The Business Investment Response to the Domestic Production Activities Deduction

Eric Ohrn
University of Michigan / Grinnell College

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Abstract

The Domestic Production Activities Deduction is a US federal tax regulation that effectively lowers the corporate income tax rate on domestic manufacturing activities by 3.15%. By exploiting industry level variation in manufacturing activity, this paper analyzes the investment impact of the policy. Results indicate investment responds strongly to the policy – the average publicly traded firm increases investment as a percentage of installed capital by approximately 12% once the deduction is fully implemented. This large response suggests that the Domestic Production Activities Deduction, and more generally a drop in corporate income tax rates, is an investment stimulus policy far superior to other recent corporate tax incentives such as the Bush Tax Cuts and Bonus Depreciation.

Keywords : Domestic production activities deduction, taxation, investment
JEL Classification : H25; H32; E22

1 Introduction

In the past several years, significant research efforts have been directed towards studying the impact of corporate tax reform on corporate behavior. A particularly large amount of attention has been given to the impacts of the "Bush Tax Cuts," which significantly reduced the top rate on individual dividend and capital gains income and to "Bonus Depreciation," which accelerates the deduction of new investment spending and thereby reduces the present value cost of physical capital. In contrast, very little academic study has been concentrated on a third major corporate tax expenditure implemented during the 2000s, the Domestic Production Activities Deduction.

The Domestic Production Activities Deduction (DPAD) allows tax payers to deduct a percentage of income derived from domestic manufacturing activities from their taxable income. The DPAD thus effectively lowers a business's effective corporate income tax rate.[1] By lowering the effective tax rate on domestic manufacturers, Congress hoped to "make our manufacturing, service, and high-technology businesses and workers more competitive and productive both at home and abroad."[2]

This paper is the first (to the author's knowledge) to directly examine whether the DPAD affects firm behavior. In particular, the research contained herein tests whether corporate investment responds to the DPAD. Business investment seems a natural first investigation into the effects of the policy given that "Investment is of paramount importance for both business cycle fluctuations and long term economic growth."[3] Additionally, investment stimulus is cited as the primary goal of the DPAD, the Bush Tax Cuts, and Bonus Depreciation. Thus, comparing the effects of the three policies which more broadly represent three different tax levers can shed light on which policy is most effective at stimulating business investment, a reduction in the corporate income tax rate, a reduction in distributed earnings rates, or an acceleration of depreciation allowances.

The research design exploits industry level variation in the percentage of income that is eligible for the deduction as derived from the IRS Statistics of Income Business Tax Statistics database. Firms that belong 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 statutory corporate income 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 investment response to the policy should be concentrated among firms in domestic manufacturing intensive industries that experience significant reductions in their effective tax rates and large increases in their effective rate-of-return on investment.

The benefit of using industry level variation in domestic manufacturing intensity is that the

[1] The DPAD was signed into law in 2004 in response to a World Trade Organization ruling that outlawed use of the Extraterritorial Income exclusion, a US tax policy that allowed firms to deduct the a portion of income derived from exports. The replacement of the ETI exclusion is

[2] Language taken from the American Jobs Creation Act of 2004.

[3] Language taken from Goolsbee (1998).

measure is plausibly exogenous with respect individual firm decisions. Empirical observations reinforce this exogeneity assumption; the percentage of income derived from domestic manufacturing activities is stable across industries and over time suggesting that a large number of firms are not making choices that confound the quasi-experimental DPAD treatment. The most pressing potential concern in using industry level variation to test the investment effects of the DPAD is that industry trends may drive the empirical results. However, due to significant variation within large economic sectors, the impact of the DPAD may be tested within sectors thereby eliminating any concerns that sector-time trends such as, for example, increasing demand for construction relative to agricultural products, might be responsible for empirical results.

The core result of this research is that, for listed firms contained in the Compustat database, the DPAD significantly increases investment activities. Upon full implementation, the DPAD increases investment as a percentage of installed capital by 12.113% for a firm with the average percentage of income derived from domestic production. For a firm whose income is all eligible for the deduction, investment as a percentage of installed capital increases by more than 30%. Even if one assumes that these effects capture only a temporary investment spike in response to the policy, the DPAD is still seems to be more effective at stimulating investment than either the Bush Tax Cuts or Bonus Depreciation. This result is robust to alternative investment specifications, alternative controls, and sector-by-year fixed effects. The policy is especially effective at stimulating investment among credit constrained firms suggesting the policy provides slack in the budget constraint.

This work is indebted to and humbly contributes to a large literature concerning both the theoretically and empirically effects of tax policy on business investment. The theoretical foundations of this literature are provided by Hall and Jorgenson (1967), King (1977), Auerbach (1979), Bradford (1981), Summers (1981), Poterba and Summers (1985), and Desai and Goolsbee (2004). The empirical study of tax incentives and investment response is highlighted by Cummins, Hassett and Hubbard (1994), Goolsbee (1998), Edgerton (2010), Yagan (2013), and Zwick and Mahon (2014). An in depth discussion of a selected few of these works is reserved for the last section in which the DPAD is compared to that of other tax policies in light of several alternative theoretical models.

The paper is organized as follows: Section 2 provides an in-depth explanation of the DPAD. Section 3 provides a simple conceptual framework that captures the effect of the policy on investment behavior paying close attention to potential heterogeneous responses to the policy based on financial constraint and taxable status. The framework produces several testable hypotheses which are subsequently taken to the data. Section 4 discusses the data sources, construction of key variables, and descriptive statistics. Section 5 describes the empirical strategy and key identifying assumptions necessary to accurately capture the investment effects of the DPAD. Baseline investment results are presented in Section 6 and investment heterogeneity results are presented in Section 7. Section 8 concludes by comparing the DPAD to other tax policies designed to encourage investment and outlining directions for future research.

2 The Domestic Production Activities Deduction

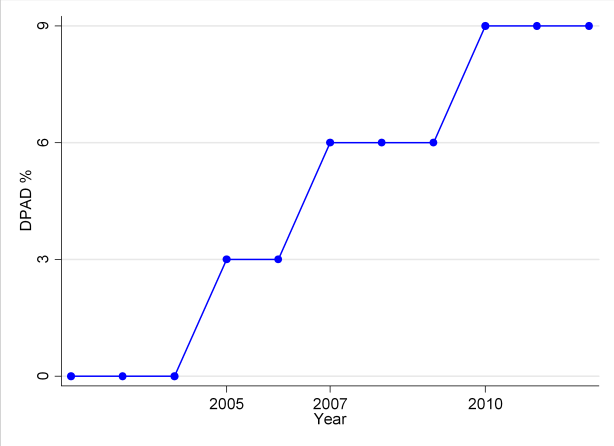
The Domestic Production Activities Deduction (DPAD) was enacted as part of the American Jobs Creation Act of 2004. In its simplest form, the DPAD is a federal corporate tax deduction that allows firms to deduct a percentage "Qualified Production Activities Income" from their taxable income. The DPAD effectively lowers the effective corporate income tax rate on income derived from domestic manufacturing. The policy was not implemented at its maximum rate and was instead phased in during the years 2005 to 2010. Three pieces of information are key to understanding the policy: the rate of the deduction, the definition of Qualified Production Activities Income (QPAI), and other factors limiting DPAD application.

The deduction was implemented at a rate of 3% in 2005, increased to 6% in 2007, and reached its maximum rate of 9% in 2010. Figure 1 presents the DPAD rates during the phase-in period. Given a statutory corporate income tax rate of 35%, these rates reduced the effective tax rate on QPAI by 1.05% in 2005 and 2006, by 2.10% in 2007–2009, and ultimately by 3.15% in years 2010 and beyond. How much these rates affect behavior depends on the percentage of income that a firm derives from QPAI (its QPAI %). If a firm has 100% QPAI, then their effective rate drops 3.15% when the DPAD is fully phased in at 9%. Firms that claim 50% of income as QPAI see an effective rate drop of 1.575%. Effective tax rates of firms that derive no income from domestic production are completely unaffected (at least in partial equilibrium). Understanding the exact definition of QPAI is critical to understanding this differential policy treatment and the estimated effects of the policy and is discussed next.

Figure 1: DPAD Phase-In

For QPAI Earned		DPAD %
After	Before	
	01/01/2005	0%
05/05/2004	01/01/2007	3%
12/31/2006	01/01/2010	6%
12/31/2010		9%

Notes: Figure 1 lists and plots the percentage of qualified production activities income that may be deducted from taxable income via the DPAD.



QPAI is equal to the excess (if any) of the firm's Domestic Production Gross Receipts (DPGR) over the Domestic Production Gross Costs (DPGC). DPGR is defined as any income that is derived from

- Lease, rental, license, sale or exchange of goods manufactured in the United States
- Construction and engineering and architectural services performed in the United States
- Except sale of prepared foods and energy transmission

And DPGC are defined as

- Costs of goods allocable to DPGR
- Other deductions, expenses or losses directly allocable to DPGR or
- A ratable portion of other expenses not directly allocable to such receipts

An item qualifies as produced in the United States if at least 20% of the total costs are the result of direct labor and overhead costs from US–based operations.

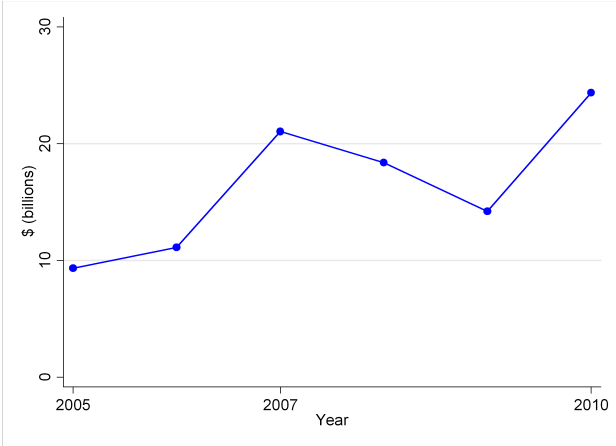
Finally the deduction is limited in two ways. First, the deduction may not exceed 50% of W-2 wages paid by the firm. Second, the deduction may not exceed gross adjusted income (taxable income).

While the 3.15% maximum rate reduction may not seem large on firm-by-firm basis, the policy actually constitutes a significant tax expenditure at the national level. Figure 2 details the total taxable income deductions resulting from the DPAD and total tax expenditure on the policy (assuming a corporate rate of 35% on all income). In 2010 when the DPAD reached 9%, corporations were able to deduct more than $24 billion from their taxable income at a cost of more than $8.5 billion to US government. Given the price tag of the policy it seems prudent to examine whether the DPAD affects business investment and hence macro-level economic growth.

Figure 2: DPAD Deduction

Year	$ (billions)	$(billions) $\times\tau$
2005	9.332	3.266
2006	11.106	3.887
2007	21.058	7.3703
2008	18.374	6.320
2009	14.198	4.970
2010	24.365	8.528

Notes: Source: IRS Statistics of Income. Corporate statutory rate $\tau = .35$



3 Conceptual Framework and Empirical Hypotheses Generation

To guide the empirical analysis carried out in Sections 6 and 7, this section presents a simple model of investment in the presence of the Domestic Production Activities deduction, investment incentives, financial constraints, and heterogeneous tax positions. The model presented here follows the recent work by Zwick and Mahon (2014) which nicely combines the Neoclassical investment models of Abel (1982) and Hyashi (1982) with the Stein (2003) model of costly external finance. The model produces several testable implications. First, investment increases due to the Domestic Production Activities Deduction and increases more for firms that derive a larger proportion of income from Qualified Production Activities. This baseline result is complemented by two predictions of investment response heterogeneity: (1) firms that are financially constrained will be less responsive to the policy, and (2) firms that are less likely to be taxable when income is derived from investment activities will be less responsive to the deduction.

3.1 Framework Primitives

Consider a firm making a one shot investment decision. The firm begin with initial retained earnings R_0 and chooses the level of investment I in an effort to maximize after tax profits. Future profits are given the concave function, $\pi(I)$. Future profits are taxed at the proportional rate τ. The DPAD allows the firm to deduct a percentage d of qualified income from its taxable income. The percentage of income that qualifies for the deduction is ρ.[4] The firm discounts the after-tax profits at the risk-adjusted rate r, thus the firms discounted after tax profits can be written as

$$\frac{[1-\tau(1-\rho d)]\pi(I)}{1+r}.$$

The DPAD may be further generalized to consider a state in which the firm is nontaxable. When the next dollar of income does not increase the firm's tax bill, then the firm can only realize the benefit of the deduction if it is carried forward to decrease taxable income in a future taxable state. The generalized version of d can be written as

$$d(\beta,\gamma) = \gamma d(\beta) + (1-\gamma)\beta\phi d(1),$$

where $\gamma \in \{0,1\}$ is an indicator for current tax state and ϕ is a discounter that reflects both the expected arrival time of the taxable state and the discount rate applied to the future and

[4] In this simple framework, ρ is assumed to be fixed over time. One can imagine a more complicated version of the model in which firms may expend resources in an effort to increase ρ by changing its business model or reclassifying earnings as qualified income. Unfortunately, without firm level data on the DPAD over time, it is hard to test predictions from this extension. Reassuringly, the percentage of QPAI seems to be stable over time both for the population as a whole and for each specific industry allaying concerns that the most active margin of response to the DPAD is not through ρ. See Figure 3 for a visual representation of these findings.

subsequent periods when the firm switches. Note that for the nontaxable firm, β applies to all future deductions; even when β equals one, ϕ is less than one and the value of the deductions are lower when the firm is nontaxable.

In additional to the DPAD, the firm can deduct a portion of the cost of the investment over time as the investment depreciates for tax purposes. The value of the deduction z is worth more to the firm if the investment can be written off more quickly or the firm discounts the future less aggressively.[5] Additional theoretical discussion of z and bonus depreciation is left out here as it is not central the DPAD analysis.[6]

External finance matters for all investment exceeding current cash flow. During the investment period, the firm faces an external finance wedge that is linear in expenses net of cash flows, that is,

$$c(I) = \lambda[(1 - \tau z)I - R_0],$$

where λ can be thought of as the shadow price on a borrowing constraint that may or may not bind now or in the future. Thus, a dollar of cash inside the firm is worth $1 + \lambda$ due to costly external finance.

3.2 Optimal Investment

The firm's optimal investment condition is found by maximizing the firm's objective function,

$$\max_I \left\{ \frac{[1 - \tau(1 - \rho d)]\pi(I)}{1 + r} - (1 - \tau z)I - \lambda(1 - \tau z)I \right\},$$

with respect to I, where terms not involving I have been suppressed. Under the assumption of concave π, the problem yields a unique interior solution characterized by the first order condition

$$\frac{[1 - \tau(1 - \rho d)]\pi'(I^*)}{1 + r} = (1 + \lambda)(1 - \tau z).$$

The optimal investment rule is intuitive; the firm chooses I to set the after-tax discounted future benefits of the marginal dollar of investment equal to the after tax price of investment and the cost of external finance. The DPAD increases d and thereby increases the benefits to investment. Investment is thus increasing in the percentage of QPAI that the firm may deduct from its taxable income. The effects of an increase in d are only distinct from the effects of a decrease in τ in that a

[5] During the last decade, the rate at which investment depreciates for tax purposes has been accelerated in an effort to stimulate investment. This largely counter-cyclical policy is known as Bonus Depreciation. Bonus Depreciation allows firms to write off a percentage of the purchase price of new capital in the first year in addition to write-offs specified in the statutory tax depreciation schedules. The empirical analysis will control Bonus Depreciation by empirically constructing z and simultaneously estimating its effect of investment.

[6] For an in depth treatment of z, including its construction both analytically and empirically and its impact on investment see Ohrn (2014), Edgerton (2012), and Zwick and Mahon (2014).

decrease in the statutory rate would be mitigated to some degree by a reduction in the tax benefits to investment through τz.

3.3 Testable Hypotheses

The DPAD increases the after-tax marginal benefit of investment and thus increases the firm's level of investment; $\partial I/\partial d > 0$. From this intuitive result, three testable hypotheses may be derived. The first may be considered the baseline empirical hypothesis. The second and third testable hypotheses describe heterogeneity in the baseline response based on financial constraint and tax status.

Hypothesis 1. *Investment responds more strongly to the DPAD for industries that derive a larger percentage of income from QPAI;* $\partial^2 I/\partial d \partial \rho > 0$.

When the DPAD is offered or increased, d, the percentage of QPAI that may be deducted from taxable income increases. The effect of the policy is amplified by the percentage of income that may be classified as QPAI, ρ. This result is intuitive – firms that are more domestic production intensive effectively receive a more generous per dollar deduction and as a result increase their investment more in response to the introduction or increase in the DPAD. This hypothesis is empirically testable because ρ varies substantially across industries. Section 4 describes the construction of industry level ρ and its variance across both the population of corporate taxpayers and across listed firms. If the DPAD does effectively stimulate investment, then the elasticity of investment with response to the DPAD should be higher for industries with high levels of ρ.

The second empirically testable hypothesis concerns how investment response to the DPAD varies based on a firms cost of external financing or more generally its level of financial constraint.

Hypothesis 2. *Investment responds more strongly to the DPAD for firms that are financially constrained;* $\partial^2 I/\partial d \partial \lambda > 0$.

For both the constrained and unconstrained firms, the DPAD increase the marginal return on investment. For the constrained firm, the policy is doubly beneficial as it also provides for additional investment slack. The change in the optimal level of investment is thus larger for firms that are financially constrained. Empirically, the level of financial constrain that a firm faces will be represented by the financial constraint index created by Hadlock and Pierce (2010) Index. Construction of the HP Index is discussed in Section refdata. If financial constraints do affect the investment response to the DPAD, then the elasticity of investment with respect to the DPAD $\partial^2 I/\partial d \partial \lambda$ should be larger for firms with higher HP Index scores. If, on the other hand, financial constraint does not play a role in investment response then there should be no heterogeneity in the investment response to the DPAD across the HP Index.

The third testable hypothesis concerns the heterogeneity in response to the DPAD across tax status and future tax status.

Hypothesis 3. *Investment responds more strongly to bonus depreciaiton for firms that expect to be taxable when income is subject to DPAD;* $\partial I/\partial d|_{\gamma=1} > \partial I/\partial d|_{\gamma=0}$.

The third hypothesis relates strongly to earlier research by Auerbach (1986) and Edgerton (2010). These studies elucidate the idea that the effectiveness of counter-cyclical fiscal stimulus in the form of investment tax incentives may be undermined if firms are non-taxable either due to their possession of tax loss carry-forwards or a less than zero amount of taxable income. The papers provide two key incites: First, investment response to investment tax stimulus is heterogeneous across tax status - firms that are currently taxable are more responsive to the credit. Second, when these polices are used in a counter-cyclical manner, then they are employed when firms are most likely to have tax losses and therefore the mean level impact of the policy is dragged down.

The hypothesis differs slightly in that the heterogeneity in response is across future tax status not current tax status. This is because the DPAD effectively lowers the tax rate on earned income only if the firm is taxable when the income derived from investment is earned, not upon the investment itself. This prediction suggests that lowering the tax rate on earned income instead of providing tax incentives to lower the cost of investment may be a better counter-cyclical policy option.

While this hypothesis provides a very exciting policy implication, it may be challenging to examine empirically. To begin to understand the empirical difficulties presented, it is instructive to just how much work has gone into correctly approximating a firms *current* taxable status and tax rate. Plesko (2003) and Edgerton (2010) both provide very careful methods to construct an indicator of taxable status (1 for positive marginal tax rates, 0 for zero marginal tax rate) using publicly available accounting data. Graham (1996), Graham (2000), and Blouin, Core and Guay (2010) attempt to go one step further by constructing marginal tax rates based on both current taxable status and the probability of future current taxable status. To test the difference in response to the DPAD based on only future taxable status, the analysis contained in Section 6 will use measures of current tax status and marginal tax rates. Whether the empirical results support the third hypothesis depends crucially on whether current and future tax status are strongly correlated.

4 Data Sources, Construction, and Descriptive Statistics

In order to empirically examine the investment response to the DPAD and test the hypotheses presented in Section 3, data from several sources must be compiled. Industry level data on the DPAD are taken from the IRS Statistics of Income Corporate Tax Statistics website.[7] Data on firm level financial statement variables are taken from the COMPUSTAT North American Annual database. Data needed to construct a measure of present value tax depreciation allowances for new investment are taken from the BEA and the IRS. Finally, marginal tax rates as computed in Blouin et al. (2010) are available on the Wharton Research Data Services (WRDS) Platform.

4.1 QPAI Percent

The effect of the DPAD differs across firms based on the percentage of income is derived from qualified production activities (ρ in Section 3). For example, at a 35% statutory corporate income tax rate, a 9% DPAD deduction would result in an effect rate drop of 3.15% for a 100% QPAI firm but in only a 1.575% for a 50% QPAI firm. The effect of the DPAD policy may therefore be estimated by examining differential impact across QPAI %.

QPAI % can be constructed at the industry level using information provided by the IRS Statistics of Income Division. Table 7 provides information on net taxable income and the DPAD for 17 sectors and 77 more finely defined industries.[8] Data in Table 7 are compiled from all Corporations that filed a tax return during the year. The IRS sectors and industries correspond to NAICS 4 digit industries which allow IRS data to be matched to financial statement data at the industry level. QPAI % is equal to qualified income divided by total income. To find qualified income, the DPAD in total dollars is divided by the DPAD rate, which varies during years 2005-2010 as described in Section 2.

Table 1 and Figure 3(A) present descriptive statistics for QPAI % over time, across sectors, and across industries within the manufacturing and information sectors. The average QPAI % during all years 2005 - 2010 is 25.528%. The percentage is lowest in 2005, the first year the DPAD was available, but then levels out to an average percentage between 25.487 and 27.588 during years 2006-2010. This economy wide trend is similar within sectors and industries. The stability of the trend after the first year suggests that firms manufacturing vs. non-manufacturing mixes are relatively fixed over time. If firms were able to easily manipulate this mix in response to tax incentives, then as the deduction increased, QPAI % would have also increased.

Critically, the stability of QPAI % over time points to the exogenity of QPAI % (essentially the treatment variable in the empirical analysis) with respect to investment (the dependent variable). If investment behavior increased QPAI %, and therefore the intensity of the treatment, QPAI %

[7] The data are specifically taken from the SOI Tax Stats Table 7: Corporate Returns with Net Income; years 2005 - 2010.

[8] Appendix A provides definitions of DPAD and Net Income from the IRS Statistics of Income.

would increase over time for the economy as a whole and more for industries that investment more. The stability ot QPAI % is in-line with these predictions at neither economy nor industry level suggesting QPAI % is an acceptable tool to analyze the impact of the DPAD on investment.

Not only does QPAI % seem to be exogenous with respect to investment, but it also varies significantly across major economic sectors and even within sectors at finer industry level. Figure 3(B) presents the average QPAI % over years 2005-2010 for each of the 17 economic sectors. The most QPAI intensive sector is construction followed closely by agriculture, information, and manufacturing. While the construction and agricultural sectors report more than 60% of their income as QPAI, eight sectors including real estate, healthcare, and finance reports less than 10% of their income as QPAI (The financial sector is excluded from the formal empirical analysis.). The variation within sector and across industries is almost as striking. Figures 3(C) and (D) present average QPAI % over years 2005-2010 for the industries contained in the manufacturing and information sectors. In the manufacturing sector, the majority of industries report more than 50% of income as QPAI but several industries including oil and gas, apparel, and leather manufacturing reports less than 30% of income as QPAI. In the information sector, QPAI % varies from just less than 80% QPAI to less than 20%. The within sector is especially appealing because the impact of the DPAD is identified even when sector fixed effects and trends are included in the analysis.

Table 1: QPAI % for IRS Sample

Variable	Year(s)	Median	Mean	10th pctile	90th pctile
QPAI %	2005-2010	9.394	25.538	0.291	71.127
QPAI %	2005	7.979	21.098	0.098	67.005
QPAI %	2006	9.571	25.487	0.156	74.922
QPAI %	2007	9.361	27.588	0.370	68.330
QPAI %	2008	10.696	26.219	0.524	70.171
QPAI %	2009	8.588	27.046	0.307	77.863
QPAI %	2010	10.013	25.883	0.280	73.811
Industries			77		
Industries x Years			462		

Notes: Table 1 provides descriptive statistics for the variable QPAI % for the IRS Sample – all corporations that filed a tax return during the year in question. QPAI % is defined as the percentage of taxable income that is derived from Qualified Production Activities.

DPAD is the variable that captures the deduction is the empirical analysis. DPAD is equal to the QPAI % multiplied by the deduction percent and intuitively is the implicit rate of tax deduction ($d\rho$ in Section 3). Here QPAI % is the average within each industry over years 2005-2010. For a 100% QPAI industry, the DPAD is equal to the DPAD rate but for a 50% QPAI industry, DPAD is only equal to half of the statutory deduction. DPAD varies over time because the deduction increases over time and across industries because they differ in their QPAI %.

Table 2 reports average QPAI % and DPAD for the Compustat Sample both over all years 2005-2010 and for each year 2005 to 2012. The average QPAI % is significantly higher for the Compustat Sample than for all corporate taxpayers meaning that firms in the Compustat sample are more concentrated in high QPAI % industries than the general population of corporate tax filers. However, because the lion's share of investment behavior is undertaken by listed firms contained in the Compustat Sample, results from the empirical analysis describe a large majority of the corporate population.

DPAD or the effective deduction rate varies from less than 0.882% in 2005 to 2.521% in 2010. The increase in the effective deduction over time is driven primarily by the increase in the statutory rate rather than an increase in the QPAI %. Given a statutory corporate tax rate of 35%, once fully phased in (2010 and beyond) the policy provides the average firm in the Compustat Sample with a effective rate reduction of 0.875 percentage points.

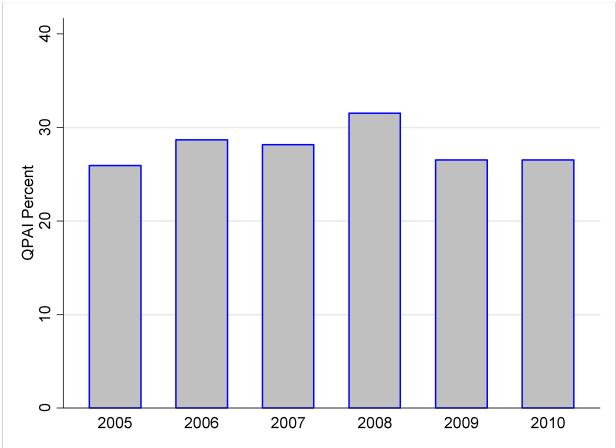
Table 2: QPAI, DPAD % for Investment Sample

Variable	Years	Median	Mean	10th pct	90th pct
QPAI%	2005 - 2012	41.335	38.7431	3.471	66.660
DPAD	2005 - 2012	2.298	2.409	0.208	4.729
DPAD	2005 - 2006	1.149	0.882	0.022	1.850
DPAD	2007 - 2009	2.298	1.729	0.045	3.699
DPAD	2010 - 2012	3.447	2.521	0.067	5.542
Firms		11,189			
Firms x Years		72,341			

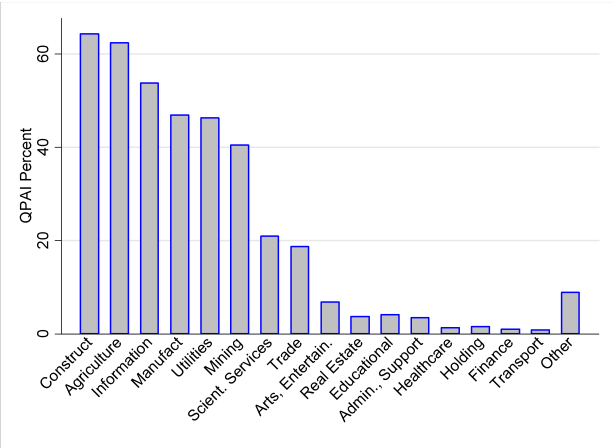
Notes: Table 2 presents QPAI % and DPAD for years 2005-2012 for the Compustat Sample - listed firms with non-zero financial statement variables needed for baseline regression analysis. QPAI % is the percentage of income derived from qualified production activities and eligible for the domestic production activities deduction. DPAD is equal to QPAI % multiplied by the statutory rate of the deduction. DPAD can be interpreted as the effective rate of the deduction given a fixed QPAI %.

Figure 3: QPAI Percent

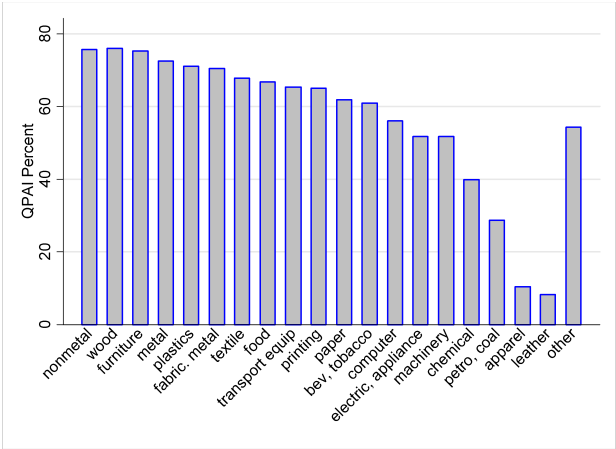
(a) QPAI Percent 2005-2010



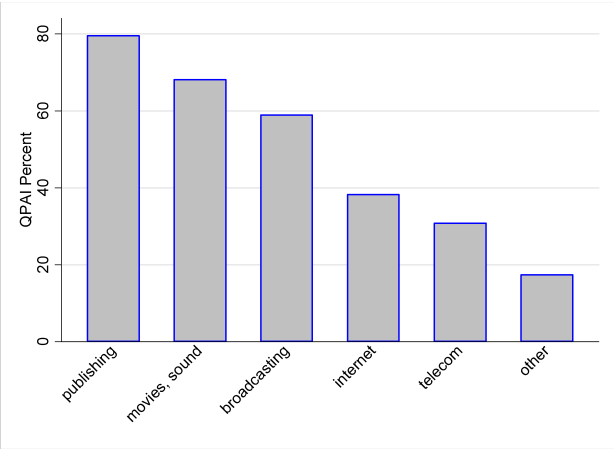
(b) QPAI by Sector



(c) Manufacturing Industries



(d) Information Industries



Note: Figures 1a - 1d present percentages of Qualified Production Income as a percentage of total income. QPAI percentage is calculated the Domestic Production Deduction divided by Income Subject to Tax as defined by the IRS Statistics of Income Division. Figure 1a presents QPAI averaged across all corporations for years 2005 - 2010. Figure 2 presents QPAI for each major production section averaged across all years 2005 - 2010. Figure 3 presents QPAI for each major industry in the manufacturing sector averaged across all years 2005 - 2010. Figure 4 presents QPAI for each major industry in the information sector averaged across all years 2005 - 2010.

4.2 Bonus Depreciation

During the time period that will be considered in the empirical analysis, a second tax policy, Bonus Depreciaiton, potentially affects investment and must be controlled for in order to accurately estimate the effects of the DPAD. Bonus depreciation works by increasing the present value of tax depreciation allowances available on $1 dollar of investment, here called the **Z Tax Term**. If firms can immediately expense investment (bonus equal to 100% as in 2011) then the Z Tax Term is equal to 1 because the firm can deduct $1 from its current tax bill. If firms cannot immediately deduct the entire purchase price of the investment from taxable income and must deduct some portion of the cost in the future, then the present value of tax depreciation allowances is less than $1 because future deductions are worth less in a present value sense. For details on the construction of the Z Tax Term, please refer to Ohrn (2014). The average value of the Z Tax Term for the investment sample is 0.917.

4.3 Firm Level Financial Statement Variables

Compustat provides financial statement data for firms listed on a major stock exchange and required to file their financial information annually with the U.S. Securities and Exchange Commission. Compustat data easily allows for the construction of the dependent investment variable and determinants of investment in addition to DPAD.

The dependent variable in all regressions contained in the body of the paper is **Investment Percent** which is equal to capital expenditure in the current year scaled by the lagged value of property plant and equipment.[9] Table 3 provides descriptive statistics for Investment Percent as well as other investment control variables. The mean value of investment percent is 0.450 with a median value of 0.196 meaning the average (median) firm replaces approximately 45% (20%) of their capital stock in a given year. The skewness of this variable is consistent with lumpy investment behavior; firms engage in large investment projects but not every year.

The additional controls that are included in the analysis and may be derived directly from Compustat data are **Marg Q** and **Cash Flow**. Marg Q controls for a firm's investment opportunities and Cash Flow controls for any investment response that may be driven by new cash on hand. Both controls have been empirically linked to investment behavior.

[9]The baseline investment analysis uses Investment Percent as the dependent variable in an effort to make results directly comparable to prior research on investment behavior among Compustat firms (Cummins et al. (1994), Desai and Goolsbee (2004), Edgerton (2010), Ohrn (2014)). The baseline results are , however, robust to alternative investment variables; baseline analyses using the log of capital expenditure are presented in Appendix C. Investment reponse to the DPAD is nearly identical under this alternative specification.

4.4 HP Index of Financial Distress

A measure of financial distress is included in the analyses to control for the effects of financing on investment in the baseline analyses and to examine the heterogeneity of investment response across firms with varying levels of financial constraint to support the second empirically testable hypothesis generated by the conceptual framework. The empirical analysis with rely on the **HP Index** as derived in Hadlock and Pierce (2010). Hadlock and Pierce (2010) find measures of financial constraint that have been used in the past (investment cash-flow sensitivity from Fazzari, Hubbard and Petersen (1988), the KZ Index from Kaplan and Zingales (1997), the Whited Wu Index from Whited and Wu (2006)) are not particularly effective at predicting financial constraint as measured by detailed qualitative information contained in financial filings. Instead, Hadlock and Pierce find that firm size and age are particularly useful predictors of financial constraint. They construct an aggregate measure of financial constraint that decreases at a decreasing rate in firm size and decreases linearly in firm age. The exact construction of the HP Index is described in Appendix B. Table 3 reports descriptive statistics for the HP Index.

4.5 Tax Status Variables

Several variables are used to capture current and future taxable status. The simplest measure of current tax status is $\mathbb{1}$**(Tax Loss)**, an indicator for whether the firm has negative taxable income.[10] To take account of the magnitude of tax losses, the continuous variable **Tax Loss** may also be used where Tax Loss is equal to negative taxable income when taxable income is less than zero and equal to zero when taxable income is equal to or greater than zero. In the investment sample, approximately 49% of firm-year observations report negative taxable income. For firms both positive and negative taxable income, the average firm has 26 million in tax losses. Among, firms with tax losses, the average firm has \$86 million in tax losses. This number is however, heavily skewed towards zero; the median firm with negative taxable income reports on \$8 million in losses.

The third measure of taxable status, **MTR**, is a simulated marginal tax rate constructed by Blouin et al. (2010). The marginal tax rates are both a function of a firms current taxable status and whether the growth trajectory of the firm will make the firm taxable in the future. The average MTR for the investment sample is 0.195 meaning the simulated tax rate on the marginal dollar of income is 19.5%. The MTRs generated by Blouin et al. (2010) are only available for years 2000-2010.

[10] Taxable income is constructed as

$$\text{Taxable Income}_t = \frac{\text{txfed}_t + \text{txfo}_t}{\tau_t} + \text{tlcf}_t - \text{tlcf}_{t-1}$$

following the reasoning laid out in Hanlon (2003). txfed is the federal tax bill reported. txfo is foreign taxes paid. tlcf is the level of tax loss carry-forwards and τ is the corporate tax rate.

Table 3: Additional Descriptive Statistics for Investment Sample

	Median	Mean	10th pctile	90th pctile
Investment Percent	0.196	0.450	0.033	0.821
Z Tax Term	0.924	0.917	0.876	0.952
Marg Q	1.493	4.630	0.835	4.986
Cash Flow	0.160	-8.368	-27.864	1.746
HP Index	-4.172	-4.129	-6.629	-1.626
$\mathbb{1}$(Tax Loss)	1.000	0.491	0.000	1.000
Tax Loss	0.000	23.423	0.000	24.000
MTR	0.224	0.202	0.021	0.347
Dec Fiscal Year	1.000	0.682	0.000	1.000
Domestic	1.000	0.672	0.000	1.000
Firms			11,189	
Firms x Years			72,341	

Notes: Table 3 reports the mean, median, 10th percentile, and 90th percentile statistics for the outcome variable (investment percent), control variables (Z Tax Term, Marg Q, Cash Flow, and HP Index), and sample splitting variables (Foreign, Foreign percent, and December Fiscal Year) for the main investment analysis sample. Tax Loss is measured in millions of dollars.

4.6 Fiscal Year Ends and Foreign Operations

Two variables are used to limit the sample to those firms that are potentially most affected by the DPAD. The first, **Dec Fiscal Year**, is an indicator equal to 1 if the firm's fiscal year ends in December and equal to 0 if the firms fiscal year ends in another month (usually March, June, or September). If firms have a December fiscal year, then the information contained in their financial statements lines up perfectly with the implementation of the DPAD – for instance, all qualified income earned in fiscal year 2004 was not subject to the DPAD and all qualified income earned in 2005 was eligible. On the other hand, qualified income earned during fiscal year 2005 for firms with June fiscal years ends may or may not be eligible for the deduction. Limiting the analysis to Dec Fiscal Year firms removes this potential source of measurement error from the analysis. 68.2% of the investment sample have fiscal years ending in December.

In several graphical analyses, the investment analysis is limited to firms that do or do not report only domestic income. Firms that report only domestic income are labeled as **Domestic**. If firms reports positive foreign income, then they presumably have foreign operations and a portion of the investment observed by the researcher may be attributable to foreign operation which generate foreign income not eligible for the DPAD. If on the other hand firms report no foreign income, then the DPAD is available for all qualified income and tests of the investment stimulus effect of the DPAD are much cleaner. 67.2% of firms in the investment sample report no income from foreign operations.

4.7 Winsorizing

Variables that potentially suffer from misreporting are Winsorized at the 1% level in an effort to limit the effects of outliers.[11] All results are robust to both more aggressive Winsorizing at the 5% level and to the absence of Winsorizing.[12] The Winsorized variables are Investment Percent, Marg Q, Cash Flow, HP Index, and Tax Losses. DPAD is left un-Winsorized because it is a product of statutory rates (3, 6, and 9%) and QPAI % which is an industry level aggregate variable and therefore already void of potential individual outliers. For the same reason, the Z Tax Term is left un-Winsorized. MTRs are constructed to vary between 0 and the top statutory tax rate. No MTR observations fall outside of these values and therefore MTRs are left unaltered. All indicator variables ($\mathbb{1}$(Tax Loss), Dec Fiscal Year, Domestic) are unaffected by the Winsorizing procedure.

[11] More precisely, observations in the bottom and top 0.5% of observations are replaced with the observations at the 0.5% and 99.5% percentile.

[12] Available upon request from the author.

5 Empirical Design and Identification

The investment impact of the DPAD may be empricailly estimated because the policy differentially affects firms that based on the percentage of income that they derive from QPAI. When the deduction is implemented and subsequented increased, the investment behaviros of the high QPAI firms may be measured against the investment behaviors of the low QPAI firms.

This differences-in-differences (DD) estimation strategy may be carried out using standard OLS regression techniques. The baseline DD specification is given by

$$\frac{I_{it}}{K_{i,t-1}} = \beta_0 + \beta_1 DPAD_{jt} + \sum_{s=2}^{n} \beta_s \text{Control}_s + \eta_i + \gamma_t + \epsilon_{it}$$

where i indexes firms, j index industries, and t indexes time. η and γ are firm and year fixed effects. In this DD specification, $DPAD$ is akin to the interaction term because it is equal to ρd in terms corresponding to the conceptual model or equal to the treatment (d) multiplied by the intensity of the treatment (ρ). ρ, which varies by firm but is fixed over time, and d, which varies over time but not by firm, are not included in the regression separately as they are captured by firm and year fixed effects.

Variation in $DPAD$ is at the industry-by-year level, so identification of the β_1 coefficient is generated from how different industries respond to the policy. The key identifying assumption is that the policies are independent of other industry-by-year shocks. To address this concerns, robustness checks are performed in which sector-by-year fixed effects, sector specific linear time trends, or sector specific quadratic time trends are included in baseline regressions. These controls account for variation at the sector level over time. With these controls, identification of the β_1 coefficient comes from how different industries within the same sectors respond to the DPAD. For example β depends on how apparel manufacturing, a low QPAI % industry in the manufacturing sector, responds to the policy compared to how furniture manufacturing, a high QPAI % industry in the manufacturing sector, responds to the policy. Reassuringly, included sector-by-year fixed effects or time trends actually increases the estimated magnitude of the policy, suggesting that sector-by-year trends do not drive empirical identification.

To test for heterogeneity in investment response across varying level of financial constraint and tax status, the DD estimation strategy is implemented for different groups of firms (high vs. low financial constraint / currently taxable vs. currently untaxable). The β_1 coefficient is then compared across the groups of firms. This technique thereby implements a differences-in-differences-in-differences (DDD) strategy; the DD coefficient is again differenced across groups that potentially respond heterogeneously to the policy. This DDD implementation is more flexible and therefore preferably to simply including a DDD term ($\rho \times d \times$ group) and cross terms in the regressions because it allows for controls to differentially affect investment across the comparison groups.

6 Investment Response

6.1 Baseline Graphical Analysis

Figure 4 presents a visual representation of the baseline DD research design described in Section 5. To construct the figures, cross sectional regressions are run in each year of the outcome variable on a rich set of controls for financial constraint, investment opportunity, cash flow, and tax depreciation allowances. The predicted values are then averaged separately for the treatment and control groups in each year. For comparability, the predicted group mean for each group in year 2002 is subtracted and the predicted mean for all firms in 2002. The treatment group is defined as firms with above 40% of income derived from QPAI and the control group are those firms with below 40% of income derived from QPAI.[13] The difference between the group mean of the treatment and control groups in years after the implementation of the DPAD in 2005 versus the the difference is years prior provides the DD estimate and quantifies the effect of the DPAD policy.

From Figure 4(A), the effect of the policy is immediately apparent. The investment behaviors of the treatment and control groups move in step during years 2002 to 2004 then diverge substantially in 2005 and beyond with the treatment group doing more investment. This striking change in investment between treatment and control group strongly supports the hypothesis that the DPAD increases investment and increases investment more among firms with a large percentage of income eligible for the deduction. A discussion the magnitude of the the investment impact is postponed until Subsection 6.2.

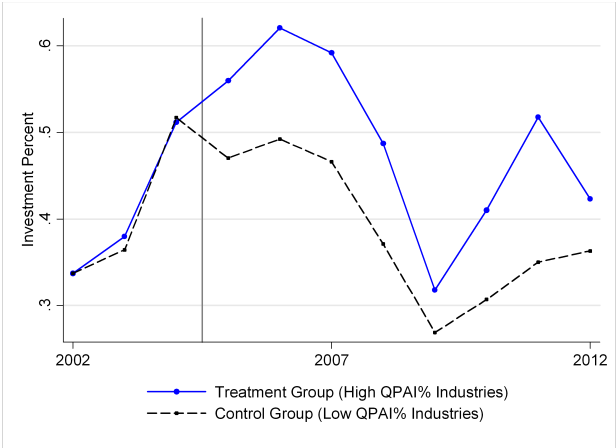
Figure 4(A) provides two additional insights. First, the nearly identical investment behavior between the treatment and control groups in years 2002 to 2005 assures that pretrends are not a concern. These years further provide placebo tests of the natural experiment and show no false positives. Second, investment behaviors diverge upon initiation of the policy but do not appreciably diverge further when the deduction is increased in 2007. There are two possible explanations for this result: either the recession of 2008 and 2009 is affecting investment behavior in a way does not allow for response by either group or, alternatievly, firms responded to the policy as if it were implemented at its long-term rate of 9%. The second result is not unintuitive given the observation that the income derived from investment projects initiated in 2005 may not arrive until 2010 and/or the *majority* of income from investment projects initiated in 2005 may arrive after 2010.

Figures 4(B) - 4(D) plot the same group means for only firms with December fiscal years, for firms that only report domestic income in years prior to 2005, and for firms that report some foreign income in years prior 2005. Consistent with the discussion presented in Section 4, the graphical analysis supports the assertion that investment behaviors of firms with December fiscal years and firms who claim no foreign income respond even more strongly to the introduction of the DPAD than the general Compustat population.

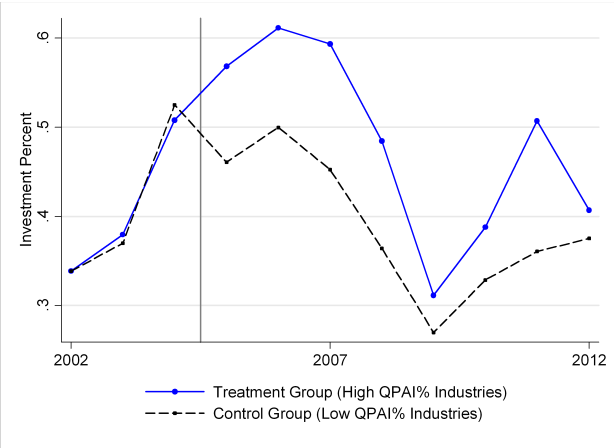
[13] The median value of QPAI is 41.335 median for the investment sample.

Figure 4: Investment Response Graphical Diff-in-Diff

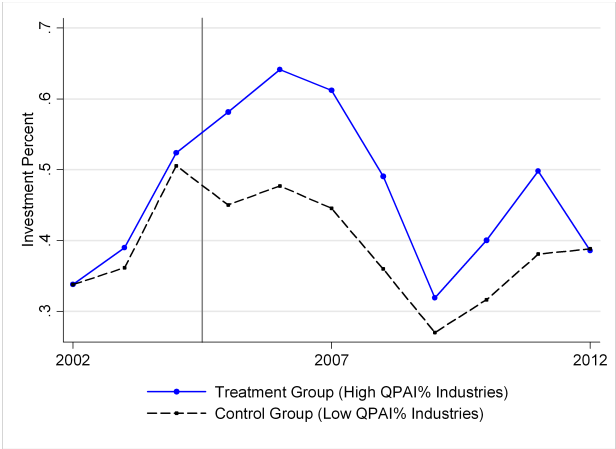
(a) All Firms



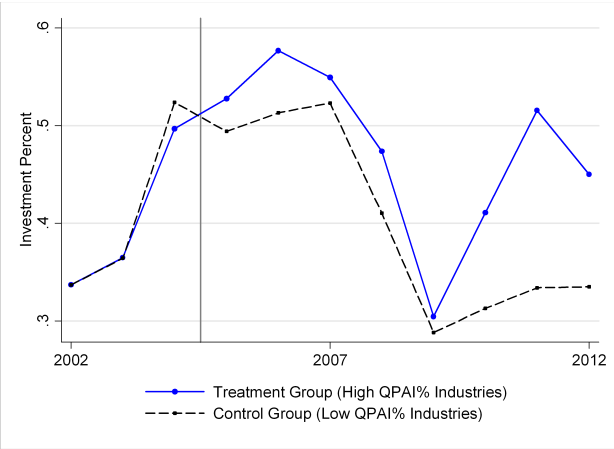
(b) December Fiscal Year Firms



(c) Domestic Firms



(d) Foreign Firms



Notes: Figures 4(A) - 4(D) plot the mean investment percent over time for groups sorted according to their industry-based treatment intensity. The intensity of the treatment depends on the percentage of income that is eligible for the Domestic Production Activities Deduction and therefore qualifies as Qualified Production Activities Income. The Treatment Group (Control Group) is defined as firms within industries in which more than (less than) 40% of income is derived from Qualified Production Activities. The treatment years are years 2005-2012 as the DPAD increases from 0 to 3 to 6 to 9% in 2005, 2007, and 2010. The averages plotted here are derived through the following procedure: cross-sectional regression of investment percent on controls for tax depreciation allowances, cash flows, and financial constraint are run in each year. Residual group means for the treatment and control group are then calculated and added to the mean investment percent for each year. Finally, group means in year 2002 are subtracted from all observations and the overall mean investment percentage in added to ease the comparison of trends. All means are count weighted.

6.2 Baseline Regression Analysis and Policy Magnitude

Table 4 presents the baseline regression analysis. Across all specifications, the coefficient on $DPAD$ is positive and statistically different from zero with at least 95% certainty. The precision and magnitude of the coefficient estimate increase when other determinants of investment behavior are added to the regression, when the analysis is limited to firms with December fiscal year ends, and when the analysis is restricted to years prior to the 2008 and 2009 recession.

The policy variable is scaled such that the $DPAD$ coefficient may be interpreted as the increase in investment percent resulting from an increase in the deduction from 0 to 9% for a firm with 100% of income eligible for the deduction. Specification (1) regresses investment percent on only $DPAD$ and firm and year fixed effects. Specification (2) includes controls for investment tax incentives, financial constraint, investment opportunities, and cash flow as well as firm and year fixed effects. The $DPAD$ coefficient in (2) is equal to 0.141 and statistically significant at the 1% level, meaning that the full implementation of the policy increases investment percent by 0.141 for a firm 100% of income derived from qualified production activities. Given the mean investment percent is 0.450, the full implementation of the policy increases investment percent by 31.3% if all income is derived from domestic production. The magnitude of the investment response to the policy is lower for the firm with the average QPAI%. In the Compustat sample, on average, firms only derive 38.7% of their income from qualified production activities. Thus, a firm that claims 38.7% of income as qualified increases investment percent by 0.055 or 12.113% in response to the full implementation of the DPAD.

The investment response to the policy may also be interpreted as an elasticity of investment percent with respect to the DPAD adjusted corporate tax rate, $\tau(1 - \rho d)$. The full implementation of the policy decreases a firm's corporate statutory tax rate by 9% and increases investment percent by 31.3% resulting in an elasticity of investment percent to corporate income tax rate of 3.47.[14] This elasticity is large relative to studies focusing on the investment impact of the bonus depreciation Desai and Goolsbee (2004), Edgerton (2010). However, the magnitude is unsurprising given arguments by Neubig (2006), Edgerton (2012), and Ohrn (2014) which assert that the accounting treatment of bonus depreciation undermines its effectiveness as an investment stimulus tool.[15] Additionally, this elasticity may be interpreted as a short run response. If there is some optimal concave time path of additional investment in response to the introduction of the policy then this estimate may be capturing a large initial increase in investment.

Specifications (3) and (4) limit the (1) and (2) analysis to firms with December fiscal years. For firms with December fiscal year ends, the introduction and subsequent increases in the policy line

[14] The elasticity of investment with respect to the net of tax rate, $1 - \tau(1 - \rho d)$, is 6.52 and comparable to net of tax elasticity of 7.2 of investment to bonus depreciation reported by Zwick and Mahon (2014).

[15] Because the DPAD affects both accounting earnings and cash flows equivalently, the response should be and is empirically larger.

up with the start of their fiscal years thus providing a cleaner test of the effects of the policy. The magnitude of the $DPAD$ coefficient estimated in specification (4) is larger than in specification (2), providing some evidence that noisiness in the data is introduced when fiscal year and the implementation of policy do not align.

Table 4: Baseline DPAD Investment Response

Dependent Variable:	Investment Percent				
Specification	(1)	(2)	(3)	(4)	(5)
DPAD	0.099**	0.141***	0.162**	0.191***	0.262***
	(0.049)	(0.050)	(0.068)	(0.068)	(0.096)
Z Tax Term		0.067***		0.127***	-0.036
		(0.024)		(0.034)	(0.056)
HP Index		-0.170***		-0.159***	-0.310***
		(0.017)		(0.022)	(0.026)
Marg Q		-0.002***		-0.002***	-0.001
		(0.000)		(0.001)	(0.001)
Cash Flow		-0.009***		-0.009***	-0.010***
		(0.000)		(0.001)	(0.001)
Dec. Fiscal Year End			✓	✓	
Prior to 2008					✓
Adj. R-Square	0.009	0.114	0.010	0.115	0.149
Firms	11,189	11,189	7,873	7,873	9,588
Firm x Years	72,341	72,341	49,338	49,338	44,532

Notes: Specifications (1) through (4) present coefficients from regressions of the form

$$\frac{I_{it}}{K_{i,t-1}} = \beta_0 + \beta_1 DPAD_{jt} + \sum_{s=1}^{n} \beta_s \text{Control}_s + \epsilon_{it}.$$

In specifications (2), (4), and (5), controls for bonus depreciation, financial distress, marginal Q, and cash flows are included. In specifications (3) and (4), the analysis is limited to firms with December fiscal year ends. Specification (5) is limited to years prior to 2008. All specifications include firm and year fixed effects. Standard errors are clustered at the firm level and are robust to heteroskedasticity. *** indicates statistical significance at the 1% level, ** at 5%, and * at 10%.

Specification (5) limits the analysis to years prior to 2008. In the restricted time domain, the investment response to the DPAD is larger. This finding is consistent with both larger short-run responses and perhaps a general lack of financing in 2008 and 2009 preventing firms from investment regardless of whether they were "treated" to a drop in their effective corporate income tax rate.

Table 5 repeats the preferred specificaiton (2) from Table 4 but includes sector-by-year fixed effects, sector linear time trends, and quadratic time trends in specifications (1), (2), and (3) respectively. Fixed effects and trends are included in order to be sure that trends in one sector versus another (such as trends in the manufacturing sector versus trends in information sector) are not driving the main empirical results. When sector controls are included, the estimates of the $DPAD$ coefficient are large and postive suggesting that the policy is effective at stimulating investment within sector and is not driven by sector level trends in investment behavior.[16]

Table 5: Investment Analysis with Sector FE and Trends

Dependent Variable:	Investment Percent		
Specification	(1)	(2)	(3)
DPAD	0.551***	0.509***	0.503***
	(0.125)	(0.112)	(0.113)
Sector x Year FE	✓		
Sector Linear Time Trends		✓	
Sector Quadratic Time Trends			✓
Adj. R-Square	0.120	0.126	0.126
Firms	10,936	10,267	10,267
Firm x Years	70,746	60,154	60,154

Notes: Specifications (1) through (4) present coefficients from regressions of the form

$$\frac{I_{it}}{K_{i,t-1}} = \beta_0 + \beta_1 DPAD_{jt} + \sum_{s=1}^{n} \beta_s \text{Control}_s + \epsilon_{it}.$$

All specifications include firm and year fixed effects and controls for bonus depreciation, financial distress, marginal Q, and cash flows. Specification (1) includes Sector x Year Fixed Effects. Specification (2) includes sector specific linear trends. Specification (3) includes sector specific quadratic time trends. Standard errors are clustered at the firm level and are robust to heteroskedasticity. *** indicates statistical significance at the 1% level, ** at 5%, and * at 10%.

[16] A large majority of Compustat firms are located in the manufacturing sector.

To summarize the findings of Section 6, there is strong support for **Hypothesis 1**; firms that derive a large portion of income from domestic manufacturing activities and thus may deduct a large percentage of profits from taxable income via the DPAD are more responsive to the policy than firms that are not significant domestic producers. Overall, the DPAD has a strong and positive effect on investment that most affects precisely the target of the policy – domestic manufacturers.

The robustness of this finding is strengthened by three additional results: (1) the response is stronger among firms whose financial data is recorded to align with the implementation of the policy suggesting that the mean investment response is downward biased via minor measurement error, (2) the response is sharper among firms that operate exclusively within the borders of the US suggesting foreign firms which record investment in foreign operations and US operations together are also undermining the baseline estimate of the policy's effect, and (3) the effect of the policy is strong and positive even in the presence of sector level fixed effects and thus the primary findings are not driven by any sector trends.

While the empirical findings strongly support **Hypothesis 1**, the empirical evidence is less clear in regard to the heterogeneity hypotheses, **Hypothesis 2** and **Hypothesis 3**. The empirical analysis continues by exploring investment responses to the DPAD according to level of financial constraint and tax status. In a manner similar to the baseline analysis, graphical analysis is presented first, followed by regression results.

7 Investment Response Heterogeneity

7.1 Heterogeneity Graphical Analysis

Figure 5 repeats the methods used to create Figure 4 (described in Subsection 6.1) separately for four groups of firms. Panel (A) focuses the analysis on firms that have below median level of averaged financial constraint during the years prior to DPAD implementation in 2005.[17] In contrast, Panel (B) examines firms with above median level of averaged financial constraint prior to 2005. The investment response of the unconstrained firms to the policy can be said to be at best lukewarm. In years 2005 through 2009, there seems to be very little difference between the behaviors of the high and low QPAI firms (the treatment and control groups). The difference between the treatment and control groups does increase in years 2010-2012, once the policy is fully implemented. In contrast, the investment behaviors of the financially constrained treatment and control groups diverge sharply upon implementation of the policy. This divergence is large and evident in all years prior to 2012. The graphical evidence provides clear support for **Hypothesis 2**; financially constrained firms seem to be much more responsive to the DPAD policy. The slack in

[17]The difference in the investment divergence between treatment and control groups across the two panels may be interpreted as a triple differenced estimation strategy. Put differently, the difference between the DD results in Panels (A) and (B) reveals heterogeneous response among financial constrained and unconstrained firms.

the borrowing constraint created by the policy seems, at least from the graphical analysis presented in Figure 5, to be a significant driver of investment response to the DPAD. Additional discussion of the effect of the policy on the borrowing constraint is postponed until regression results are presented in Subsection 7.2.

The graphical DD analysis is applied to Taxable and Non Taxable firms in panels (C) and (D). The definition of Taxable used in the graphical analysis is whether the firms had positive taxable income in more than 3/4 of years prior to the implementation of the DPAD.[18] The definition of Non Taxable is firms which reported positive taxable income in fewer than 1/4 of years prior to policy implementation. As in the financial constraint graphical analysis, the heterogeneity across firms is an ex-ante description of firm characteristics in an effort the avoid endogeneity concerns; for example, firms with high QPAI % that are more responsive to the policy may be more likely to be Non Taxable after the DPAD is enacted because their investment expenditure significantly decreases taxable income levels.

Both Taxable and Non Taxable treatment groups increase investment relative to the control groups suggesting the investment response to the policy is positive regardless of ex-ante tax status. Interestingly, the investment divergence is larger for the Non Taxable firms in years 2005 to 2008. If current tax status is strongly correlated with future tax status, then this result lies in direct opposition to **Hypothesis 3** – those firms that are less likely to be taxable once the policy is implemented and therefore less likely to benefit from the policy are most responsive to it.

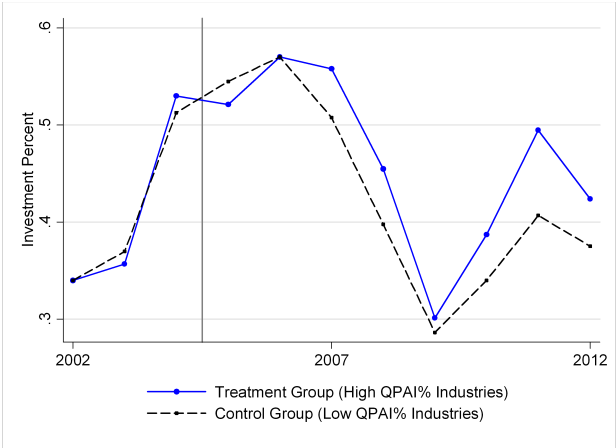
There are however, several other plausible scenarios under which these graphical findings either do not conflict with the tax status hypothesis or may, in fact, support the hypothesis. Under tax status mean reversion, the firms that are currently non-taxable may be more likely to be taxable in the future. This assumption could be born of lumpy investment behavior, those firms making large investments now could have low taxable income but plan to reap higher future profits. In this case, Non Taxable firms now are Taxable in the future and are likely to benefit from the deduction thereby explaining the relatively strong investment response among the Non Taxable group. Alternatively, current Tax Status may contain no information about future Tax Status. Under this assumption, the graphical results are not surprising.

Finally, taxable income may not be directly tied to corporate profits. Firms that report low or zero taxable income may be using tax shields such as debt to actively lower taxable income. Under this interpretation, the firms reporting tax losses in a majority of years prior to 2005 are those firms most actively pursuing tax minimizing strategies. These tax minimizers may be precisely those firms that expend resources to optimally respond to tax incentives. This reasoning would suggest that tax minimizers may increase investment most in response to the DPAD.

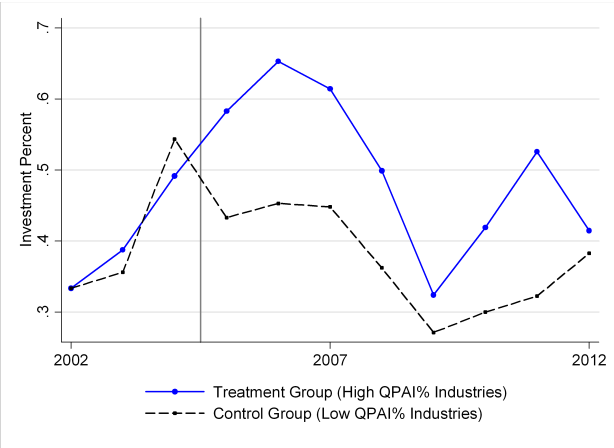
[18] For most firms, tax status is available for years 2001 - 2004. Firms have fewer than 4 observations prior to policy implementation only if the firms was added to the Compustat database after 2001 or if data needed to derive the taxable income variable was missing.

Figure 5: Heterogeneous Investment Response Graphical Diff-in-Diff

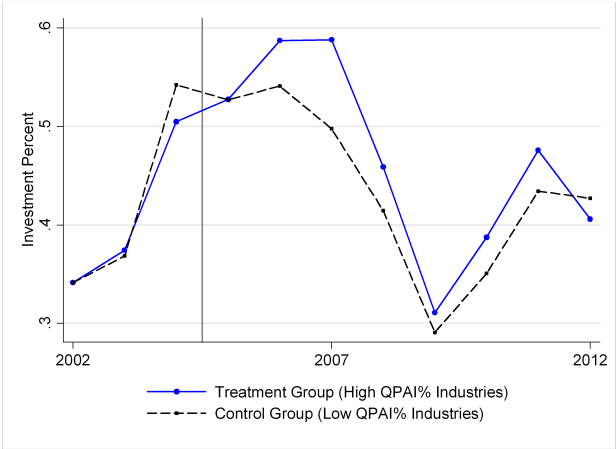
(a) Unconstrained Firms



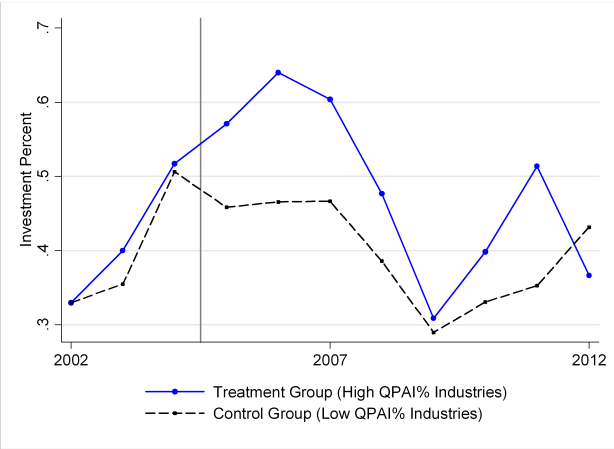
(b) Constrained Firms



(c) Taxable



(d) Non Taxable



Notes: Figure 5 plots the mean investment percent over time for groups sorted according to their industry-based treatment intensity. The intensity of the treatment depends on the percentage of income that is eligible for the Domestic Production Activities Deduction and therefore qualifies as Qualified Production Activities Income. The Treatment Group (Control Group) is defined as firms within industries in which more than (less than) 40% of income is derived from Qualified Production Activities. The treatment years are years 2005-2012 as the DPAD increases from 0 to 3 to 6 to 9% in 2005, 2007, and 2010. The averages plotted here are derived through the following procedure: cross-sectional regression of investment percent on controls for tax depreciation allowances, cash flows, and financial constraint are run in each year. Residual group means for the treatment and control group are then calculated and added to the mean investment percent for each year. Finally, group means in year 2002 are subtracted from all observations and the overall mean investment percentage in added to ease the comparison of trends. Unconstrained firms have less than median level average HP Index during years prior to 2005. Taxable (Non Taxable) firms are those with taxable income in at least (less than) half of the years prior to 2005. All means are count weighted.

7.2 Heterogeneity Regression Analysis

The heterogeneity graphical findings are echoed by the regression analysis presented in Tables 6 and 7. Specifications (1) and (2) in Table 6 presents the baseline regression of Investment Percent on $DPAD$ separately for firms with below median and above median ex ante financial constraint. Both sets of firms respond positively to the DPAD. From Specification (1), a 100% QPAI firm that is less financially constrained increases Investment Percent by 0.058 or 12.8% in response to full implementation of the policy. Whereas, from Specification (2), a 100% QPAI firm that is more financially constrained increases Investment Percent by 0.223 or nearly 50%. This divergence in responses between the more and less constrained firms suggests that the financial slack created by the policy plays an important role in investment behavior. If borrowing constraints matter for investment response then external financing must be costly suggesting a world in which information asymmetries and principal-agent problems are prevalent. Furthermore, the findings reiterates the sentiment of recent research suggesting that financial constraint actually amplifies the effect of investment stimulus policies.

While the magnitude of the difference in these responses is large, the difference between these point estimates is not statistically different from zero at even the 10% level. The statistical imprecision of the estimates may be due to a limited sample size, a weak relationship between ex ante measures of financial constraint and financial constraint upon DPAD implementation, or median sample split being sub-optimal in this context. While the first concern cannot be addressed without access to better data, the latter two concerns are addressed in Specifications (3)–(6) of Table 6. Specifications (3) and (4) limit analysis to years prior to 2008 when ex ante financial constraint data are better predictors of financial constraint during implementation. Following this logic, the difference in investment response between constrained and unconstrained firms is large and statistically significant. In years 2005-2007, all of the response to the DPAD policy was driven by financially constrained firms.

Specifications (5) and (6) limit the DPAD analysis to firms below the 80th percentile of ex ante financial constraint and above 80th percentile of financial constraint. The sample split is moved to isolate the top end of the distribution of financially constrained firms. Compustat firms are generally very large and well established, thus facing little financial constraint on average. Thus, only a small subset of Compustat firms may face hard budget constraints and be affected by additional financing slack generated by the DPAD. This sample split generates extreme response heterogeneity. The investment behavior of firms that are not financially constrained is not statistically different from zero. On the other hand, the average firms (in terms of QPAI%) increases investment percent in response to the policy by 42%. The different in investment response between these groups of firms is statistically different from zero at the 10% level. Overall, the graphical and regression evidence supports the **Hypothesis 2** prediction that financially constrained firms are more responsive to the DPAD.

Table 6: Investment Response and Financial Constraint

Dep. Variable:	Investment Percent					
Specification	(1)	(2)	(3)	(4)	(5)	(6)
HP Index Split	<Medan	>=Median	<Median	>=Median	>80%	>=80%
DPAD	0.058*	0.223*	-0.032	0.466**	0.063	0.545**
	(0.030)	(0.114)	(0.052)	(0.204)	(0.040)	(0.258)
Equality Test	P = 0.160		P = 0.018**		P= 0.064*	
Prior to 2008			✓	✓		
Adj. R-Square	0.016	0.124	0.011	0.154	0.030	0.159
Firms	3,782	4,763	3,743	4,743	6,518	2,027
Firm x Years	31,296	31,294	20,531	22,141	50,080	12,510

Notes: All specifications present coefficients from regressions of the form

$$\frac{I_{it}}{K_{i,t-1}} = \beta_0 + \beta_1 DPAD_{jt} + \sum_{s=2}^{n} \beta_s \text{Control}_s + \epsilon_{it}.$$

All specifications include controls for bonus depreciation, marginal Q, and cash flows. Specifications (1) and (3) limit the analysis to firms with below median levels of financial constraint as measured by the HP Index. Specifications (2) and (4) limit the analysis to firms with above median levels of financial constraint. Specifications (5) and (6) limits analysis to firms with above and below the 80th percentile of financial constraint respectively. Specifications (3) and (4) limits the analysis to years prior to 2008. The equality test measures whether the $DPAD$ coefficient is equal in specifications (1) and (2), (3) and (4), and (5) and (6); P-values are presented. All specifications include firm and year fixed effects. Standard errors are clustered at the firm level and are robust to heteroskedasticity. *** indicates statistical significance at the 1% level, ** at 5%, and * at 10%.

As with the financial constraint analysis, regressions focused on Tax Status heterogeneity echo graphical results. Specifications (1) and (2) split the sample in the same way as the graphical analysis. The Taxable firms analyzed in Specification (1) of Table 7, those with fewer than 2 years of tax losses in years prior to 2005, are positively responsive to the policy with a $DPAD$ coefficient of 0.118. The $DPAD$ coefficient for Non Taxable firms, presented in Specification (2), is larger but not statistically different from zero, perhaps owing to a smaller sample of firms that were not taxable for more than 2 years during years prior to 2005. The behavior of one group cannot with any confidence be said to be different than that of the other. Again, several plausible explanations are possible to reconcile this finding with **Hypothesis 3**. These include mean reversion of tax status, minimal relation between current and future taxable status, and tax loss as a signal of general responsiveness of corporate behavior to tax policy. Additionally, as noted by Edgerton (2010), "one cannot rule out, however, the possibility that difficulties in measuring firms ' taxable status drive the relative unimportance of taxable status observed in the Compustata data."

Specifications (3) and (4) split the sample based on whether firms always (3) or never (4) have taxable income in years prior to 2005. Again, the difference in behavior between the two groups is not statistically different from zero. If anything, the patterns seem to suggest that firms that never have taxable income in years 2001-2005 are more responsive to the policy. This finding may gently push support towards tax reversion or tax avoidance explanations.

Specifications (5) and (6) use estimated marginal tax rates to split the analysis instead of taxable income measures. The analysis is split at the median average MTR during years 2001 to 2005. The results are strikingly similar to the alternative tax loss splits. Firms with below median ex ante MTRs seem to be more responsive to the DPAD. The difference in behaviors is again not statistically different from zero. The results presented in Table 7 are robust to many different sample splits both on ex-ante measures of taxable income and MTR – firms that are currently less profitable and thereby have lower measures of taxable income and MTR seem to be more responsive to the DPAD in terms of point estimates. The difference in behaviors between the two groups are never statistically different from zero.

While the graphical and regression analyses provide strong support for the prediction of heterogeneous response based on financial constraint, the analyses do not provide strong empirical support for **Hypothesis 3**. Both of these findings speak to the progressivity of the DPAD policy. Theory predicted the DPAD to provide more benefit to firms that were financially constrained but profitable and therefore taxable. While the first prediction was progressive in that it benefits the firms that need financing the most, the second prediction was regressive in that it benefited most those firm with high measures of taxable income. Empirically, however, investment response is concentrated only based on financial constraint not tax status, a finding that supports only the progressive theoretical prediction.

Table 7: Investment Response and Tax Status

Dep. Variable:	Investment Percent					
Specification	(1)	(2)	(3)	(4)	(5)	(6)
Tax Loss Split	<2 Yr	>2 Yr	Taxable	Tax Loss		
MTR Split					>21%	<=21%
DPAD	0.118*	0.152	0.073	0.291	0.054	0.207*
	(0.062)	(0.120)	(0.075)	(0.268)	(0.042)	(0.124)
Equality Test	P = 0.802		P = 0.433		P= 0.245	
Adj. R-Square	0.109	0.141	0.125	0.110	0.013	0.159
Firms	4,148	3,050	3,376	1,162	2,692	3,600
Firm x Years	31,379	20,526	24,596	6,529	22,533	23,063

Notes: All specifications present coefficients from regressions of the form

$$\frac{I_{it}}{K_{i,t-1}} = \beta_0 + \beta_1 DPAD_{jt} + \sum_{s=2}^{n} \beta_s \text{Control}_s + \epsilon_{it}.$$

All specifications include controls for bonus depreciation, marginal Q, and cash flows. Specifications (1) and (2) split the sample based on whether the firm is taxable in fewer than 2 or more than 2 years during the period 2002-2004. Specifications (3) and 42) split the sample based on whether the firm is taxable in all years or no years during the period 2002-2004. Specifications (5) and (6) limit the analysis to firms with above/below median average MTRs during years 2001-2004. The equality test measures whether the $DPAD$ coefficient is equal in specifications (1) and (2), (3) and (4), and (5) and (6); P-values are presented. All specifications include firm and year fixed effects. Standard errors are clustered at the firm level and are robust to heteroskedasticity. *** indicates statistical significance at the 1% level, ** at 5%, and * at 10%.

8 Conclusions and Future Directions

The conclusions of this research, while exciting in their own right, are most enlightening when compared to the behavioral impacts of other recently enacted corporate tax incentives. In particular, the effects of the DPAD may be readily compared to responses to the Bush Tax Cuts (as studied by Chetty and Saez (2005) and Yagan (2013)) and to responses to Bonus Depreciation (as studied by Edgerton (2010), Zwick and Mahon (2014), and Ohrn (2014)). In doing so, one can draw more general conclusions about the impact of reductions in corporate income tax rates (DPAD) to reduction in capital gains and dividend tax rates (Bush Tax Cuts) to investment incentives (Bonus Depreciation).

8.1 Comparing the DPAD and the Bush Tax Cuts

The Jobs and Growth Tax Relief Act of 2003 reduced the top tax rate on dividend income in the US from 38.6% to 15% and the top rate on capital gains from 20% to 15%. These "Bush Tax Cuts" were predicted by President George W. Bush, himself, to provide "near-term support to investment" and "capital to build factories, to buy equipment, [and] hire more people." In short, these tax cuts were sold to the American people on the auspices that they would increase business investment, a key driver of macro-level economic activity. The tax cuts, however, induced no increase in investment and, in fact, led to an increase in total payouts to shareholders - a behavior that could be considered essentially the opposite of corporate investment (Yagan (2013)).

Where the Bush Tax Cuts failed to produce the desired investment response, this research suggests the DPAD was remarkably successful. For the average listed firm, the DPAD increased investment as a percentage of installed property plant and equipment by 12.113%. If this result is generalized to the corporate income tax rate, a 1% reduction in the corporate income tax rate results in a more than a 3% increase in investment as a percentage of installed capital stock. The lesson to be taken from this comparison is simple: if the government wishes to stimulate corporate investment and is choosing between a reduction in taxation on payouts to shareholders or a reduction in taxation on corporate profits, the income taxation lever is the superior tool.

From a theoretical point of view, this superiority result may be unsurprising depending on one's opinion regrading the marginal source of corporate finance. In models where marginal investments are funded from retained earnings and riskless debt as opposed to equity issuance and risky debt (King (1977), Auerbach (1979), Bradford (1981)), decreases in the corporate income tax rate should increase investment behavior while decreases in dividend and capital gains taxation should have no effect of investment – a result know as the dividend taxation neutrality. Alternatively, models in which firms finance investment though equity issuance and risky debt would predict that both levers should positively impact business investment.

8.2 Comparing the DPAD and Bonus Depreciation

Bonus Depreciation, as discussed in Section 4, is a business investment stimulus policy that has been used off and on and in varying intensities since 2001. The policy theoretically works to stimulate investment by accelerating the rate at which investments may be depreciated and deducted from taxable income. This acceleration decreases the present value price of new investment purchases.[19] The effect of the policy on Compustat firms who are responsible for the majority of US business investment has been lukewarm at best. House and Shapiro (2008), Edgerton (2010), and Ohrn (2014) all report that the policy is not as effective as theory would predict. Ohrn (2014) reports that 100% bonus depreciation policy induces the average firm to increase investment as a percentage of property, plant, and equipment by a mere 4.2% relative to statutory IRS depreciation rates. This estimated mean level investment response cannot be statistically differentiated from a zero response. Again, in contrast to this investment stimulus policy option, this study finds the DPAD effectively increases investment.

Several explanations may be offered for why the DPAD has succeeded where bonus depreciation has been generally ineffective. In fact, Neubig (2006) offers seven reasons that firms would prefer a corporate income tax rate cut to an acceleration of tax deprecation allowances. The two most applicable to understanding the investment stimulus effects of the two policies are: (1) Bonus depreciation offers only a timing benefit that does not increase the financial statement earnings associated with any given investment project. A drop in the corporate tax rate, on the other hand, offers real tax savings and as a result a lower financial statement effective tax rate. (2) Bonus depreciation only benefits tangible assets. A drop in the income tax rate incentivizes investment in both tangible and intangible assets which may be complements in the production process. Given this reasoning, its no wonder that the DPAD, which effectively decreases the corporate income tax rate, is a more effective investment stimulus policy than bonus depreciation.[20]

8.3 Future Work: the DPAD, Corporate Profits, and Corporate Payouts

While this research has presented strong evidence that the DPAD effectively increased investment among domestic producers, there is much more work to be done regarding this policy. Does the DPAD induce multinational firms to relocate production activities to the United States? Do firms increase their taxable income in response to the policy? Do firms increase dividends and share

[19] In order for Bonus Depreciation to be an effective investment stimulus, firms must positive rates of return on investment or be financially constrained. Under these conditions, receiving tax depreciation allowances today as opposed to in the future decreases the price of investment.

[20] While Bonus Depreciation may be a poor investment stimulus tool, its cost at least from a government budget perspective is zero. Government budgets do not use discounting in constructing their outlays. Thus, allowing firms to deduct new investment from taxable income now as opposed to in two or three years costs the same from a budgeting perspective. This budgeting nuance may explain why the Bonus Depreciation was extended several times even after exhaustive research efforts both by academics and government agencies concluded the policy was ineffective.

repurchases in response to the policy? Do firms hire more workers or increase wages as a result of the policy? The exogenous variation in QPAI % used in this study may be combined with data from the BEA Survey of Foreign Direct Investment, IRS Corporate Income Tax Returns, and the Longitudinal Employer–Household Dynamics to answer these important questions.

Until these question are answered, at the very least, the DPAD seems to be the investment stimulus tool that policymakers have been trying to find. In contrast to other ineffective federal tax policies, firms increase investment in response to the DPAD. The DPAD is especially effective for the ideal policy target, firms that are domestic manufacturers and are financially constrained.

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Appendix A Data Definitions from IRS "Corporate Returns - Explanation of Terms"

Income Subject to Tax: This was generally the amount of income subject to tax at the corporate level. For most corporations, income subject to tax consisted of net income minus the "Statutory Special Deductions" described in this section. However, there were certain exceptions. S corporations were usually not taxable at the corporate level and so did not have income subject to tax. Some, however, had a limited tax liability on capital gains and so were included in the statistics for this item. Likewise, regulated investment companies and real estate investment trusts generally passed their net income on to be taxed at the shareholder level; but any taxable amounts not distributed were included in income subject to tax. Because insurance companies were permitted to use reserve accounting for tax purposes, insurance income subject to tax was based on changes in reserve accounts; life insurance companies could also have been allowed an additional special deduction (discussed in Statutory Special Deductions). Consolidated returns that contain life insurance subsidiaries were not allowed to offset all of the life insurance subsidiarys gains by losses from nonlife companies, so it was possible for such a consolidated return to show no net income but still have a positive amount of income subject to tax.

Statutory Special Deductions: Statutory special deductions in the tables was the sum of the deductions for net operating loss carryovers from prior years and the special deductions for dividends and other corporate attributes allowed by the Code. These deductions were in addition to ordinary and necessary business deductions and were shown in the statistics as deductions from net income. In general, net income less statutory special deductions equaled income subject to tax. The following components of Statutory Special Deductions are shown separately in Table 20.

Domestic Production Deduction: The Domestic Production Deduction (DPD) was added as part of the American Jobs Creation Act and is available for Tax Years beginning after December 31, 2004. By keeping manufacturing and software development activities in the United States, exporters may claim a deduction for a percent of their income from qualified exports. The provision, which can be found under code section 199, was largely written to satisfy WTO objections to Extraterritorial Income (ETI) and Foreign Sales Corporation provisions. The credit is figured on Form 8903.

Appendix B Investment Control Variables

- **Marg Q**

  Marginal Q or Tobin's Q is the marginal value of an additional dollar of investment. Marg Q is empirically measured as the ratio of the market value of equity plus the book value of liabilities excluding deferred taxes, divided by the book value of assets,

  $$Q_t = \frac{\text{prcc}_t \times \text{csho}_t + \text{at}_t - \text{ceq}_t + \text{txdb}_t}{\text{at}_t},$$

  Where prcc is the price of outstanding shares, csho is the number of outstanding shares, at is total assets, ceq is outstanding equity and txdbt is the differed tax liabilities.

- **Cash Flow**

  The measure of cash flow is constructed following Kaplan and Zingales (1997). "Cash Flow/PPE" is defined as

  $$\text{Cash Flow}_t = \frac{\text{ib18}_t + \text{dp14}_t}{\text{ppent8}_{t-1}}.$$

  This ratio is the income before extraordinary items plus depreciation and amortization, scaled by the capital stock at the beginning of the year.

- **HP Index**

  Hadlock and Pierce (2010) propose a measure of financial constraint based on firm size and age.

  $$\text{HP Index} = -0.737 * \text{size} + 0.043 * \text{size}^2 - 0.04 * \text{age}$$

  where size $= \min\{\text{assets in 2004 dollars}, \$4.5 \text{ billion}\}$ and
  age $= \min\{\text{years on Compustat tapes}, 37\}$.

Appendix C Log Capx Investment Analysis

Table 8: Log CapX Investment Analysis

Dependent Variable:	Log Investment				
Specification	(1)	(2)	(3)	(4)	(5)
DPAD	0.146*	0.303***	0.232**	0.388***	0.012
	(0.081)	(0.063)	(0.100)	(0.078)	(0.092)
Z Tax Term		-0.079***		-0.109**	-0.037
		(0.030)		(0.044)	(0.054)
HP Index		-1.279***		-1.274***	-1.254***
		(0.019)		(0.022)	(0.024)
Marg Q		0.007***		0.007***	0.008***
		(0.001)		(0.001)	(0.001)
Cash Flow		-0.000		-0.000	-0.001***
		(0.000)		(0.000)	(0.000)
Dec. Fiscal Year			✓	✓	
Prior to 2008					✓
Adj. R-Square	0.062	0.305	0.071	0.307	0.286
Firms	12,302	12,302	8,850	8,850	10,480
Firm x Years	77,536	77,536	54,150	54,150	46,998

Notes: Specifications (1) through (4) present coefficients from regressions of the form

$$\ln(I_{it}) = \beta_0 + \beta_1 DPAD_{jt} + \sum_{s=1}^{n} \beta_s \text{Control}_s + \epsilon_{it}.$$

In specifications (2), (4), and (5), controls for bonus depreciation, financial distress, marginal Q, and cash flows are included. In specifications (3) and (4), the analysis is limited to firms with December fiscal year ends. Specification (5) is limited to years prior to 2008. All specifications include firm and year fixed effects. Standard errors are clustered at the firm level and are robust to heteroskedasticity. *** indicates statistical significance at the 1% level, ** at 5%, and * at 10%.

Appendix D Investment Analysis with Alternative Controls

Table 9: Investment Analysis with Alternative Controls

Dependent Variable:	Investment %		Log Capx	
Specification	(1)	(2)	(3)	(4)
DPAD	0.064	0.115*	0.090	0.193**
	(0.048)	(0.066)	(0.071)	(0.087)
Dec. Fiscal Year End		✓		✓
Adj. R-Square	0.018	0.021	0.096	0.101
Firms	10,480	7,463	13,211	9,644
Firm x Years	67,336	46,346	89,107	62,811

Notes: Specifications (1) through (4) present coefficients from regressions of the form

$$\text{Investment Var} = \beta_0 + \beta_1 DPAD_{jt} + \sum_{s=1}^{n} \beta_s \text{Control}_s + \epsilon_{it}.$$

All specifications include firm and year fixed effects, the Z Tax Term and ten piece linear splines in assets, sales, profit margin, and firm age. Specification (1) includes Sector x Year Fixed Effects. In specifications (1) and (2), the dependent investment variable is Capital Expenditure scaled by lagged Property, Plant, and Equipment. In specifications (3) and (4) the dependent investment variable is the log of Capital Expenditure. Specifications (2) and (4) limit the analysis to firms with December fiscal year ends. Standard errors are clustered at the firm level and are robust to heteroskedasticity. *** indicates statistical significance at the 1% level, ** at 5%, and * at 10%.