ONLINE APPENDIX

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

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Appendix A Accelerated Depreciation Model Extension

Consider an extension to the Section II model in which investments are depreciated at an accelerated rate for tax purposes. As in the original model, portion δ of the investment, I, is used up in year 1 production and may not be salvaged in year 2. Portion z of the investment (as opposed to δ in the original model) may be depreciated for tax purposes. The representative firm's maximization problem is now written as

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

where zI is deducted from the firm's taxable income which are subject to the DPAD adjusted tax rate $\tau_c(1-d)$. The firm's first order conditions with respect to its three potential sources or finance can now be written as

$$\begin{aligned}
\Pi'(G) &= \frac{r}{1-\tau_c(1-d)} + \frac{\delta - \tau_c(1-d)z}{1-\tau_c(1-d)}, \\
\Pi'(E) &= \frac{r}{(1-\tau_d)(1-\tau_c(1-d))} + \frac{\delta - \tau_c(1-d)z}{1-\tau_c(1-d)}, \text{ and} \\
\Pi'(B) &= c + \frac{\delta - \tau_c(1-d)z}{1-\tau_c(1-d)}.
\end{aligned}$$

For all three sources of finance, the partial derivative with respect to z is the same and indicates how investment financed through any means responds to accelerated depreciation policies;

$$\frac{\partial I}{\partial z} = \frac{\tau_c d}{1-\tau_c(1-d)}.$$

The partial derivative is positive meaning accelerated depreciation stimulates investment. In contrast, the second partial derivative with respect to d is negative indicating that the effect of accelerated depreciation is undermined when the DPAD (and the corporate tax rate more generally) is increased.[1] The concernis that this interaction may lead the DPAD to depress investment and invalidate the empirical hypotheses presented in Section II.

To address this, first consider that for internally generated funds and for new equity issuances the effect of the DPAD on the tax adjusted return to investment swamps the effect of accelerated depreciation benefits so $\partial G/\partial d > 0$ and $\partial E/\partial d > 0$ as long as $r > (z-\delta)$. As $z-\delta$ is at most 3.6 percent during the sample period and r is usually considered by firms to be around 10 percent, this condition likely holds. Interestingly, no matter the size of r relative to the benefits of accelerated depreciation, $\partial B/\partial d < 0$ meaning the DPAD disincentives debt financed investment. As in the simplified model, **Hypothesis 1** and **Hypothesis 2** follow from these partial derivatives.

[1] Appendix C explores this interaction empirically.

Appendix B Data and Descriptive Statistics

B.1 QPAI Percent and DPAD Treatment

I construct **QPAI Percent** using information provided by the IRS Statistics of Income (SOI) division. SOI Tax Stats Table 17 provides annual balance sheet, income statement, tax, and selected other items broken down by major industry based on a stratified sample of U.S corporate income tax returns (Form 1120) with positive net income. For each of approximately 75 IRS industries, Table 17 provides total Income Subject to Tax and total Domestic Production Activities Deduction.[2] 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.

Data from the SOI Corporate Source Book is then used to rescale this industry-varying QPAI Percent precursor according to firm size. The Corporate Source Book Section 3 Table 1 provides the same information as Table 17 but now the statistics are disaggregated into 12 asset-classes based on the size of a firm's total assets. For each asset class in years 2005–2012, ρ is computed. This asset-class ρ is then dividend by the average value of ρ across all corporations. This process generates 12 asset-class multipliers in each year that describe how much more or less firms in an asset-class make use of the DPAD than the average firm.[3] The industry-level QPAI precursor is then cross multiplied with these asset-class multipliers to generate the final QPAI Percent variable.[4] QPAI Percent varies across approximately 900 (75×12) 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 total assets. Figure 1 displays averages of QPAI Percent over time, across IRS sectors, and across firm-size groups.

Before moving on to describe how QPAI Percent is used in the empirical analysis, two points must be made with regard to its construction. The first is that QPAI Percent is based on the returns of corporations with positive net income but is assigned to all firms regardless of their net income status. The assumption underlying this correspondence is that QPAI Percent is the same

[2] There are several reasons the number of industry treatments changes over time. First, the IRS added several industries during the sample period. Second, some industry-year combinations are excluded from the analysis due to small samples in the SOI survey. SOI states that some of their industry estimates of taxable income and DPAD "should be used with caution because of the small number of sample returns". When the taxable income value or the DPAD value for an industry-size-year cell is described in this way, the firms in the cell are excluded from the analysis.

[3] The Corporate Source Book data is based on all types of corporate returns not just Form 1120 returns. This could introduce significant measurement error in the asset-class multipliers. However, most COMPUSTAT firms fall into the largest 4 asset-class categories and 85% of firms in these categories fill out 1120 forms (Section 4 of the Corporate Source Book). Thus, contamination of asset-class multipliers by non-1120 returns is likely small for the large majority of the analysis sample.

[4] Scaling the QPAI precursor by aggregate asset-class multipliers that do not vary at the industry level could introduce measurement error into the QPAI Percent variable. This concern is addressed in Appendix H.

for firms with and without positive net income within each industry-size cell. Put another way, if the negative net income firms later turn a profit, the percentage of income derived from qualified production activities will be the same as other firms in their industry-size cell. This assumption holds as long as production functions do not change after firms cross the zero net income threshold.

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 The DPAD variable and all other analysis 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 while the DPAD reduced the 75th 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, the deduction is limited by the firm's gross taxable income. As a result, 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.2 Other Tax Policy Variables Construction

B.2.1 ETI Construction

ETI is designed to captures the impact of the Extraterritorial Income Exclusion.[5] ETI varies by industry and over time and is constructed in a manner similar to DPAD. The ETI allows firms to deduct 15 percent of income from exports. For each industry, **Export Percent** is constructed as industry-level gross export receipts from USA Trade Online divided by industry-level total receipts from IRS tax data.[6,7] Export Percent is then multiplied by the statutory deduction rate (0.15)

[5] Control variables are not constructed to capture the effects of DISC and FSC rules as these policies applied to a very limited subset of firms. All results are robust to limiting the sample period to years 2000 and beyond, once the older DISC and FSC rules had been replaced with the ETI.

[6] USA Trade Online is a Census data product and is the official source for U.S. merchandise trade data.

[7] USA Trade Online does not record exporting data on every NAICS 3-digit industry. Data is not recorded for many industries because they produce zero or a negligible amount of products for export. Examples of industries

then the corporation income tax rate (35) to transform it into an industry-level measure of the percentage point reduction in the corporate income tax rate that firms in the industry receive via the ETI.

B.2.2 BONUS Construction

I follow Cummins et al. (1994), Desai and Goolsbee (2004), House and Shapiro (2008), Edgerton (2010), and Zwick and Mahon (2017) in constructing an industry-by-time measure to capture the effects of bonus depreciation. Under a tax regime without bonus depreciation, firms deduct a portion of the purchase price of new assets from their tax bill each year according to the Modified Accelerated Cost Recovery System (MACRS). The discounted value of MACRS depreciation deductions on a dollar of new capital expenditures equals

$$z_0 = a_0 + \sum_{t=1}^{T} \frac{a_i}{(1+r)^t}$$

where a_i is the allowable deduction per dollar of investment in year t, T is the life of the investment, and r is risk-adjusted rate the firm uses to discount future cash flows. MACRS determines the life of the investment and annual allowable deductions based on the type of investment. Investments such as computers are depreciated faster for tax purposes than mining and oilfield machinery. Prescribed depreciation schedules for all investment types are detailed in IRS Publication 946. Due to discounting, z_0 is larger and therefore more valuable for shorter-lived investments. In the most extreme case, firms "expense" investments and can deduct the full dollar immediately. The value of deduction is maximized under expensing; when z_0 is equal to 1.

Bonus depreciation allows firms to deduct an additional percent of investment costs, b, in the first year then depreciate the remaining $1-b$ according to the normal MACRS schedule. After incorporating bonus, the present value of depreciation deductions on one dollar of investment is equal to

$$z = b + (1-b)z_0.$$

The key concept behind the bonus depreciation identification strategy used here (and in previous studies) is that bonus increases the present value of longer-lived investments more than shorter-lived investments. The variable used in this analysis to capture the effect of the policy is

$$\mathbf{BONUS} = (z - z_0)\tau_c(1 - \rho d)$$

where ρ is the percent of income that qualifies for the DPAD and $\tau_c(1-\rho d)$ is the DPAD adjusted

that do not appear in the USA Trade Online data are transportation, healthcare, and real estate. For the purposes of estimating the impact of the ETI on investment, these industries are assigned an Export Percent of 0.

corporate income tax rate in percentage points. $z\tau_c(1 - \rho d)$ is the after-tax value of depreciation deductions under the bonus regime and $z_0\tau_c(1-\rho d)$ is the same value under a normal regime. Thus, BONUS captures the percentage point decrease in the discounted after-tax purchase price of new equipment investments and is measured in a manner similar to the DPAD variable and ETI.

To compute BONUS, first, z_0 is calculated for each investment type detailed in IRS publication 946 using a 7 percent discount rate. Then z_0 is computed at the 4-digit NAICS level as a simple average using BEA data on industry-level shares in each investment type prior to 2001 (prior to bonus implementation). To construct z, industry level z_0 is adjusted based on the size of the bonus.[8] Finally, BONUS is calculated as $(z - z_0)\tau_c$ where τ_c is equal to 35 times $(1 - \rho d)$. BONUS, as constructed, varies over industries and across time which allows its effects to be identified in the presence of time and firm fixed effects.

B.3 Control and Heterogeneity Variables

Three firm-level control variables constructed from COMPUSTAT data are added to each regression to control for financial constraints, cash flows, and investment opportunities. Following Hadlock and Pierce (2010), the **HP Index** measures financial constraint and is equal to $-0.737 * \textbf{size} + 0.043 * \textbf{size}^2 - 0.04 * \textbf{age}$ 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. **Marg 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. Cash Flow and Marg Q were used in Kaplan and Zingales (1997) and later Edgerton (2010) to control for non-tax determinants of firm investment behavior.

Section VII explores potential heterogeneous effects of the DPAD using the variables **Marginal Tax Rate**, **Revenue**, **Age**, **Cash Flows**, and **Repatriate**. Marginal Tax Rate is Blouin, Core and Guay (2010) simulated marginal tax rate variable. Marginal Tax Rate is only available for the years 2000–2010. Revenue is equal to firm sales in 2010 dollars. Age is the number of years a firm has been in the COMPUSTAT database. Cash Flow is constructed as described above. 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. Repatriate is derived from data collected by Sebastien Bradley (Bradley (2013)). Table 3 presents descriptive statistics for all outcome, control, and heterogeneity variables.

All variables constructed using COMPUSTAT data are winsorized at the 2nd and 98th percentiles to minimize the risk of misreported data affecting the analysis.

[8] Bonus depreciation was first implemented at a rate of 30 percent in 2001. It was increased to 50 percent in 2002–2004 then turned off during years 2005–2007. Bonus was turned back on at 50 percent in 2008 and has remained at 50 percent, save for in 2011 when bonus was equal to 100 percent.

Appendix C BONUS and DPAD Interaction

The effect of bonus depreciation on the price of investments depends on the marginal tax rate faced by the corporation. At higher tax rates, bonus has a bigger effect on investment prices. Because the DPAD decreases the marginal tax rate faced by a firm, it mitigates the effect of bonus depreciation. Thus, to accurately quantify the effect of the DPAD, one must take into account the interaction between bonus depreciation and the DPAD.

To understand this interaction, first consider that the percentage point decrease in the purchase price of investments due to bonus depreciation is defined as

$$\text{BONUS} = (z - z_0)\tau_c(1 - \rho d)$$

Where $z - z_0$ is the increase in the present value of depreciation expenses on one dollar of investment due to bonus, ρ is the percent of income classified as QPAI, and $\tau_c(1 - \rho d)$ is the DPAD adjusted corporate tax rate. Because $\tau_c\rho$ =DPAD, the bonus variable can be rewritten as

$$\text{BONUS} = \text{BONUS}^1 - (z - z_0)\text{DPAD} \tag{1}$$

where BONUS^1 is the effect of bonus depreciation at the statutory corporate tax rate, τ_c. In order to quantity if the effect of the interaction on the DPAD investment response, estimates from the baseline model can be reinterpreted using this identity.

The baseline empirical specification can we written as

$$\text{Investment} = \beta_0 + \beta_D\text{DPAD} + \beta_B\text{BONUS} + \epsilon$$

where subscripts have been suppressed for ease of exposition. Using the identity above, the estimating equation can be rewritten as

$$\text{Investment} = \beta_0 + \beta_D\text{DPAD} + \beta_B\text{BONUS}^1 - \beta_B(z - z_0)\text{DPAD} + \epsilon.$$

Taking the derivative of investment with respect to the DPAD yields $\beta_D - (z - z_0)\beta_B$. This expression represents the effect of the DPAD at varying levels of bonus as captured by $(z - z_0)$. Table A1 shows the bonus adjusted DPAD effects. The baseline DPAD coefficient is 0.0473. At 50 percent bonus, this coefficient is 3.66 percent smaller. At 100 percent, the coefficient is 7.76 percent smaller. Overall, the mitigating effect of the interaction does not significantly diminish the effect of the DPAD on investment.

Table A1: Interaction of DPAD and BONUS

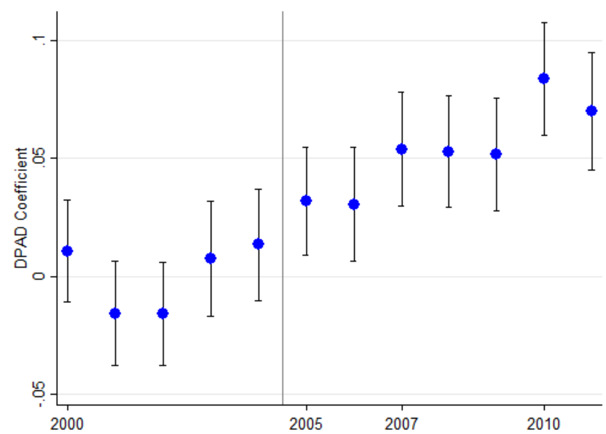
Bonus percent	$(z-z_0)$	β_D	β_B	$(z-z_0)\beta_B$	$\beta_D-(z-z_0)\beta_B$	ΔDPAD Effect
0	0	0.0473	0.0290	0	0.0473	0 percent
50	0.597	0.0473	0.0290	0.00173	0.0455	- 3.66 percent
100	1.268	0.0473	0.0290	0.00367	0.0436	-7.76 percent

Notes: Table A1 calculates the semi-elasticity of investment with respect to the DPAD (Specification (1a) from Table 4) at different levels of bonus depreciation.

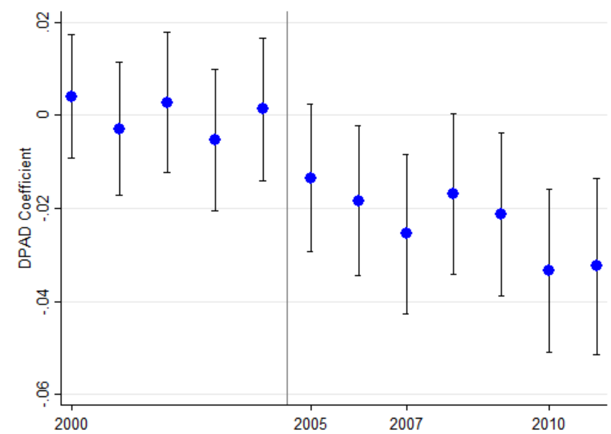
Appendix D Autor (2003) Type Difference-in-Differences Figures

Figure A1: Effects of the DPAD on Corporate Activities

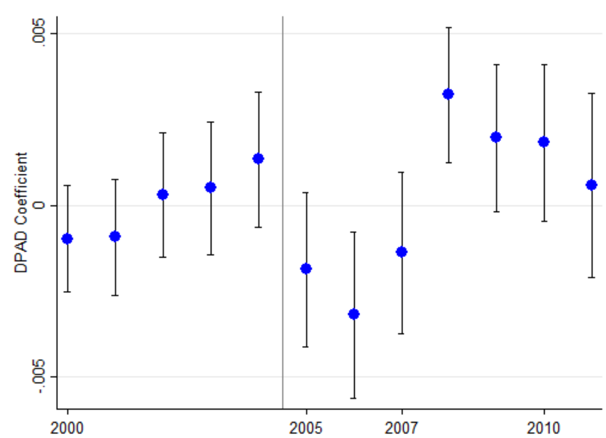
(a) Investment (per dollar lagged capital)



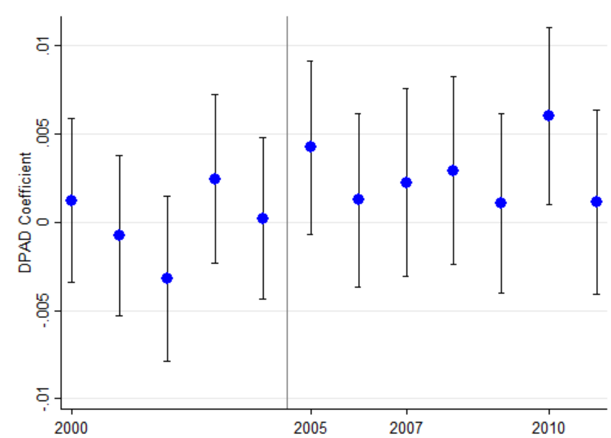
(b) Debt (per dollar total assets)



(c) Payouts (per dollar lagged revenue)



(d) Taxable Income (per dollar total assets)



Notes: Figure A1 presents a visual implementation of the differences-in-differences (DD) research design described in Section IV in the style of Autor (2003) for each of the four outcome variables investigated in the primary empirical analysis. To create each plot, first QPAI Percent is average for each industry by asset class group over the years 2005–2012. The outcome variable is then regressed on this averaged QPAI treatment interacted with year dummies as well as the baseline set of controls (Specifications (2), (5), (8) and (11) from Table 4. The coefficients are then adjusted so the average effect prior to DPAD implementation is zero. The normalized coefficients and 90 percent confidence intervals are then plotted. Each plotted coefficient represents the change in the outcome for 100 percent Domestic Manufacturing Firms versus 0 percent Domestic Manufacturing Firms relative to the same average difference in years 2000–2005.

Appendix E Robustness of Results

TABLE A2: ROBUSTNESS TO ALTERNATIVE SPECIFICATIONS 1

	Panel A			Panel B		
Dep Var.:	Investment (per $ lagged capital)			Debt (per $ total assets)		
	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)
DPAD	0.0338**	0.0404**	0.0769***	-0.0497***	-0.0590***	-0.0252**
	(0.0159)	(0.0164)	(0.0250)	(0.0153)	(0.0199)	(0.0109)
BONUS		0.0283**	0.0207***		-0.0084	0.0047
		(0.0118)	(0.0077)		(0.0057)	(0.0037)
ETI		0.0540***	0.0574***		-0.0150	-0.0040
		(0.0209)	(0.0213)		(0.0115)	(0.0077)
DPAD IV		✓			✓	
Ind, Size Trends			✓			✓
firm-years	90,398	89,060	90,398	90,398	89,060	90,398
firms	12,443	11,105	12,443	12,443	11,105	12,443
Implied $\mathcal{E}_{\text{DPAD}}$	4.677	5.588	10.381	-5.464	-6.483	-2.772

	Panel C			Panel D		
Dep Var.:	Payouts (per $ lagged revenue)			Taxable Income (per $ total assets)		
	(1c)	(2c)	(3c)	(1d)	(2d)	(3d)
DPAD	0.0028**	0.0017	0.0018	0.0008	0.0004	0.0039
	(0.0014)	(0.0015)	(0.0013)	(0.0039)	(0.0035)	(0.0065)
BONUS		-0.0005	-0.0014*		0.0006	0.0016
		(0.0008)	(0.0008)		(0.0018)	(0.0012)
ETI		0.0009	0.0010		-0.0052	-0.0058
		(0.0008)	(0.0008)		(0.0064)	(0.0062)
DPAD IV		✓			✓	
Ind, Size Trends			✓			✓
firm-years	86,949	85,607	86,949	51,368	49,640	51,368
firms	12,069	10,727	12,069	9,026	7,298	9,026
Implied $\mathcal{E}_{\text{DPAD}}$	9.568	6.025	6.401	1.073	.583	5.607

Notes: Table A2 reports estimates of the effect of the DPAD on corporate behavior. All columns display the DPAD coefficient from a regression of the outcome on DPAD, year and firm fixed effects, as well as Cash Flow, Marginal Q, HP Index. Specifications (2) and (3) include BONUS and ETI. Specification (2) instruments for DPAD with the value of DPAD in 2006. Specification (3) includes industry and size linear time trends. Implied $\mathcal{E}_{\text{DPAD}}$ is the elasticity of the outcome variable with respect to one-minus-the-top-statutory-corporate-income-tax-rate on domestic manufacturing income. Standard errors are presented in parentheses and are clustered at the industry level.

Table A3: Robustness to Alternative Specifications 2

	Panel A			Panel B		
Dep Var.:	Investment (per \$ lagged capital)			Debt (per \$ total assets)		
	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)
DPAD	0.0537***	0.0473***	0.0275***	-0.0517***	-0.0531***	-0.0156**
	(0.0167)	(0.0165)	(0.0090)	(0.0169)	(0.0160)	(0.0072)
BONUS	0.0391**	0.0290**	0.0277**	-0.0098	-0.0077	-0.0063
	(0.0191)	(0.0117)	(0.0117)	(0.0078)	(0.0058)	(0.0057)
ETI	0.0758**	0.0557***	0.0563***	-0.0069	-0.0135	-0.0098
	(0.0302)	(0.0204)	(0.0189)	(0.0140)	(0.0109)	(0.0085)
Dec FYR	✓			✓		
Balanced		✓			✓	
No ρ			✓			✓
firm-years	60,926	90,398	95,792	60,926	90,398	96,512
firms	8,717	12,443	13,226	8,717	12,443	13,281
Implied $\mathcal{E}_{\text{DPAD}}$	7.423	6.538	3.716	-5.684	-5.832	-1.714
	Panel C			Panel D		
Dep Var.:	Payouts (per \$ lagged revenue)			Taxable Income (per \$ total assets)		
	(1c)	(2c)	(3c)	(1d)	(2d)	(3d)
DPAD	0.0032*	0.0029**	0.0014*	-0.0001	0.0003	0.0009
	(0.0017)	(0.0014)	(0.0008)	(0.0032)	(0.0030)	(0.0047)
BONUS	-0.0010	-0.0004	-0.0005	0.0013	0.0008	-0.0089*
	(0.0018)	(0.0008)	(0.0008)	(0.0015)	(0.0013)	(0.0049)
ETI	0.0023**	0.0012	0.0012	-0.0017	-0.0002	-0.0158**
	(0.0009)	(0.0008)	(0.0008)	(0.0038)	(0.0045)	(0.0067)
firm-years	58,557	86,949	93,126	33,893	51,368	96,697
firms	8,479	12,069	12,907	6,163	9,026	13,288
Dec FYR	✓			✓		
Balanced		✓			✓	
No ρ			✓			✓
firm-years	58,557	86,949	93,126	33,893	51,368	96,697
firms	8,479	12,069	12,907	6,163	9,026	13,288
Implied $\mathcal{E}_{\text{DPAD}}$	11.141	10.11	4.906	-0.079	0.182	0.455

Notes: Table A3 reports estimates of the effect of the DPAD on corporate behavior. All columns display the DPAD coefficient from a regression of the outcome on DPAD, year and firm fixed effects, as well as Cash Flow, Marginal Q, and HP Index, BOPUSm and ETI. Specification (1) in each panel limits the analysis sample to firms with December fiscal year ends. Specification (2) in each panel limits the analysis to firms with non-missing data for years 2000 to 2012. Specifiction (3) uses DPAD prior to asset-class weighting. Implied $\mathcal{E}_{\text{DPAD}}$ is the elasticity of the outcome variable with respect to one-minus-the-top-statutory-corporate-income-tax-rate on domestic manufacturing income. Standard errors are presented in parentheses and are clustered at the industry level.

Appendix F Correcting for Business Cycles

One potential threat to the identification strategy is that estimates are generated by differential responses to the business cycle across industries. To further address this concern (permutation tests in Section VI also address this concern although less directly), I estimate the impact of the DPAD after the outcome variables have been purged of cyclical trends. To do this, I follow a two-stage procedure for each of the four primary outcome variables. First, for each of the IRS industries, the firm level outcome is estimated as a function of the annual percent change in GDP using data from the years 1980–2000 as in the following equation:

$$\text{Outcome}_{i,t} = \alpha_j + \beta_j[\ \text{percent}\Delta\text{GDP}_t] + \gamma_j[\ \text{percent}\Delta\text{GDP}_t^2] + \epsilon_{it}.$$

Second, from the regressions, industry-level estimates of α, β and γ are recovered and used to predict an expected outcome, $(\widehat{\text{Outcome}})$, for each industry during each year 2002–2012.

To incorporate these predictions into the baseline DPAD analysis, a residual outcome variable is created that is equal to the difference between the observed firm-level outcome and the industry-level predicted outcome during the years 2000–2012 as in:

$$\text{Residual Outcome}_{it} = \text{Outcome}_{it} - \widehat{\text{Outcome}}_{jt}.$$

The baseline specifications (Table 4, Specification (2)) are then re-estimated using these residual outcomes. Estimates are presented in Table A4. Across all four residual outcomes, estimates of the effect of the DPAD are very similar to those presented in the baseline specifications, allaying concerns that differential industry-level responses to business cycles are responsible for the DPAD estimates.

Table A4: Business Cycle Corrected DPAD Effects

Residual Dep Var:	Investment/ \$ lagged capital	Debt/ \$ total assets	Payouts/ \$ total assets	Taxable Income/ \$ revenue
	(1)	(2)	(3)	(4)
DPAD	0.054***	-0.045***	0.003*	0.004
	(0.015)	(0.013)	(0.001)	(0.005)
firm-years	65,588	65,588	62,779	36,511
firms	9,972	9,972	9,617	6,899

Notes: Table A4 reports estimates of the effect of the DPAD on corporate behavior after the outcome variables have been "corrected" to account for differential business cycle trends across industries, as described in Subsection A4. All regressions includes year and firm fixed effects and controls for Cash Flow, Marginal Q, the HP Index, BONUS and ETI. Standard errors are presented in parentheses and are clustered at the industry level.

Appendix G Additional Financing Results

Firms can lower the debt ratio by issuing less debt, issuing more equity, or retaining a larger portion of earnings. The first three columns of Table A5 break down the financing response into finer measures to answer this remaining question. The results suggest that firms do not issue less debt but do issue 3.7 percent more equity per dollar of total assets in response to a one percentage point reduction in effective corporate tax rates via the DPAD. Although the coefficient is not statistically significant, the Specification (3) result suggest that firms may also increase retained earnings by 1.3 percent of lagged total assets when the DPAD increases by one percentage point. Specifications (4)–(6) show that firms with positive pretax income respond by increasing retained earnings.

These additional financing results can be used to reconcile the cash inflows and outflows generated by the policy. The average firm in the sample classifies 46 percent of income as QPAI and as a result, once fully phased-in, the DPAD reduces its effective tax rate by 1.41 percentage points. These equity issuance results suggest that the average firm increases equity issuance by $378 million per year. Cash flows for the average firm also increase as a result of the deduction itself by $3.4 million. Investments in physical capital increase by $68.6 and payouts increase by $ 10.3 million. Thus, the estimates presented in this study show that the cash inflow effects cover and, in fact, far outweigh its cash outflow effects. Of course, investment in physical capital is only one type of investment that when financed with equity or retained earnings garners the DPAD tax benefits. Firms are likely using a large portion of cash inflows from equity issuances to purchase non-capital inputs such as intellectual property and labor that also generate QPAI.[9]

Table A5: Additional Financing Results

	All Firms			Positive Pretax Income		
Dep Var:	New Debt Issued	New Equity Issued	Change in RE	New Debt Issued	New Equity Issued	Change in RE
	(1)	(2)	(3)	(4)	(5)	(6)
DPAD	0.005	0.037**	0.012	0.005	0.016	0.005**
	(0.005)	(0.017)	(0.009)	(0.004)	(0.016)	(0.002)
Obs.	90,322	88,877	88,950	51,336	50,245	50,283
Firms	12,442	12,257	12,258	9,023	8,847	8,850

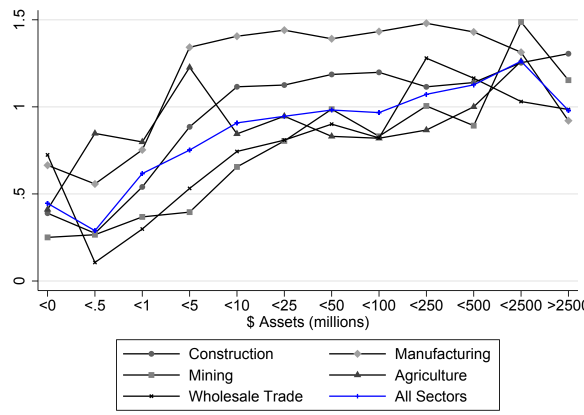
Notes: Table A5 presents estimates of the effect of DPAD on three finer measures of financing: New Debt Issued, New Equity Issued, and Change in Retained Earnings. Specifications (4)–(6) are limited to firms that report positive pretax income. All regressions include year and firm fixed effects, and controls for Cash Flow, Marginal Q, the HP Index, BONUS and ETI. Standard errors are presented in parentheses and are clustered at the industry level.

[9] Cash flows are calculated based on 2004 averages. The average firm reported $7.7 billion in assets, $236 million in pretax income, $2.4 billion in sales, and $1.0 billion in capital stock.

Appendix H On the Use of Aggregate Asset-Class Multipliers

A potential concern is that the distribution of QPAI Percent across asset-classes may not be the same across industries. If this is the case, then using aggregate asset-class multipliers to scale the DPAD variable will introduce measurement error. The analysis contained in this appendix takes two steps to address this concern. First, using sector-level data from the Corporate Source Book, I construct sector-level multipliers for the five highest QPAI Percent sectors for which DPAD and taxable income is reported in each asset-class. Figure A2 compares these multipliers to the aggregate asset-class multipliers. The sector-level multipliers largely covary with the aggregate multipliers assuaging the mismeasurement concern, at least partially.

Figure A2: Sector-Level Multipliers



Notes: Figure A2 presents asset-class multipliers for the five sectors that report the highest percentage of income as QPAI during the sample period and have data for each asset class. Asset-class multipliers are constructed as ρ in each asset for each sector divided by the average ρ across asset-classes in each sector.

Second, I reweight the DPAD variable using the sector-level multipliers from Figure A2 instead of the aggregate multipliers and repeat the Table 4 Series 1 analysis using data from these five sectors; results are presented in Table A6. Across all four outcomes, the results are similar but slightly more muted than baseline estimates likely owing to the fact that the most untreated units are necessarily excluded from these regressions. Overall, the analysis contained in this appendix suggests measurement error induced by aggregate as opposed to more granular asset-class multipliers is not a critical concern to the validity of the study.

Table A6: Baseline Analysis using Sector-by-Size Multipliers

Dep Var:	Investment	Debt	Payouts	Taxable Income
DPAD	0.0318**	-0.0366***	0.0019*	-0.0013
	(0.0130)	(0.0095)	(0.0011)	(0.0025)
firm-years	57,598	57,598	54,876	33,505
firms	7,400	7,400	7,105	5,524

Notes: Table A6 reports baseline estimates (Table 4, series (A)) when the DPAD is scaled by sector-by-asset level multipliers. Due to sector-by-asset level data availability, the analysis is performed only using data on firms in the construction, mining, wholesale trade, manufacturing, and agriculture sectors. Standard errors are presented in parentheses and are clustered at the industry level.

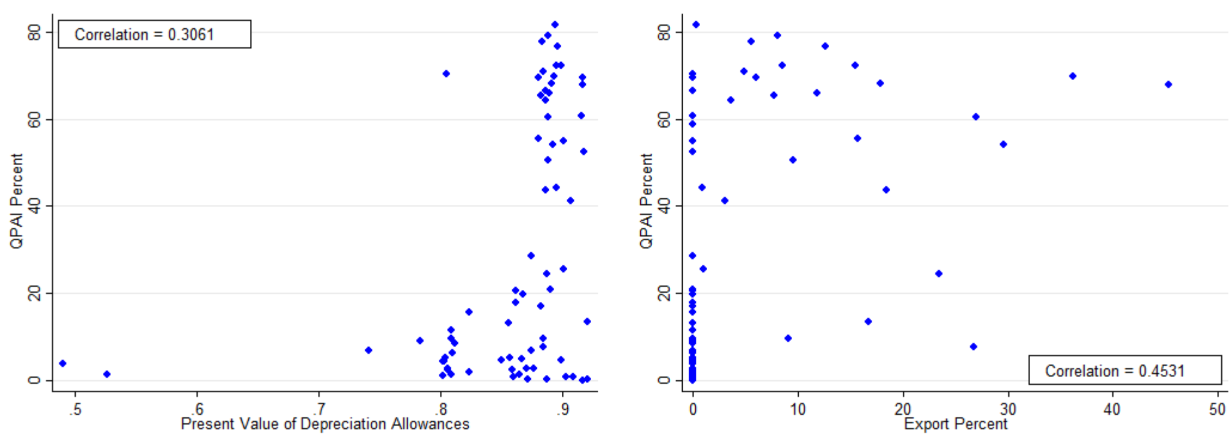
Appendix I Overlapping Corporate Tax Policies

Figure A3 presents scatterplots that describe how bonus depreciation and the DPAD and the ETI and the DPAD overlap. Panel (A) plots z_0, the present value of tax depreciation allowances in the absence of bonus against QPAI Percent for each IRS industry. The graph shows a positive relationship (correlation coefficient equal to 0.3061); as z_0 increases and bonus depreciation has less impact, the percentage of income classified as QPAI increases and the DPAD has more impact. Thus, the industries that benefit *most* from bonus are those that benefit *least* from the DPAD.

Panel (B) plots the percentage of income derived from exporting versus QPAI Percent for each IRS industry. Again, the graph shows a positive correlation (correlation coefficient = 0.4531) meaning that those firms that export more are also those that are more domestic manufacturing intensive. Therefore, the industries that benefit *most* from the ETI are also those that benefit *most* from the DPAD.

Figure A3: Overlapping Corporate Tax Policies

(A) BONUS & DPAD (B) ETI & DPAD



Notes: Figure A3 presents scatterplots of QPAI Percent against Z_0, the present value of depreciation allowances in the absence of bonus depreciation, in Panel (A) and of QPAI Percent against Export Percent in Panel (B). The plots are presented at the IRS industry level and the values are averages over the sample period.

Table A7: Internal Validity Considerations w.r.t ETI and BONUS

	Panel A			Panel B		
Dep Var.:	Investment (per $ lagged capital)			Debt (per $ total assets)		
	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)
DPAD	0.0587***	0.0540	0.0390**	-0.0505***	-0.0737**	-0.0581***
	(0.0183)	(0.0347)	(0.0174)	(0.0099)	(0.0319)	(0.0199)
BONUS	0.0135	0.0442**	-0.0118	0.0013	-0.0029	0.0211***
	(0.0109)	(0.0203)	(0.0097)	(0.0059)	(0.0061)	(0.0064)
ETI		0.0654***	0.0278		-0.0099	-0.0137
		(0.0247)	(0.0213)		(0.0066)	(0.0259)
Post 2006	✓			✓		
Pre 2008		✓			✓	
Low Bonus			✓			✓
firms	6,604	11,262	9,567	6,604	11,262	9,567
firm-years	31,260	68,782	52,857	31,260	68,782	52,857
	Panel C			Panel D		
Dep Var.:	Payouts (per $ lagged revenue)			Taxable Income (per $ total assets)		
	(1c)	(2c)	(3c)	(1d)	(2d)	(3d)
DPAD	0.0050**	-0.0003	0.0041**	0.0054	0.0020	0.0013
	(0.0019)	(0.0035)	(0.0018)	(0.0049)	(0.0103)	(0.0040)
BONUS	-0.0006	-0.0023*	-0.0007	0.0010	0.0037**	-0.0008
	(0.0008)	(0.0012)	(0.0006)	(0.0024)	(0.0018)	(0.0022)
ETI		0.0009	-0.0010		0.0017	-0.0033
		(0.0009)	(0.0014)		(0.0040)	(0.0071)
Post 2006	✓			✓		
Pre 2008		✓			✓	
Low Bonus			✓			✓
firms	6,268	11,009	9,207	4,737	8,124	6,663
firm-years	29,681	66,456	50,445	18,400	38,852	29,071

Notes: Table A7 repeats Table 4 series (1) estimates the effect of the DPAD on corporate outcomes of interest but limits the sample in several ways to address internal validity concerns arising from two contemporaneous tax policies: bonus depreciation and the extraterritorial income exclusion. Specifications (1a)–(1d) limit the analysis sample to years after 2006 to avoid the effects of the 2004 repeals of the ETI and BONUS. Specifications (2a)–(2d) limit the analysis to years prior to 2008 to avoid correlated BONUS years. Specifications (3a)–(3d) limit the analysis to firms in industries that, on average, invest in the shortest lived equipment and thus are the least likely to be affected by bonus depreciation. Each specification includes year and firm fixed effects, as well as controls for cash flow, financial constraint, BONUS, and ETI. Standard errors are presented in parentheses and are clustered at the industry level.

Appendix J Calculating Comparable Estimates and Elasticities

DPAD

The closest estimates of the impact of the DPAD on investment come from Lester (2015). Lester (2015) uses an indicator for DPAD treatment and estimates that firms that report any DPAD benefit increase investment by 2.2 percent of installed capital after the DPAD was implemented relative to a matched sample of non-reporting firms. To compare this result to my Specification (2a) from Table 4 estimate, I divide the 2.2 by 0.69, the average percentage point rate reduction that a firm receives in my sample during the years 2005–2012. The resulting adjusted finding suggests firms increased domestic investment by 3.19 cents per dollar of installed capital for each one percentage point DPAD reduction they receive.

BONUS

Zwick and Mahon (2017) provides the most recent estimates of the effect of bonus on investment. The study reports that for all U.S. businesses, the average firm increases investment by 1.6 percent of installed capital the user cost elasticity tax term increases by 1 unit.[10] That is,

$$\partial \frac{(I_t/K_{t-1})}{\partial \left(\frac{1-\tau z}{1-\tau}\right)} = 1.6.$$

Larger firms, closer in size to the COMPUSTAT sample are approximately half as responsive increasing, I_t/K_{t-1} by 0.8 percent[11]. To compare this response to the BONUS estimates contained in this paper, I use the 0.8 to calculate a $\mathcal{E}_{\text{BONUS}}$ that can be compared to the elasticities noted in Section VIII. To adjust the 0.8, I first divide by 0.65 to to find how investment responds to $(1-\tau_c z)$. Now, Investment Percent increases by 1.23 when $(1-\tau_c z)$ increases by 1 unit.

Next, because the Zwick and Mahon (2017) estimates are made using gross as opposed to net installed capital, the elasticity is multiplied by 2 – gross PPE is twice as large as net PPE among COMPUSTAT sized firms. The resulting semi-elasticity is 2.46. Finally, to calculate the net-of-tax elasticity, I 2.46 multiplied by mean $1 - \tau z_0 = 0.692$ and divide by mean $I_t/K_{t-1} = 0.47$. The resulting Zwick and Mahon (2017) elasticity of investment with respect to the net of tax rate ($\mathcal{E}_{\text{BONUS}}$) is 3.96.

PAYOUTS

Yagan (2015) finds that firms increased payouts by between 23 and 45 cents per dollar of lagged revenue in response to the cut. To compare the magnitude of this response to the DPAD payout response, consider that the corporate income tax rate and the dividend tax rate both affect the

[10] Table 3, Row 3, Column 1.
[11] Figure 4, Panel B.

cost of equity finance. Auerbach (1983) derives and parameterizes this cost as

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

where p is the percentage of payouts made via dividends and τ_{cg} is the capital gains tax rate. Assuming 1/2 of payouts are made as dividends, the 2003 tax rate changes decreased the equity cost of capital by 23 percent. Before the rate cut, the average payouts were only 3/10 of a cent per dollar of revenue. Thus, Yagan (2015) finds the elasticity of payouts with respect to the cost of equity is between 3.2 and 6.3.

A one percentage point increase in the DPAD decreases the cost of equity capital by 1.5 percent and increases Payouts by between 7 and 15 percent. Thus, the estimated 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.

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