through their investment decisions. The magnitude of the *Investment* response to *BONUS* is smaller. A 1 percentage point decrease in the statutory corporate tax rate via the DPAD increases investment by 4.73 percent of installed capital ($\mathcal{E}_{DPAD} = 6.538$), whereas a 1 percentage point decrease in tax-adjusted investment costs via bonus increases investment by 2.90 percent ($\mathcal{E}_{BONUS} = 3.977$). These estimates suggest a one percentage point income tax rate reduction via the DPAD is 64 percent more effective at stimulating investment than a 1 percentage point decrease in investment costs via bonus.

Critically, the revenue the government must sacrifice to achieve each of these 1 percentage point reductions is not equal. The per firm cost of decreasing the effective corporate income tax rate by 1 percentage point is $0.01 \times$ average reported taxable income per firm. Averaged over the last 10 years of the sample (2003–2012), total positive taxable income divided by the total number of COMPUSTAT firms was \$577.3 million. Therefore, a 1 percentage point decrease in the effective tax rate costs the government approximately \$5.77 million per firm per year in uncollected tax revenue.

Under bonus depreciation, businesses can deduct investment costs from taxable income sooner, decreasing the *present value* after-tax cost of an investment. From the government's perspective, tax revenue is collected later, decreasing the *present value* of tax revenues. If businesses and the government have the same discount rate, then bonus depreciation decreases the present value of government revenues by the exact same dollar amount that it decreases the present value cost of investment. Therefore, the revenue costs of a one percentage point decrease in investment costs via bonus is equal to $0.01 \times$ the level of investment. Average investment calculated the same way as taxable income above is equal to \$367.9 million and, as a result, a one percentage point decrease in investment costs via bonus will cost the United States government \$3.67 million per firm per year.

These calculations suggest that a 1 percentage point reduction in corporate tax rates is 59 percent more costly than a one percentage point reduction in investment costs via accelerated deprecation. Based on these relative costs and benefits, spending \$1 to decrease the corporate income tax rate is only 5 percent more effective at stimulating investment than spending \$1 to decrease investment costs via accelerated deprecation. That the dollar-for-dollar comparison between the policies is so close challenges the conventional wisdom that revenue neutral tax reforms that cut the rate and broaden the base will have a large stimulative effect on business investment (at least among listed US corporations that do the lion's share of investment).

A few points related to this dual cost-benefit analysis are important. The first is that in the calculation above, both the government and firms are assumed to discount future earnings at a 7 percent rate because this is the rate used to quantify the *BONUS* variable. To the extent that the government is more patient than publicly traded corporations or corporations are less patient than the government, the cost of a 1 percentage point reduction in investment costs via bonus is even less costly relative to a 1 percentage point reduction in the effective tax rate because the government cares relatively less about receiving revenue in the future as opposed to in the present.

Second, as mentioned previously, the *DPAD* and *BONUS* point estimates used above are not statistically different from each other. If a 1 percentage point decrease in the corporate rate and a 1 percentage point decrease in investment costs via accelerated depreciation induce the same investment response, then accelerated depreciation, which is less costly from the perspective of the government, is a better dollar-for-dollar policy. This point and the previous one suggest that a more appropriate interpretation of the conclusion presented in the preceding paragraph is that rate lowering, base broadening, revenue neutral reforms will increase business investment by *at most* 5 percent and may even decrease investment.

Third, the estimates in this paper suggest that both types of corporate tax reform are very successful at simulating investment. One dollar spent either lowering the corporate income tax rate or accelerating depreciation generates approximately \$6 in additional capital expenditure. While it is unclear that swapping one policy for the other will affect investment, unilaterally increasing either does. This conclusion means Destination Based Cash Flow Tax-type reforms which often include provisions to both lower rates and allow firms to expense new investment for tax purposes would have a significant positive effect on business investment.

Finally, because the Congressional Budget Office (CBO) must project the revenue baseline using current law and over a ten-year window, if accelerated depreciation is implemented through temporary one-year provisions and "extenders" as has been the case over the past 15 years, the tax break does not *seem* to have a significant effect on government revenues, at least from the point of view of Congress. On the other hand, a permanent rate reduction evaluated using the same methodology would *seem* to have significant revenue implications (Gravelle 2014; Altshuler 2012). Therefore, the *perceived* cost-benefit of bonus may be higher than that of a corporate rate reduction when in reality they are the same.

IX. Conclusion

This study uses a quasi-experimental research design to estimate the investment and financial policy responses to the DPAP. Because the DPAD creates plausibly exogenous variation in effective corporate income tax rates, the policy creates empirical variation, which can be leveraged to address an understudied question of first-order importance: How do corporate income tax rates affect corporate behavior and the economy at large?

I find that corporations respond strongly to the DPAD, and corporate income tax rate cuts more generally, by increasing investment and payouts and decreasing debt usage. The average firm does not report more taxable income per dollar of asset, suggesting that any increases in revenue generated by corporate tax rate reductions are the product of real effects such as investment, but not decreased avoidance activity. As expected, the responses to the policy are driven by older, larger, more liquid firms that face higher marginal tax rates.

These results are especially important as momentum for corporate tax reform builds. This study finds that among large corporations, revenue neutral reforms that lower rates and broaden the base are not the panacea for corporate growth that proponents have claimed. In fact, estimates suggest using the revenue generated by eliminating accelerated depreciation to finance corporate rate cuts has only a modest impact on corporate investment. In contrast to this investment effect neutrality, the two types of investment stimulus policies are very different in other ways. Firms increase payouts and issue equity in response to rate cuts. Firms that respond to accelerated depreciation are, in contrast, less likely to payout earnings and choose to finance expansions with debt. Whereas larger firms with more cash flow respond to corporate rate reductions, smaller more financially constrained firms are more responsive to depreciation policies. As a result, lawmakers should choose to champion revenue-neutral reforms only under the conditions that (i) they seek to incentivize corporate payouts and equity financing and (ii) they prefer policies that benefit larger, more financially flush corporations. Ultimately, the only reforms that benefit all US businesses may necessarily decrease corporate tax revenues.

REFERENCES

Altshuler, Rosanne. 2012. "Testimony of Dr. Rosanne Altshuler Professor and Chair, Department of Economics, Rutgers University Before the Senate Finance Committee Hearing on Extenders and Tax Reform: Seeking Long-Term Solutions." https://www.finance.senate.gov/imo/media/doc/Altshuler%20Testimony%20SFC%20Tax%20Extenders1.pdf.

Auerbach, Alan J. 1979. "Wealth Maximization and the Cost of Capital." *Quarterly Journal of Economics* 93 (3): 433–46.

Auerbach, Alan J., and Joel Slemrod. 1997. "The Economic Effects of the Tax Reform Act of 1986." *Journal of Economic Literature* 35 (2): 589–632.

Autor, David H. 2003. "Outsourcing at Will: The Contribution of Unjust Dismissal Doctrine to the Growth of Employment Outsourcing." *Journal of Labor Economics* 21 (1): 1–42.
Baker, Malcolm, and Jeffrey Wurgler. 2002. "Market Timing and Capital Structure." *Journal of Finance* 57 (1): 1–32.
Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. 2004. "How Much Should We Trust Differences-In-Differences Estimates?" *Quarterly Journal of Economics* 119 (1): 249–75.
Blouin, Jennifer, John E. Core, and Wayne Guay. 2010. "Have the tax benefits of debt been overestimated?" *Journal of Financial Economics* 98 (2): 195–213.
Blouin, Jennifer L., Linda K. Krull, and Casey M. Schwab. 2014. "The Effect of the Domestic Production Activities Deduction on Corporate Payout Behavior." https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1092222.
Blouin, Jennifer L., Jana S. Raedy, and Douglas A. Shackelford. 2011. "Dividends, Share Repurchases, and Tax Clienteles: Evidence from the 2003 Reductions in Shareholder Taxes." *Accounting Review* 86 (3): 887–914.
Bradford, David F. 1981. "The incidence and allocation effects of a tax on corporate distributions." *Journal of Public Economics* 15 (1): 1–22.
Bradley, Sebastien J. 2013. "Investor Responses to Dividends Received Deductions: Rewarding Multinational Tax Avoidance?" https://www.researchgate.net/publication/271911020_Investor_Responses_to_Dividends_Received_Deductions_Rewarding_Multinational_Tax_Avoidance.
Cameron, A. Colin, and Douglas L. Miller. 2015. "A Practitioner's Guide to Cluster-Robust Inference." *Journal of Human Resources* 50 (2): 317–72.
Chetty, Raj, Adam Looney, and Kory Kroft. 2009. "Salience and Taxation: Theory and Evidence." *American Economic Review* 99 (4): 1145–77.
Chetty, Raj, and Emmanuel Saez. 2005. "Dividend Taxes and Corporate Behavior: Evidence from the 2003 Dividend Tax Cut." *Quarterly Journal of Economics* 120 (3): 791–833.
Compustat. 2016. Standard and Poor's. (accessed June 2016).
Cummins, Jason G., Kevin A. Hassett, and R. Glenn Hubbard. 1994. "A Reconsideration of Investment Behavior Using Tax Reforms as Natural Experiments." *Brookings Papers on Economic Activity* 24 (2): 1–74.
De Mooij, Ruud A. 2011. "The Tax Elasticity of Corporate Debt: A Synthesis of Size and Variations." http://www.imf.org/en/Publications/WP/Issues/2016/12/31/The-Tax-Elasticity-of-Corporate-Debt-A-Synthesis-of-Size-and-Variations-24816.
Desai, Mihir A., and Austan Goolsbee. 2004. "Investment, Overhang, and Tax Policy." *Brookings Papers on Economic Activity* 34 (2): 285–355.
Devereux, Michael P., Rachel Griffith, and Alexander Klemm. 2002. "Corporate Income Tax Reforms and International Tax Competition." *Economic Policy* 17 (35): 449–95.
Devereux, Michael P., Li Liu, and Simon Loretz. 2014. "The Elasticity of Corporate Taxable Income: New Evidence from UK Tax Records." *American Economic Journal: Economic Policy* 6 (2): 19–53.
Dharmapala, Dhammika, C. Fritz Foley, and Kristin J. Forbes. 2011. "Watch What I Do, Not What I Say: The Unintended Consequences of the Homeland Investment Act." *Journal of Finance* 66 (3): 753–87.
Djankov, Simeon, Tim Ganser, Caralee McLiesh, Rita Ramalho, and Andrei Shleifer. 2010. "The Effect of Corporate Taxes on Investment and Entrepreneurship." *American Economic Journal: Macroeconomics* 2 (3): 31–64.
Dyreng, Scott D., Michelle Hanlon, and Edward L. Maydew. 2010. "The Effects of Executives on Corporate Tax Avoidance." *Accounting Review* 85 (4): 1163–89.
Edgerton, Jesse. 2010. "Investment incentives and corporate tax asymmetries." *Journal of Public Economics* 94 (11–12): 936–52.
Edgerton, Jesse. 2013. "Four Facts about Dividend Payouts and the 2003 Tax Cut." *International Tax and Public Finance* 20 (5): 769–84.
Farre-Mensa, Joan, Roni Michaely, and Martin Schmalz. 2014. "Payout Policy." *Annual Review of Financial Economics* 6 (1): 75–134.
Feldstein, Martin S. 1970. "Corporate Taxation and Dividend Behaviour." *Review of Economic Studies* 37 (1): 57–72.
Goolsbee, Austan. 1998. "Investment Tax Incentives, Prices, and the Supply of Capital Goods." *Quarterly Journal of Economics* 113 (1): 121–48.
Graham, John R. 1996. "Debt and the Marginal Tax Rate." *Journal of Financial Economics* 41 (1): 41–73.
Gravelle, Jane G. 2014. *Bonus Depreciation: Economic and Budgetary Issues*. *Congressional Research Service.* Washington, DC, July.

Gruber, Jonathan, and Joshua Rauh. 2007. "How Elastic Is the Corporate Income Tax Base?" *Taxing Corporate Income in the 21st Century,* edited by Alan J. Auerbach, James R. Hines Jr., and Joel Slemrod, 140–63. Cambridge: Cambridge University Press.

Hadlock, Charles J., and Joshua R. Pierce. 2010. "New Evidence on Measuring Financial Constraints: Moving Beyond the KZ Index." *Review of Financial Studies* 23 (5): 1909–40.

Hall, Robert E., and Dale W. Jorgenson. 1967. "Tax Policy and Investment Behavior." *American Economic Review* 57 (3): 391–414.

Harberger, Arnold C. 1962. "The Incidence of the Corporation Income Tax." *Journal of Political Economy* 70 (3): 215–40.

Hassett, Kevin A., and R. Glenn Hubbard. 2002. "Tax Policy and Business Investment." In *Handbook of Public Economics*, Vol. 3, edited by Alan J. Auerbach and Martin Feldstein, 1293–1343. Amsterdam: North-Holland.

House, Christopher L., and Matthew D. Shapiro. 2008. "Temporary Investment Tax Incentives: Theory with Evidence from Bonus Depreciation." *American Economic Review* 98 (3): 737–68.

Kawano, Laura, and Joel Slemrod. 2016. "How do corporate tax bases change when corporate tax rates change? With implications for the tax rate elasticity of corporate tax revenues." *International Tax and Public Finance* 23 (3): 401–33.

King, Mervyn A. 1977. *Cambridge Studies in Applied Econometrics: Public Policy and the Corporation.* New York: Wiley.

Lester, Rebecca. 2015. "Made in the U.S.A.? A Study of Firm Responses to Domestic Production Incentives." https://www.gsb.stanford.edu/sites/gsb/files/working-paper-accounting-2014-lester.pdf.

Lester, Rebecca, and Ralph Rector. 2016. "Which Companies Use the Domestic Production Activities Deduction?" *Tax Notes* 152 (9): 1269–92.

MacKie-Mason, Jeffrey K. 1990. "Do Taxes Affect Corporate Financing Decisions?" *Journal of Finance* 45 (5): 1471–93.

Ohrn, Eric. 2018. "The Effect of Tax Incentives on US Manufacturing: Evidence from State Accelerated Depreciation Policies." Grinell College Working Paper.

Ohrn, Eric. 2018. "The Effect of Corporate Taxation on Investment and Financial Policy: Evidence from the DPAD: Dataset." *American Economic Journal: Economic Policy*. https://doi.org./10.1257/pol.20150378.

Patel, Elena, Nathan Seegert, and Matthew Grady Smith. 2016. "At a Loss: The Real and Reporting Elasticity of Corporate Taxable Income." Unpublished.

Poterba, James, and Lawrence Summers. 1985. "The Economics Effects of Dividend Taxation." In *Recent Advances in Corporate Finance*, edited by Edward I. Altman and Martin Subrahmanya, 227–84. Homewood, IL: Dow-Jones-Irwin Publishing.

Stickney, Clyde P., and Victor E. McGee. 1983. "Effective corporate tax rates: The effect of size, capital intensity, leverage, and other factors." *Journal of Accounting and Public Policy* 1 (2): 125–52.

Summers, Lawrence H. 1981. "Taxation and Corporate Investment: A q-Theory Approach." *Brookings Papers on Economic Activity* 11 (1): 67–140.

Yagan, Danny. 2015. "Capital Tax Reform and the Real Economy: The Effects of the 2003 Dividend Tax Cut." *American Economic Review* 105 (12): 3531–63.

Zidar, Owen M. 2015. "Tax Cuts For Whom? Heterogeneous Effects of Income Tax Changes on Growth and Employment." National Bureau of Economic Research (NBER) Working Paper 21035.

Zwick, Eric, and James Mahon. 2017. "Tax Policy and Heterogeneous Investment Behavior." *American Economic Review* 107 (1): 217–48.