Investment, Accounting, and the Salience of the Corporate Income Tax

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Abstract

This paper develops and tests the hypothesis that accounting rules mitigate the impact of tax policy on firm investment decisions by obscuring the timing of tax payments. I model a firm that maximizes a discounted weighted average of after-tax cash flows and accounting profits. I estimate the weight placed on accounting profits by comparing the effectiveness of tax incentives that do and do not affect them. Investment tax credits, which do affect accounting profits, have more impact on investment than accelerated depreciation, which does not. This difference in estimated impact is not obviously driven by discounting, cash flow effects, or measurement error. Results thus suggest that accelerated depreciation provisions are less effective than they otherwise would be and that the tax burden on corporate capital could possibly be lower than we would otherwise estimate.

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1 Introduction

The effects of taxation on capital formation have inspired a great deal of economic research and frequent tax policy changes. Striking results from Chamley [1986] and Judd [1985] indicate that the socially optimal tax system involves no distortion to capital investment decisions, which is often interpreted as a zero tax rate on capital income. However, Hall and Jorgenson [1967] and Abel [2007] have stressed that the size of any effect of tax policy on investment decisions does not depend solely on the statutory tax rate, but also on the timing of deductions from taxable income that firms take to account for depreciation.[1]

Indeed, the U.S. government has used accelerated depreciation provisions to encourage capital expenditures for more than 50 years.[2] Recently, so-called “bonus depreciation”—a large, temporary acceleration of depreciation deductions—was among the major policy responses to the recessions of 2001 and 2008. Full deductibility of all equipment investment (known as “expensing”) was in place during 2011, and a permanent switch to expensing is often discussed as a component of possible corporate tax reforms.[3]

This paper studies how the accounting system may affect the perception of the timing of these depreciation deductions and may thus affect the impact of tax policy on firm investment decisions. Both anecdotes and evidence suggest that shareholders, managers, and observers of publicly-traded firms focus a great deal of attention on one particular measure of firm performance among the vast amount of data available on public firms. This measure is the bottom line of a firm’s income statement when prepared under Generally Accepted Accounting Principles (GAAP), the set of rules that govern financial reporting in the United States.[4] This measure is commonly referred to as “net income,” or “earnings,” and I will

[1] When deductions are permitted at a faster rate than economic depreciation, depreciation is said to be “accelerated.” Note further that if interest payments are deductible from taxable income, then investment may effectively be subsidized under accelerated depreciation or expensing.

[2] In 1954, depreciation rules were liberalized explicitly “to maintain the present high level of investment in plant and equipment” (Senate Finance Committee, quoted in Brazell, Dworin, and Walsh [1989]). Legislation changed the depreciation rules several times since then, but the intention to encourage investment through accelerated depreciation has persisted.

[3] See, for example, The President’s Economic Recovery Advisory Board [2010].

[4] In fact, some may focus on Earnings Before Interest and Taxes (EBIT) or Earnings Before Interest

hereafter refer to it as "book earnings."

Equity analysts and the business press devote a great deal of attention to book earnings. Commonly reported and forecasted metrics like earnings growth, earnings per share, and the price-to-earnings ratio are all based on this measure. The literature on the "accrual anomaly" further supports the notion that investors focus attention on earnings. Sloan [1996] writes that "stock prices are found to act as if investors 'fixate' on earnings, failing to reflect fully information contained in the accrual and cash-flow components of current earnings." This "fixation" is consistent with boundedly-rational investors attempting to make decisions based on only a subset of the information potentially available to them.

If investors fixate on book earnings, managers may rationally devote their energy to improving them. Indeed, incentive payments are often explicitly tied to earnings and other accounting metrics.[5] In their survey of corporate Chief Financial Officers, Graham, Harvey, and Rajgopal [2005] find that, "CFOs believe that earnings, not cash flows, are the key metric considered by outsiders." Beyond this survey evidence, accounting researchers have documented myriad empirical examples where managers sacrifice actual cash flows or alter real decisions in order to improve book earnings. For example, Erickson, Hanlon, and Maydew [2004] report that their sample of 27 firms paid a total of $320 million dollars of real cash taxes on earnings that were later alleged to be fraudulent. Baber, Fairfield, and Haggard [1991] and others suggest that firms may reduce their real spending on activities like research and development in order to avoid reporting a loss for accounting purposes, in an example of what is known as "real earnings management." Shackelford, Slemrod, and Sallee [2007] survey related literature and call for more research into its implications for tax policy.

This paper develops, formalizes, and tests the hypothesis that GAAP accounting rules

Taxes and Depreciation and Amortization (EBITDA). As these measures completely ignore tax payments, any focus on them would strengthen the points made in this paper. Obviously, it is also possible to construct performance measures that do correctly reflect the timing of cash tax payments, and some investors, firms, and managers undoubtedly pay attention to these as well. The purpose of the empirical work in this paper is to test whether any evidence for a fixation on earnings can be found in investment data.

[5] See, for example, Ittner, Larcker, and Rajan [1997].

obscure the timing of tax payments in a way that can mitigate the impact of tax policy on investment decisions. A key tenet of GAAP is the "matching principle," or the notion that revenues and expenses associated with the same activity should affect earnings at the same time. For example, expenses associated with future repairs to goods sold under warranty are recorded when the goods are sold, even though the repairs have not yet been made. Application of the matching principle to depreciation of investment goods requires that tax savings from depreciation deductions be recognized at the same time that depreciation is recognized. Although the timing of cash tax payments is affected by accelerated depreciation in the tax code, the income tax expense reported in GAAP earnings is not.

The effects of this matching on the impact of tax policy on investment can be better understood through a comparison to expensing.[6] Under expensing, firms are not required to make immediate expenditures on investment and recoup their associated tax deductions only in the future—instead they realize the tax savings immediately as well. It has long been understood that a tax system with expensing need not distort investment decisions at all, and it is this matching in time of expenditure on investment and the tax deductions associated with that investment that makes expensing nondistortionary.

A key insight of the paper is that the book earnings numbers reported under GAAP enforce a similar matching in time of expenditures and tax savings. The "cost" of an investment under GAAP—the depreciation expense—occurs at the same time as the associated benefit in the form of tax savings. When managers focus more heavily on book earnings, their decisions could, in a particular sense that I will describe, more closely resemble the undistorted decisions they would make under expensing. As a result, the long-run effective tax burden on corporate capital could feasibly be lower than it otherwise would be, but, in the short run, accelerated depreciation provisions are likely less effective than they otherwise would be.

I embed this behavior in a formal model of a firm that chooses its investment policy

[6] Again, "expensing" refers to the practice of deducting 100% of investment spending from taxable income in the year the investment is made, rather than deducting some portion in future years.

in order to maximize a weighted average of book earnings and cash flows. I show how the cost of capital and the impact of tax incentives for investment depend on the weight placed on book earnings. I also show how this weight can be estimated by comparing the impact of accelerated depreciation (which does not affect book earnings) and the investment tax credit (which does) on firm investment decisions. I estimate this weight using data from the Compustat panel of firms and historical changes in the depreciation and ITC rules. There is considerable variation across specifications, but baseline estimates suggest that accelerated depreciation has been about half as effective as the ITC in influencing firm investment decisions.

There are reasons to be concerned, however, that accelerated depreciation may be less effective than the ITC for reasons other than its accounting treatment. First, measuring the present value of future depreciation deductions requires assumptions about appropriate discount rates. If these discount rates are improperly measured, estimates of the effect of accelerated depreciation could be improperly attenuated or otherwise biased. Second, if changes in accelerated depreciation rules take the form of shifting tax deductions from a distant future year to a less distant future year, then these changes have no impact on firm cash flows in the year of investment. The ITC, of course, does affect firm cash flows in the year of invesment. If cash flows affect investment decisions, we might expect the ITC to have more impact on investment through this cash flow channel alone.

Fortunately, it is possible to isolate the depreciation deductions that are available to the firm in the year it makes an investment. These deductions need not be discounted and have the same cash flow implications as the ITC. I find little evidence that these first-year depreciation deductions have any more impact than discounted future depreciation deductions, so results do not appear to be driven by these obvious discounting or cash flow channels. I discuss a number of other factors that one might suggest as reasons that accelerated depreciation could be less effective than the ITC, but none seem clearly compelling. I thus conclude that results are at least consistent with a role for the accounting system in determining investment responses to tax policy, although I suspect that many readers will wish to see more evidence before drawing definitive conclusions.

In the next section of the paper, I briefly discuss related literature, provide additional intuition on why a tax system with expensing does not distort investment decisions, and discuss accounting rules related to depreciation deductions in more detail. Section 3 models a firm that chooses its investment policy to maximize a weighted average of cash flows and book earnings. In section 4, I discuss the data used to estimate this weight. Section 5 presents results, and Section 6 concludes.

2 Background

2.1 Related literature

I consider this paper part of the literature in behavioral corporate finance. Baker, Ruback, and Wurgler [2007] distinguish two types of behavioral corporate finance—one where managers themselves may be irrational (or boundedly-rational), and a second where managers respond rationally to the irrationality of others. In my view, this paper falls in the second category—I test the hypothesis that boundedly-rational investors focus their attention on earnings, leading rational managers to focus on them as well.[7] Note that even if one was not interested in the effects of tax policy for their own sake, one could motivate this paper with the question "Does the accounting system affect real investment decisions?" This paper provides a tax-based test of this hypothesis.

I also consider this paper part of a recent strand of public finance literature that has emphasized the importance of the salience of taxation in understanding its effects on behavior. This literature develops the insight—perhaps obvious to non-economists—that less noticeable taxes may have smaller effects on the behavior of boundedly-rational agents. Chetty,

[7] One could feasibly argue that real informational frictions make it optimal for even fully rational investors to focus on earnings, but the view of investors as boundedly-rational strikes me as more compelling.

Looney, and Kroft [2009] find that sales taxes have larger effects on consumer purchases when these taxes are more salient, and Chetty and Saez [2009] find that providing detailed information on the structure of the earned income tax credit increases its effects on labor supply. This paper argues that salience may also be important for understanding the impact of taxation on business investment decisions, although through a more nuanced channel. In this case, it is investors and other firm outsiders for whom book earnings are claimed to be particularly salient. Given this fixation on earnings, perfectly rational managers would have the incentive to act *as if* they did not find taxes salient, even if they actually understand the tax code very well.

Note that in a well-known paper by Stein [1989], a rational market still induces managers to forsake positive NPV investments in order to boost current earnings. However, Stein's use of the term "earnings" does not comport with the accounting definition used in this paper. In fact, in the model presented in this paper, a focus on current accounting earnings would tend to encourage *over*investment, because the upfront cash cost of investment does not appear on the earnings statement immediately—rather it appears only in depreciation charges in future quarters. Rogerson [1997] formalizes the well-known notion that focusing attention (and compensation) on appropriately-calculated alternative performance measures like economic value added can restore appropriate investment incentives.

Finally, this paper joins recent literature that brings insights from the study of the separation of ownership and control in corporate finance to bear on our understanding of the effects of taxation. Examples include Desai, Dyck, and Zingales [2007], Chetty and Saez [2010], Edgerton [2010], and Keuschnigg and Ribi [2010]. Beyond the previously-cited Shackelford, Slemrod, and Sallee [2007], however, few papers have yet studied the potential implications for tax policy of the much-discussed fixation on earnings. Neubig [2006] and Poterba, Rao, and Seidman [2011] discuss implications for the political economy of corporate tax reform. Graham, Hanlon, and Shevlin [2010] report survey evidence suggesting that the accounting treatment of taxation is quite important for multinational firms deciding where to locate their operations and when to repatriate earnings. Perhaps the paper most similar to this one is Robinson and Sansing [2008], who study a model where both cash flows and accounting profits enter the objective function of a manager choosing a mix of tangible and intangible investments. Their key insight is that an accounting system that fails to distinguish between operating expenses and intangibles investment could tend to discourage intangibles investment. This issue is distinct from the ones studied in this paper.

2.2 Why expensing does not distort investment decisions

The result that a tax system with expensing need not distort investment decisions dates at least to Hall and Jorgenson [1967]. To make clear the parallel between expensing and the accounting treatment of depreciation, I revisit this result in a simple model of an equity-financed firm evaluating an investment project using the net present value criterion.[8] The firm considers an investment project that requires an expenditure I_0 today that will produce expected cash flows π_t in year t. Students in an introductory corporate finance course would be taught to calculate the net present value of this project by discounting the future cash flows at an appropriate risk-adjusted rate r, with,

$$NPV_0 = -I_0 + \sum_{t=0}^{T} \frac{\pi_t}{(1+r)^t}.$$

If $NPV_0 > 0$, the firm should make the investment, while if $NPV_0 < 0$, it should not.[9]

Now introduce a tax on the project's future cash flows at a rate τ, and also allow the firm

[8]Again, note that the additional debt tax shields associated with an investment can actually result in a net *subsidy* to investment under expensing or sufficiently accelerated depreciation.

[9]In a more general setting, projects should be evaluated by considering the covariation of the project's cash flows with the pricing kernel or stochastic discount factor, that is, with the price of consumption in the states of nature in which the project produces cash flows. For example, if μ_{θ_t} is the value at time zero of a payout at time t in state of nature θ_t, then the value of a project that requires investments I_{θ_t} and produces payouts π_{θ_t} at time t in state of nature θ_t, will be,

$$NPV_0 = \sum_{t=0}^{T} \sum_{\theta_t \in \Theta_t} \mu_{\theta_t}(-I_{\theta_t} + \pi_{\theta_t}).$$

It is again clear that under expensing, the after-tax NPV of the project is still simply $(1-\tau)NPV_0$.

to *expense* its initial investment, that is, to realize tax savings of τI_0 in the year of investment. Throughout the paper, I will assume that a firm's taxable income is large enough for the firm to fully utilize any tax deductions or credits. See Edgerton [2010] for a detailed treatment of the effects of investment incentives on loss-making firms. With this tax system in place, the project now has an after-tax NPV of NPV_τ, with,

$$
\begin{aligned}
NPV_\tau &= -I_0 + \tau I_0 + \sum_{t=0}^{T} \frac{(1-\tau)\pi_t}{(1+r)^t} \\
&= (1-\tau)NPV_0.
\end{aligned}
$$

Thus, under expensing, the government simply captures a fraction τ of the project's NPV. Crucially, any investment project with $NPV_0 > 0$ that would be implemented in the absence of taxation will also have $NPV_\tau > 0$, and thus it will still be implemented in the presence of taxation. And any project that would not be implemented in the absence of taxation ($NPV_0 < 0$), will still not be implemented in the presence of taxation (because $NPV_\tau < 0$).

This tax system does not alter investment decisions because the cost of investment and the tax savings from the investment are realized at the same time, which ensures that the present values of the tax payments and the tax deductions on marginal projects (with $NPV = 0$) are exactly the same. It is easy to see that if the tax savings τI_0 in the model above were realized in future years and were thus discounted, there could indeed be projects that would have a positive NPV with no taxation, but a negative NPV with taxation. Under the current U.S. tax system, for example, the tax savings from investment are not realized at the same time as investment expenditures; rather they are realized in future years in accordance with the depreciation schedules required by the tax code. As a result, few would disagree that the current tax code discourages some investments that would be made in the absence of taxation.

2.3 Accounting for investment and depreciation

When firms make an investment in physical capital, this spending appears as a capital expenditure on the cash flow statement, but it does not appear immediately on the earnings statement. The "cost" of an investment appears on the earnings statement only as depreciation is deducted over the life of the investment, typically in a straight-line pattern. As noted earlier, application of GAAP's matching principle to depreciation of investment goods requires that tax savings from depreciation deductions be recognized at the same time that the depreciation itself is recognized. That is, GAAP requires that recognition of tax savings from depreciation deductions follow the same straight-line pattern as the recognition of depreciation, regardless of the timing of the tax savings that policymakers put into the tax code. This discrepancy between the timing of the accounting recognition of expenses for tax and financial reporting purposes creates what is known as a "temporary book-tax difference."[10]

The difference is only temporary because the total amount of depreciation deductions available for book and tax purposes is the same, but the time at which deductions are taken differs. Tax depreciation typically exceeds book depreciation in the year an investment is made, but, at some point in the future, book depreciation for the investment will exceed tax depreciation. GAAP views any tax savings in excess of book depreciation early on as a "deferred tax liability" that will have to be "paid back" by the end of the life of the investment. Eventually, the investment will have been fully depreciated for both tax and book purposes, and the deferred tax liability will be zero.

Table 1 presents a simple numerical example to illustrate these accounting concepts. It depicts a firm that is considering buying a machine for \$36 in year 1. The machine produces net sales of \$20 in each of years 1 and 2, and it depreciates completely by the end of year 2, so that it can produce nothing and has no salvage value. The firm is taxed on its profits at a rate $\tau = 0.5$, and it makes no interest payments.

[10] See Hanlon and Shevlin [2005] or Desai [2003] for more on book-tax differences and their recent behavior.

Table 1: Numerical Example

	Straight-line		Expensing	
	Year 1	Year 2	Year 1	Year 2
(1) Sales	20	20	20	20
(2) Book Depreciation	18	18	18	18
(3) Tax Depreciation	18	18	36	0
(4) Pretax Income = (1)-(2)	2	2	2	2
(5) Income Tax Expense = (4)$\times\tau$	1	1	1	1
(6) Current Taxes = ((1)-(3))$\times\tau$	1	1	-8	10
(7) Deferred Taxes = (5)-(6)	0	0	9	-9
(8) Cash Flow = (1)-(6) (-$36 in Year 1)	-17	19	-8	10
Memo: NPV of Cash Flows (r=.2)		-1.2		0.3
(9) Earnings = (4)-(5)	1	1	1	1

This table illustrates an example investment in a $36 machine that produces $20 of net sales in each year and depreciates evenly over two years for book purposes. Switching from straight-line depreciation for tax purposes to expensing shifts the project's NPV of cash flows from negative to positive, but it does not affect the project's book earnings.

The "Straight-line" columns depict the firm's income and cash flows when book and tax depreciation are both equal to straight-line depreciation of $18 per year. The firm's earnings in both years for both book and tax purposes are Sales ($20) - Depreciation ($18) - Current Taxes ($1) = $1. In year 1, the firm's cash flows are Sales ($20) - Current Taxes ($1) - Capital Expenditure ($36) = -$17. In year 2, cash flows are Sales ($20) - Current Taxes ($1) = $19.

The "Expensing" columns depict the same firm making the same investment when it may expense the investment for tax purposes—that is, when it may deduct the entire purchase price of the machine in the year it is puchased. We see that this treatment shifts $9 worth of tax liability from year 1 into year 2, and thus that $9 of cash flow is shifted forward from year 2 to year 1. With any positive discount rate, expensing thus makes the project more attractive. The memo line shows that with a discount rate of 20%, the project has a negative NPV under straight-line depreciation, but a positive NPV under expensing. Thus, if the firm evaluates projects based on the NPV of their cash flows, a switch to expensing would encourage this firm to make an investment that it otherwise would not make.

Note, however, that *expensing does not change the timing of book earnings* (line 9). Because the firm will still record \$18 of book depreciation in both year 1 and year 2, the matching principle dictates that it still book \$18 of tax savings from depreciation deductions in each year. Expensing has saved the firm \$9 in cash in year 1, which it will instead pay in year 2. GAAP, however, treats this saving as "Deferred Taxes," which will need to be "paid back" in year 2 (line 7), and thus still deducts the \$1 in income tax expense from earnings in year 1.

The key point, of course, is that expensing affects only the cash flow line and has no effect at all on the earnings line. If a firm considers the cash flow line when evaluating whether to undertake the investment, then expensing makes the net present value of making the investment larger. The more focus that the firm places on the earnings line when evaluating the project, however, the smaller are the benefits of a switch to expensing (or of any acceleration of depreciation deductions in the tax code). To summarize, *if firms evaluate projects based on any function of the projects' streams of book earnings, then depreciation schedules in the tax code have no effect on investment decisions.*[11]

Note that with the tax rate of 0.5, earnings in each of year of the project are \$1, while with no taxes at all, earnings in each year would be \$2. Thus the NPV of the earnings from the project with taxes is exactly $(1 - \tau)$ times the earnings of the project with no taxes (known as "Pretax Income"). This observation highlights a key insight of the paper: the matching principle of GAAP enforces the same matching in time of the costs and tax savings from investment that is the hallmark of expensing. If one were evaluating an investment project based on the NPV of its book earnings, one could always write the after-tax NPV of the project as $(1 - \tau)$ times the NPV with no taxes, just as we could in the expensing example in the previous section.[12] Thus every project has a positive NPV after taxes if and only if

[11]Exceptions would arise if other parameters of a function used to evaluate the stream of earnings depend on depreciation schedules. For example, it is possible that, in the long run, firms could move towards choosing projects by discounting future earnings at rates that partially correct for the impact of depreciation deductions on cash flows.

[12]More explicitly, suppose a project will produce sales net of operating expenses π_t and book depreciation

it has a positive NPV with no taxes at all. To summarize, *if firms evaluate projects based on the NPV of the projects' book earnings, the tax rate will have no effect on investment decisions.*[13]

Note that one might well question the premise of this statement, that is, that NPV is the function of earnings upon which investors and firms are focused. Indeed, some accounts of the earnings fixation would suggest that firms are most concerned with smoothing the volatility of earnings or with minimizing any shortfall in earnings relative to their or outsiders' stated expectations. If these views are the correct ones, then the conclusion of the italicized statement need not hold.

However, the insight in the statement is also somewhat more general than it first appears. In fact, the result applies in any case where firms evaluate projects based on any weighted sum of the earnings that the projects produce over time. As an example, equity analysts and investors often calculate a "target price" for a firm's stock using a multiple of earnings during the past year or a projection of earnings during the coming year. That is, they arrive at a valuation of the stock by multiplying the sum of earnings over some period by a constant, where the constant is a target price-to-earnings ratio perhaps based on the valuations of comparable firms. If the firm's manager's objective is to maximize analysts' valuation of his stock, the neutrality of investment decisions with respect to the tax rate is preserved, because any project that increases earnings in the absence of taxation will still increase earnings in the presence of taxation (just by less). Any investment that would be made with $\tau = 0$ will

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deductions D_t in each period t. The NPV of the project's earnings is then,

$$NPV_0 = \sum_{t=0}^{\infty} \frac{\pi_t - D_t}{(1+r)^t}.$$

If we introduce a tax at rate τ, the matching principle ensures that the tax savings from depreciation that can be booked in each period must be equal to τD_t. Thus, we can always write the NPV of the project's after-tax earnings as,

$$NPV_\tau = \sum_{t=0}^{\infty} \frac{(1-\tau)\pi_t - (1-\tau)D_t}{(1+r)^t} = (1-\tau)NPV_0,$$

much like we could under expensing.

[13]Note that all of these statements apply only in the absence of the ITC, as does the original Hall and Jorgenson [1967] result on the nondistortionary nature of expensing.

still be made if $\tau > 0$.

Note also the distinction between this second result and the earlier conclusion that a focus on book earnings will mitigate any effect of changes in the depreciation schedules in the tax code. This first conclusion is more robust to changes in the form of the earnings fixation, because a move toward expensing has no effect at all on the time path of earnings. For example, suppose a firm is considering a new investment, but narrowly decides against the investment because depreciation deductions would push the firm's earnings for the year below analysts' expectations. In this case, a stimulus package that included a sudden switch to expensing would do little to alter the decision, because expensing does not matter for the effect of the investment on the firm's earnings.

Although studying the implications of a focus on other functions of the earnings stream may well prove fruitful at some point, considering a firm as concerned with the NPV of both its cash flows and its earnings seems a natural place to start. The next section of the paper embeds such an assumption into a canonical investment model that can easily be taken to the data.

3 A Model of the Firm

3.1 Terminology and Setup

Firms will maximize a discounted weighted average of their streams of after-tax cash flows (CF_t) and their book earnings (BE_t). Define after-tax cash flows as,

$$CF_t = (1-\tau)[F(K_t) - p\psi(I_t, K_t) - rD_t] + B_t + \tau\delta^T K_t^T - pI_t(1 - ITC),$$

where τ is the corporate tax rate and p is the unit price of capital. K_t is the capital stock, and I_t is investment. K_t evolves according to,

$$\dot{K}_t = I_t - \delta K_t$$

for depreciation δ. D_t is the stock of debt outstanding, and B_t is new borrowing. D_t evolves according to,

$$\dot{D}_t = B_t.$$

F is a net operating income function, which could incorporate maximization over variable factors. The function ψ represents costs of adjustment from production slowdowns or worker retraining associated with the installation of new capital. Investment I_t requires a cash payment of pI_t and entitles the firm to investment tax credit savings of $pI_t ITC$.

The depreciation deductions permitted for tax purposes are determined by the stock of the firm's past capital expenditures that have not yet been used as a deduction from taxable income. I denote this quantity by K_t^T, and I will hereafter refer to it as "tax capital." Deductions are allowed in the amount $\delta^T K_t^T$, so that tax capital evolves according to:

$$\dot{K}_t^T = pI_t - \delta^T K_t^T.$$

The tax savings afforded by these deductions are in the amount $\tau\delta^T K_t^T$, and this term appears in CF_t above. The policy parameter δ^T determines the extent to which depreciation is accelerated for tax purposes.

Next define the firm's accounting profits, or book earnings, as,

$$BE_t = (1-\tau)[F(K_t) - p\psi(I_t, K_t) - rD_t - \delta^B K_t^B] + pI_t ITC.$$

Note that revenues $F(K_t)$, adjustment costs $p\psi(I_t, K_t)$, interest payments rD_t, and invest-

Table 2: The Income Statement

EBITDA	(1)	$F(K_t) - p\psi(I_t, K_t)$
− Depreciation	(2)	$\delta^B K_t^B$
= EBIT	(3)	$F(K_t) - p\psi(I_t, K_t) - \delta^B K_t^B$
− Interest Expense	(4)	rD_t
= Pretax Income	(5)	$F(K_t) - p\psi(I_t, K_t) - \delta^B K_t^B - rD_t$
− Income Taxes	(6)	$\tau[F(K_t) - p\psi(I_t, K_t) - rD_t - \delta_t^T K_t^T] - pI_t ITC$
− Deferred Taxes	(7)	$\tau[\delta^T K_t^T - \delta^B K_t^B]$
= Net Income	(8)	$(1-\tau)[F(K_t) - p\psi(I_t, K_t) - rD_t - \delta^B K_t^B] + pI_t ITC$

ment tax credits $pI_t ITC$ enter into both after-tax cash flows and book earnings.[14] In lieu of the capital expenditure pI_t and cash tax savings $\tau\delta^T K_t^T$ that appear in cash flows, there appears in book earnings a book measure of depreciation deductions $\delta^B K_t^B$ and their associated tax savings $\tau\delta^B K_t^B$. Much like tax capital, book capital evolves according to,

$$\dot{K}_t^B = pI_t - \delta^B K_t^B.$$

The difference between after-tax cash flows and book earnings is,

$$CF_t - BE_t = \delta^B K_t^B + \tau(\delta^T K_t^T - \delta^B K_t^B) - pI_t + B_t.$$

These terms should be familiar to anyone acquainted with the reconciliation of earnings and cash flows that appears in firms' Statement of Cash Flows under GAAP. Beginning with book earnings, one adds back the noncash charges for depreciation ($\delta^B K_t^B$) and deferred taxes ($\tau(\delta^T K_t^T - \delta^B K_t^B)$) to reach Cash Flow from Operating Activities. To Cash Flow

[14] I have assumed here that firms use the "flow-through method" of accounting for the investment tax credit, meaning that the credit is recognized as a reduction in income tax expense in the year of the investment. Under Accounting Principles Board Opinion No. 4, in effect from 1964 through the repeal of the investment tax credit in 1986, firms had the option to use either the flow-through method or the "deferral method," under which the credit is recognized gradually over the course of the life of the investment. Choosing the flow-through method maximizes the present value of the tax savings from the credit, while choosing the deferral method would smooth the savings over time. Consistent with the model developed in this paper, anecdotal evidence suggests that most firms chose the flow-through method. For example, in their "Intermediate Accounting" textbook, Davidson, Hanouille, Stickney, and Weill [1985] state that "the flow-through method of accounting for the investment credit is far more commonly used in practice."

Table 3: The Cash Flow Statement

Net Income	(1)	$(1-\tau)[F(K_t) - p\psi(I_t, K_t) - \delta^B K_t^B - rD_t] + pI_t ITC$
+ Depreciation	(2)	$\delta^B K_t^B$
+ Deferred Taxes	(3)	$\tau[\delta^T K_t^T - \delta^B K_t^B]$
= Operating Cash Flow	(4)	$(1-\tau)[F(K_t) - p\psi(I_t, K_t) - rD_t] + \tau\delta_t^T K_t^T + pI_t ITC$
+ Investing Cash Flow	(5)	$-\, pI_t$
+ Financing Cash Flow	(6)	B_t
= Net Cash Flow	(7)	$(1-\tau)[F(K_t) - p\psi(I_t, K_t) - rD_t]$ $+ \tau\delta^T K_t^T - pI_t(1 - ITC) + B_t$

from Operating Activities, we add Cash Flow from Investing Activities ($-pI_t$), and Cash Flow from Financing Activities (B_t), to reach total Net Cash Flow. Tables 2 and 3 present the income and cash flow statements that would appear in SEC filings or annual reports presented under US GAAP for the firm in the model.

3.2 Investment Policy

I assume that the firm places a weight α on book earnings (BE) and a weight $(1-\alpha)$ on after-tax cash flows (CF) when choosing its investment. The firm solves,

$$\max_{\{I_t, B_t\}} \int_0^\infty e^{-rt} \left[\alpha BE_t + (1-\alpha) CF_t\right] dt$$

subject to,

$$\begin{aligned} \dot{K}_t &= I_t - \delta K_t \\ \dot{K}_t^B &= pI_t - \delta^B K_t^B \\ \dot{K}_t^T &= pI_t - \delta^T K_t^T \\ \dot{D}_t &= B_t \\ D_t &\leq \bar{D}. \end{aligned}$$

The final constraint crudely prevents the firm from choosing to be fully debt financed, which would otherwise be optimal.[15] This problem is very similar to a standard investment problem, with two important differences. First, it is traditionally assumed that $\alpha = 0$ and the firm considers only its cash flows. Second, there are now three types of capital stocks that the firm must track. The stock of physical capital, K_t, is familiar from traditional models, but I have now introduced accounting measures of this stock for both book and tax purposes, K_t^B and K_t^T.

From this model, with no adjustment costs ($\psi = 0$), I derive the user cost of capital,

$$F'(K_t) = \frac{(r+\delta)p}{1-\tau}\left(1 - \alpha + \alpha z^B - \tau[(1-\alpha)z^T + \alpha z^B] - ITC\right), \tag{1}$$

where z^T and z^B are the present values of depreciation deductions for tax and book purposes, respectively.[16] Derivations appear in an appendix. When $\alpha = 0$, the user cost expression found in (1) simplifies to the one in Hall and Jorgenson [1967],

$$F'(K_t) = \frac{(r+\delta)p}{1-\tau}\left(1 - \tau z^T - ITC\right).$$

Thus the model shows how this canonical expression should be modified if a firm cares about its book earnings in addition to its cash flows. Namely, the optimal level of the capital stock will also reflect α, the weight placed on book earnings, and z^B, the present value of future depreciation deductions for book purposes.

Define the *tax wedge* as the distortion to the return on a marginal dollar of investment

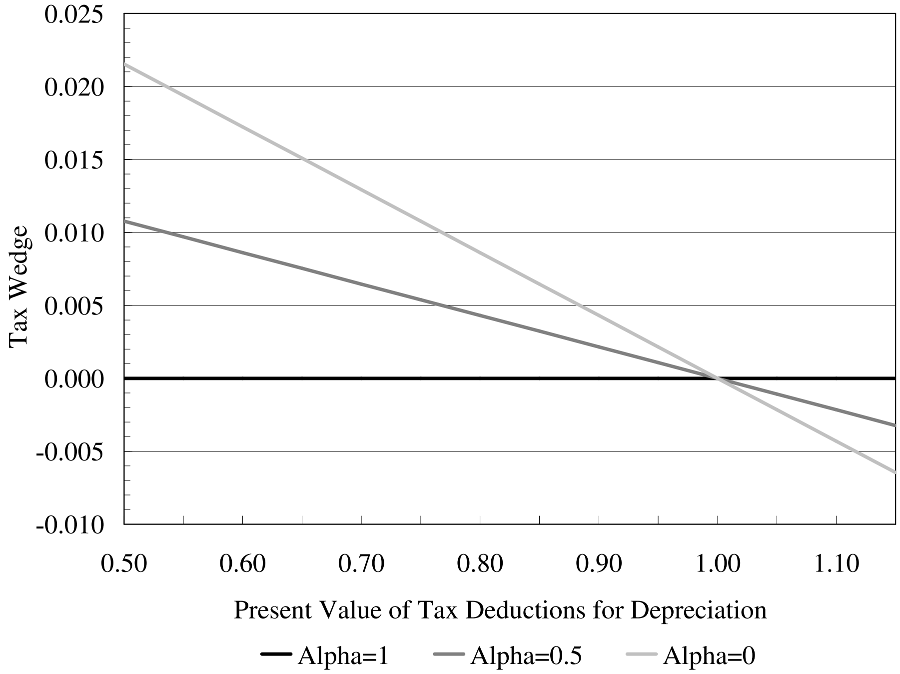
[15] The specification of this constraint can matter for the effective tax burden on capital when the limit on borrowing or debt depends on the amount of investment or the size of the capital stock. It does not, however, affect the relative impact of accelerated depreciation and the ITC, so I abstract from these complications here.

[16] That is,

$$z^T = \int_0^\infty e^{-rs}\delta^T e^{-\delta^T s} ds = \frac{\delta^T}{r+\delta^T}$$

$$z^B = \int_0^\infty e^{-rs}\delta^B e^{-\delta^B s} ds = \frac{\delta^B}{r+\delta^B}.$$

Figure 1: Tax Wedge as Function of z^T for Different Values of α



that is induced by the tax system:

$$F'(\tilde{K}_{SS})/p - F'(K_{SS})/p = \left[(1-\alpha)\tau(1-z^T) - ITC\right]\frac{r+\delta}{1-\tau},$$

where K_{SS} is the capital stock *without* tax distortion, and $\tilde{K}_{SS}$ is the capital stock *with* tax distortion. Figure 1 plots the tax wedge as a a function of z^T for $\alpha = 0$, $\alpha = 0.5$, and $\alpha = 1$, with $r = 0.05$, $\tau = 0.35$ and $ITC = 0$. I set $\delta = 0.03$, roughly the rate of depreciation on nonresidential structures.[17] First, note that the tax wedge is still zero under full expensing ($z^T = 1$), no matter the value of α. Second, note that the tax wedge is zero if $\alpha = 1$, regardless of the tax parameters. As I've argued above, the book treatment of depreciation resembles expensing, in that deductions for depreciation and their associated tax savings appear contemporaneously. If firms focus entirely on the NPV of book earnings, then there is no distortion to investment imposed by the tax rate.[18]

[17]See, for example, Gravelle [1994].

[18]Tax distortions are often described using *effective tax rates* (ETRs), where the tax wedge above is

As z^T falls below 1, the tax wedge rises less quickly when $\alpha > 0$ than when $\alpha = 0$. The departure from expensing induces less distortion when $\alpha > 0$ because it affects only cash flows and not book earnings. These results suggest that the distortion to the capital stock created by the corporate income tax is smaller than we would calculate if we assumed that firms did not include book earnings in their objective function. Likewise, a policy change that moves towards expensing would have smaller effects than we might otherwise anticipate.

For example, under current law, most business investments in structures are depreciated over 39 years. The present discounted value of the depreciation deductions associated with \$1 of investment in business structures is not far from \$0.55. If $\alpha = 0$, then Figure 1 suggests that the tax wedge on equity-financed business structures is about 2 percentage points (on a base around 5%, for a rate of 40%). A switch to expensing would drastically reduce the tax wedge from 2% to zero. If, however, $\alpha = 0.5$, then the tax wedge on structures is only 1 percentage point to begin with, and a switch to expensing would produce only half as large a reduction in the tax burden.

3.3 Estimating α

With adjustment costs nonzero, I solve for the derivative of the adjustment cost function,

$$\psi_I = \frac{\frac{\lambda_0}{p_0} - \left(1 - \alpha + \alpha z^B - \tau[(1-\alpha)z^T + \alpha z^B] - ITC\right)}{1-\tau}, \tag{2}$$

expressed as a percentage of the pre-tax, tax-distorted rate of return. This exercise is complicated a bit in this setting by the fact that a focus on book earnings would already distort, in a sense, the firm's investment choice relative to its choice if it focused entirely on cash flows. In fact, it would distort investment upwards, since the "cost" of investment is reduced from p to pz^B, the present value of future book depreciation deductions. Since changes in α shift the denominator of the ETR as well as the numerator, the ETR calculated in this way can either increase or decrease with α, depending on the value of z^B relative to economic depreciation. I judge that the tax wedge discussed in the text is thus the best way of summarizing the effects of the tax system on incentives for investment when α may vary.

Regarding the potential for a focus on book earnings to distort investment upwards, it is important to remember that other features of the separation of ownership and control, namely investors' uncertainty that managers will pay out the returns to their investments, would tend to distort aggregate investment downwards. Most commentators seem to think that aggregate savings and investment rates are "too low" in some sense, so I find it most natural to think about taxation exacerbating this downward distortion rather than correcting an upward distortion.

where λ_0/p is the shadow value to the firm of a marginal dollar of capital, or Q. With $\alpha = 0$, this simplifies to an expression like one in Summers [1981],

$$\psi_I = \frac{\frac{\lambda_0}{p} - \left(1 - \tau z^T - ITC\right)}{1-\tau},$$

known as "tax-adjusted Q." Again, the model shows us how a canonical investment function should be modified if a firm cares about its book earnings in addition to its cash flows.

In particular, with $\alpha > 0$, we find new implications for the effects of the tax policy variables. First, note that changes to the investment tax credit, ITC, are no longer equivalent to changes to depreciation allowances, τz^T. That is,

$$\frac{\partial \psi_I}{\partial ITC} = \frac{1}{1-\tau} > \frac{1-\alpha}{1-\tau} = \frac{1}{\tau}\frac{\partial \psi_I}{\partial z^T}.$$

If α were equal to zero, these two forms of investment incentives would have the same effect. Now, however, the effects of depreciation allowances are mitigated because they do not affect book earnings in the way that the ITC does.

In principle, α can be estimated quite easily. Under the familiar assumption of quadratic adjustment costs,

$$\psi(I_t, K_t) = \frac{1}{2c}\left[\frac{I_t}{K_t} - a\right]^2 K_t,$$

we reach a linear expression for the investment ratio,

$$\frac{I_0}{K_0} = a + c\frac{\frac{\lambda_0}{p_0} - \left(1 - \alpha + \alpha z^B - \tau[(1-\alpha)z^T + \alpha z^B] - ITC\right)}{1-\tau}. \qquad (3)$$

In theory, the same coefficient c should multiply both marginal Q (that is, λ_0/p) and the tax variables. When estimating c, however, some measure of the market value of a firm divided by the replacement cost of its capital must be used as a proxy for marginal Q. The poor performance of these measures in investment equations, particularly when compared to cash flow variables, has inspired many attempts to solve the potential problem of measurement error in marginal Q. Examples include Cummins, Hassett, and Hubbard [1994], Erickson and Whited [2000], and Cummins, Hassett, and Oliner [2006].

Desai and Goolsbee [2004] take a particularly simple and transparent approach to dealing with this measurement error for the purpose of isolating the effects of the tax variables. They observe that,

$$\frac{\frac{\lambda}{p} - (1 - \tau z - ITC)}{1-\tau} = \frac{\frac{\lambda}{p}}{1-\tau} - \frac{1 - \tau z - ITC}{1-\tau},$$

and they estimate variations of,

$$\frac{I_{it}}{K_{i,t-1}} = \beta_1 \left[\frac{\frac{\lambda_{ti}}{p_t}}{1-\tau_t} \right] + \beta_2 \left[\frac{1 - \tau_t z_{tj} - ITC_{tj}}{1-\tau_t} \right],$$

where subscripts index firm i in industry j in year t. That is, they simply allow different coefficient estimates on the "Q" and "tax term" components of tax-adjusted Q, so that problems measuring Q do not improperly attenuate estimates of the effects of the tax variables.

I take a very similar approach by simply noting that the expression in (3) above can be written,

$$\frac{I_0}{K_0} = a + c\frac{ITC}{1-\tau} + c(1-\alpha)\frac{\tau z^T}{1-\tau} + c\frac{\frac{\lambda_0}{p_0} - 1}{1-\tau} + c\alpha\frac{1}{1-\tau} - c\alpha z^B. \tag{4}$$

That is, the ITC and accelerated depreciation terms can also be separated. If I run the simple linear regression,

$$\frac{I_{it}}{K_{i,t-1}} = \beta_0 + \beta_1\frac{ITC_{it}}{1-\tau_t} + \beta_2\frac{\tau_t z_{it}^T}{1-\tau_t} + \beta_3\frac{\frac{\lambda_{it}}{p_{it}} - 1}{1-\tau_t}, \tag{5}$$

then the ratio β_2/β_1 identifies $(1-\alpha)$.

Note that (4) suggests that other coefficients might also be of use in estimating α. However, I would not expect the coefficient on the Q term to provide useful information due to the well-known attenuation problems discussed above. The penultimate term will be absorbed by year fixed effects. The last term involving z^B, the present value of depreciation deductions for book purposes, will largely be absorbed by firm fixed effects.[19]

The model just presented provides an explicit theoretical foundation for the equation to be estimated, but this specification is also intuitively appealing. Results will take the form of simple, transparent OLS regressions of investment ratios on tax variables, controlling for variables like Q (and cash flows) that are known to affect investment decisions. These results are also straightforward modifications of specifications that have a long history in the literature on taxes and investment, and thus should be familiar to readers of this literature. Finally, the key result is a simple, intuitive comparison of two coefficients. The hypothesis developed in the paper thus far suggests that tax incentives for investment that affect both book earnings and cash flows should have more impact than those that affect only cash flows. A simple comparison of the coefficients on the ITC and accelerated depreciation provides an intuitively appealing test of this hypothesis.

4 Data

Following many prior papers in the literature, I use firm-level financial statement data from Compustat to construct measures of investment, Q, and cash flows. I also construct tax variables that reflect repeated changes in corporate tax laws in the United States over the last several decades. Legislation changed corporate tax rates in 1964, 1968, 1970, 1979, and 1987. There were important changes to depreciation rules in 1962, 1971, 1981, and 1987. Bonus depreciation was in place from 2002 to 2004 (and again from 2008 to 2010). The investment tax credit was introduced in 1962, repealed in 1969, reinstated in 1971, increased

[19] One might note, however, that this term could change somewhat over time as each firm's investment mix evolves and as interest rates change. One could consider constructing a time-varying measure of z^B from the information on book depreciation charges in Compustat to include in my regressions, but this exercise strikes me as unlikely to produce much more than noise. I will thus include no controls for z^B beyond firm fixed effects. Some readers could then worry that the omission of z^B from the equation above will bias empirical estimates. For this concern to be valid, however, one would need to assume that $\alpha > 0$ and thus that the null hypothesis to be tested can already be rejected.

It is also worth noting that firms appear to have some discretion over their choice of depreciation method for book purposes, and a small literature examines this choice, for example, Keating and Zimmerman [1999]. The interaction of this choice with firm investment decisions is a bit beyond the scope of this paper, but would be an interesting topic for future research.

in 1975, and repealed in 1986.[20] These changes have often differentially affected investments in different assets in rather arbitrary ways. As one example, the Tax Reform Act of 1986 changed the investment tax credit available for trucks from 10% to 0%, while it changed the ITC available for cars from 6% to 0%.[21]

I follow Cummins, Hassett, and Hubbard [1994], Desai and Goolsbee [2004], and others in using this variation in the tax treatment of different kinds of assets to identify the impact of tax variables on investment. I thank Dale Jorgenson for providing data on investment tax credits and the present value of depreciation deductions available in each year for each asset type. I collected additional information on the depreciation deduction available in the year of investment from IRS publications. These variables are matched to the 1997 Capital Flows table from the Bureau of Economic Analysis, which records the amount of investment made by each industry in each asset category.[22] I construct depreciation deduction values and investment tax credit rates at the industry level by taking a weighted average across the assets purchased by each industry, with the weights equal to the percentage of the industry's spending accounted for by each asset. I then construct the tax term components of tax-adjusted Q,

$$\text{Tax term}_{it} \equiv \frac{\tau_t z_{jt} + ITC_{jt}}{1-\tau_t},$$

for firm i in industry j and year t. The tax term is constructed separately for equipment investment and structures investment. Note that the tax term does not vary across firms within each industry-year combination, so it is not possible to control for variation at the industry-year level by including industry-year dummies in regressions.

[20]Note that all variation in the ITC thus occurs in data that is more than twenty years old. I would be delighted to see future research designs capable of testing the hypotheses from in this paper using more recent data.

[21]See Brazell, Dworin, and Walsh [1989], Cummins, Hassett, and Hubbard [1994], or Gravelle [1994] for more on the history of relevant tax policy.

[22]There are 28 equipment categories, with examples including Computers and Peripheral Equipment, Metalworking Machinery, and Autos. There are 23 structures categories, with examples including Industrial Buildings, Railroads, and Petroleum Pipelines. There are 123 industries, which are roughly at the three-digit NAICS level. Examples include Coal Mining, Plastic and Rubber Products Manufacturing, and Air Transportation.

Tax terms constructed in this manner depend only on statutory variables like the corporate tax rate, depreciation schedules, and investment tax credit parameters.[23] These variables are averaged at the industry level using a set of weights that are fixed over time and do not vary with any (possibly tax-induced) changes in the mix of assets employed by a given industry. Thus, there is no mechanical relation between the decisions of firms in Compustat and changes in the tax variables that are included in regression results. Further, I present specifications that include year fixed effects to deflect concerns about policy endogeneity that would arise, for example, when investment incentives become more generous exactly when investment is low. With year fixed effects included, identification of the effects of tax variables comes only from differences across industries in changes in the tax treatment of the assets that they purchase (with the bundle of assets held fixed) and not from time series variation in the generosity of tax incentives. I present results from the sample period 1962 to 2005.[24]

5 Results

Columns 1 and 2 of Table 4 present regressions of the form,

$$\frac{I_{it}}{K_{i,t-1}} = \beta_0 + \beta_1 \frac{\tau_t z_{it}^T + ITC_{it}}{1-\tau_t} + \beta_2 \frac{\frac{\lambda_{it}}{p_{it}} - 1}{1-\tau_t} + \beta_3 \frac{\text{CashFlow}_{it}}{K_{i,t-1}}.$$

All specifications presented in the paper include firm fixed effects. Column 1 does not include year fixed effects; column 2 does include them. Thus we might expect the tax coefficients in the column 1 to be biased downward by policy endogeneity if accelerated depreciation and

[23]I ignore any progressivity in the corporate tax rate schedule that would create different marginal rates in a narrow range of incomes near zero. The present value of depreciation deductions also varies somewhat over time with the interest rates used to do the discounting. These calculations were done by Dale Jorgenson using the after-tax BAA rate.

[24]Edgerton [2010] finds that the effects of investment incentives may be mitigated in firms that lose money or have low cash flows. As losses have been high and cash flows low during the bonus depreciation episodes of the 2000s, one could worry that that these episodes would improperly depress the coefficients on accelerated depreciation. Prior versions of the paper, however, used samples through 1990 for this reason, and estimates of α were little different.

the ITC are used as counter-cyclical policy tools. The results in the table are consistent with this story. That is, the coefficient on the tax term for equipment is smaller in magnitude when excluding year effects than when including them. The coefficient on the tax term for structures is actually negative when excluding the year effects (consistent with tax incentives for structures investment becoming more generous in years when investment was low) and essentially zero when including them. The results that tax incentives for equipment are more effective than those for structures (and that, in general, structures investment is more difficult to explain than equipment investment) have a long history in the literature. I thus focus in these results on the equipment tax term.

The results in column 2 are quite similar to those of Desai and Goolsbee [2004] in that the coefficient on the "Tax Term", $(\tau z^T + ITC)/(1-\tau)$, is economically important. When clustering standard errors at the firm level, Desai and Goolsbee [2004] find it to be statistically significant as well. However, in this setting where the annual variation in the tax variables occurs only at the industry level, it is appropriate to cluster standard errors at the industry level. Column 2 shows that the Desai and Goolsbee [2004] result is no longer statistically significant at conventional levels when clustering by industry, although it is significant at the 21% level. Note again, however, that we should expect a *downward* bias on the tax term coefficient in column 1, where year dummies are not included. Thus the coefficient in this column still provides evidence of an economically important effect of the tax variables on investment that is also robustly statistically significant.

In columns 3 through 8 of Table 4, the terms on the right-hand side are rearranged as in Equation 5 above. The equipment tax term is split into two parts—one for the present value of depreciation deductions τz^T, and the other for the ITC. The even-numbered columns include year fixed effects; the odd-numbered columns do not. The distribution of investment is highly skewed towards the largest firms, so it is useful to test whether results hold in samples consisting only of large firms. The sample in columns 3 and 4 include all Compustat firms, columns 5 and 6 include only the largest 3000 firms when ranked by assets in the previous year, and columns 7 and 8 include only the largest 500 firms each year.

Results show clearly that the effect of the Tax Term in columns 1 and 2 is driven more by the investment tax credit than by accelerated depreciation. That is, the coefficient on the ITC is larger in magnitude than that on the depreciation term in every column. The bottom row of estimates presents the value of $(1 - \hat{\beta}_2/\hat{\beta}_1)$, the estimate of α. The next row presents the p-value from the linear hypothesis test that the coefficients on the ITC and τz^T are equal, which would imply $\alpha = 0$.

Table 4: Regressions of investment to capital stock ratio on tax variables and controls

	All Firms	All Firms	All Firms	All Firms	Largest 3000	Largest 3000	Largest 500	Largest 500
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Equipment Tax Term	.408	.720						
	(.040)***	(.570)						
Equipment $\frac{ITC}{1-\tau}$			.517	1.329	.603	.773	.270	.276
			(.068)***	(.686)*	(.064)***	(.583)	(.041)***	(.615)
Equipment $\frac{\tau z^T}{1-\tau}$			.286	.577	.277	.144	.137	.229
			(.047)***	(.577)	(.038)***	(.485)	(.047)***	(.476)
Structures Tax Term	-.219	.033	-.166	-.018	-.211	-.055	-.064	-.044
	(.040)***	(.128)	(.034)***	(.144)	(.032)***	(.117)	(.038)*	(.092)
$\frac{Q-1}{1-\tau}$	.037	.036	.037	.036	.053	.052	.021	.020
	(.003)***	(.003)***	(.003)***	(.003)***	(.003)***	(.003)***	(.005)***	(.004)***
Cash flow	-.006	-.007	-.006	-.007	.011	.011	.078	.075
	(.003)*	(.003)**	(.003)*	(.003)**	(.008)	(.008)	(.022)***	(.022)***
Year Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
Alpha			.447	.566	.540	.814	.494	.169
P-Value			.011	.096	.00003	.138	.044	.930
Firms	12457	12457	12457	12457	9249	9249	1474	1474
Observations	128023	128023	128023	128023	97479	97479	20409	20409
R^2	.333	.345	.333	.345	.397	.41	.435	.465

Columns 1 and 2 present regressions of the form,

$$\frac{I_{it}}{K_{i,t-1}} = \beta_0 + \beta_1 \frac{ITC_{it} + \tau_t z_{it}^T}{1-\tau_t} + \beta_2 \frac{\frac{\lambda_{it}}{p_{it}} - 1}{1-\tau_t} + \beta_3 \frac{\text{CashFlow}_{it}}{K_{i,t-1}}.$$

Columns 3 through 8 present regressions of the form,

$$\frac{I_{it}}{K_{i,t-1}} = \beta_0 + \beta_1 \frac{ITC_{it}}{1-\tau_t} + \beta_2 \frac{\tau_t z_{it}^T}{1-\tau_t} + \beta_3 \frac{\frac{\lambda_{it}}{p_{it}} - 1}{1-\tau_t} + \beta_4 \frac{\text{CashFlow}_{it}}{K_{i,t-1}}.$$

The Alpha row reports the value of $(1 - \hat{\beta}_2/\hat{\beta}_1)$, the measure of the weight that firms place on book earnings when making investment decisions. The P-Value row reports the p-value from the linear hypothesis test that $\beta_1 = \beta_2$. Columns 1 through 4 include all non-missing Compustat firm-year observations from 1962 to 2005. Columns 5 and 6 restrict the sample to the largest 3000 firms by prior-year total assets in years when there are more than 3000 firms in the sample. Columns 7 and 8 restrict the sample to the largest 500 firms. All specifications include firm fixed effects. Standard errors in parentheses are clustered at the industry level.
*** indicates statistical significance at the 1% level, ** at 5%, and * at 10%.

Estimates of α range from .169 in column 8 to 0.814 in column 6, with the other four estimates all close to 0.5. The equality of the τz^T and ITC coefficients can be rejected with 95% confidence in columns 3, 5 and 7, and with 90% confidence in column 4. The p-value in the test of the null hypothesis of coefficient equality in column 6 is 0.138. Only in column 8, which includes year dummies and limits the sample to the largest 500 firms in each year, is the difference between coefficients not close to statistical significance. It is worth noting also that the estimated magnitude of the overall effect of the tax variables tends to decline as the sample is limited to larger and larger firms. As the larger firms have a far larger impact on aggregate investment, this suggests that the baseline results from Desai and Goolsbee [2004] would tend to overstate the magnitude of the effect of tax variables on aggregate investment because they weight the small firms equally.

Table 5 presents results to address the concern that τz^T may mismeasure the value of depreciation deductions relative to investment tax credits. As calculated, z^T reflects assumptions about the discount rate applied to future depreciation deductions. If these assumptions are incorrect, estimated coefficients could be attenuated by classical measurement error or otherwise biased. Further, the investment tax credit may provide additional cash flows in the year of investment, making it more effective than accelerating depreciation deductions from one future year to another. Table 5 addresses these concerns by estimating a separate coefficient for depreciation deductions available in the year an investment is made. These deductions need not be discounted and have the same cash flow benefits as the ITC.

Table 5 provides little reason to worry that the observed lack of responsiveness to accelerated depreciation is driven by discounting or cash flows. The estimates of α coming from a comparison of the coefficient on the ITC and on the first-year depreciation deduction are a bit lower than those in Table 4 in the even-numbered specifications which include year dummies, but are actually higher in the specifications without year dummies. In fact, the estimated coefficient on the first-year depreciation deduction is actually slightly negative in the odd-numbered columns without year dummies. Again this is consistent with policy

Table 5: Regressions of investment to capital stock ratio on tax variables and controls, with detail on depreciation allowances

	All Firms	All Firms	Largest 3000	Largest 3000	Largest 500	Largest 500
	(1)	(2)	(3)	(4)	(5)	(6)
Equipment $\frac{ITC}{1-\tau}$	.533	1.324	.623	.767	.299	.273
	(.069)***	(.684)*	(.064)***	(.580)	(.041)***	(.616)
Equipment $\frac{\tau z^T}{1-\tau}$, First Year Only	-.057	.600	-.064	.172	-.140	.254
	(.044)	(.567)	(.047)	(.483)	(.053)***	(.465)
Equipment $\frac{\tau z^T}{1-\tau}$, Future Years	.464	.542	.433	.100	.232	.185
	(.046)***	(.621)	(.039)***	(.519)	(.044)***	(.510)
Structures Tax Term	-.258	-.017	-.293	-.054	-.123	-.041
	(.037)***	(.144)	(.037)***	(.116)	(.037)***	(.092)
$\frac{Q-1}{1-\tau}$	.036	.036	.051	.052	.020	.020
	(.003)***	(.003)***	(.003)***	(.003)***	(.004)***	(.004)***
Cash flow	-.006	-.007	.012	.011	.079	.075
	(.003)*	(.003)**	(.008)	(.008)	(.022)***	(.022)***
Year Fixed Effects	No	Yes	No	Yes	No	Yes
Alpha	1.106	.547	1.102	.776	1.467	.069
P-Value	3.79e-09	.093	1.13e-12	.146	1.56e-08	.973
Firms	12457	12457	9249	9249	1474	1474
Observations	128023	128023	97479	97479	20409	20409
R^2	.337	.345	.402	.41	.444	.465

All specifications include firm fixed effects. Standard errors in parentheses are clustered at the industry level. *** indicates statistical significance at the 1% level, ** at 5%, and * at 10%.

endogeneity in the form of depreciation being accelerated into the first year during downturns in investment. In columns with year dummies, there is little difference between the coefficients on the first-year depreciation deduction and those on the discounted, future deductions. Thus it seems that there is little reason to believe that the results in Table 4 are driven by discounting or cash flows.

5.1 Discussion

Some might also worry that an exercise comparing two coefficients like this one is easily confounded by measurement error.[25] One could worry here that depreciation deductions—even in the first year, when they need not be discounted—are measured less accurately than the investment tax credit, inappropriately producing more attenuated coefficients on depreciation deductions than on the ITC. I see little reason, however, to suspect that more errors would arise in identifying the correct depreciation schedule for an asset than the correct ITC amount. In fact, the ITC amounts were determined based on the same equipment categories as the depreciation schedules.

There is, however, one important sense in which the statutory maximum depreciation deduction available in the first year that I include in Table 5 mismeasures the depreciation deductions that firms actually used. Namely, *firms often did not claim the most accelerated depreciation schedule that was available to them.* Congress explicitly authorized the use of double declining balance depreciation in 1954 (Brazell, Dworin, and Walsh [1989]), but Jorgenson and Sullivan [1981] report that a substantial fraction of investment was still depreciated using straight line methods up until the mandatory adoption of the Accelerated Cost Recovery System in 1981. A similar lack of take-up has been reported for recent bonus depreciation incentives by Knittel [2007]. I would not consider this discrepancy between statutory maximum deductions and the deductions actually taken by firms to be measure-

[25]Note first that using the industry-level average tax variables for each firm does not itself create classical measurement error. OLS with right-hand-side variables replaced by group means is unbiased in situations where OLS is unbiased, as long as the group selection is not correlated with the error term.

ment error—rather, I would consider it a reflection of the phenomenon under study. Firms do not appear to value accelerated depreciation as much as economists think they should.

Still, one must wonder if this apparent undervaluation of depreciation deductions results not from the accounting channel which I study in this paper, but from other facets of accelerated depreciation. A prime candidate would be the complexity of the depreciation rules. Firms may have simply preferred to stick with straight line depreciation after double declining balance was available because the calculations were simpler. Firms may opt to continue claiming depreciation under the Modified Accelerated Cost Recovery System rather than claiming bonus depreciation because they are already familiar with the MACRS rules or because state-level tax laws did not always change to allow bonus depreciation. It is hard, however, to square this story with the economist's typical view of firms—particularly the large publicly-traded firms in Compustat—as coldly calculating profit-maximizers with teams of accountants and lawyers ready to wring savings from the tax code. Particularly in recent years, tax accounting software should make it essentially costless for firms to maximize their depreciation deductions.

One could also wonder if there are other aspects of the tax code that might make depreciation deductions less attractive than ITCs. One might ask, for example, if firms in a loss position benefit more from ITCs than from accelerated depreciation. I see little reason, however, why this should be the case. It was true from 1964 to 1976 that an ITC could be carried forward for 7 years and a loss for only 5, but this could make only a trivial difference for their relative values. One could also wonder if the timing of investment during the year might affect the two kinds of incentives differently. It is true that the depreciation deductions available from an investment can sometimes depend on the month during the year when an investment is placed in service. If a large portion of investments were placed in service during the last quarter of the year and thus qualified for less than the standard first-year deduction, the variables used in regressions here could overstate the true value of depreciation deductions to many firms. However, data from the Census Bureau indicate that seasonality in equipment investment is relatively muted.[26] Thus, it again seems that any impact on the true value of depreciation deductions must be trivial.

In summary, the most obvious alternative explanations for the weaker impact of accelerated depreciation do not receive much support from the data. Nonetheless, I find it hard to shake the suspicion that something other than the accounting system could drive the results in Tables 4 and 5. I thus view them as more suggestive than conclusive.

6 Conclusions

A large literature and a great deal of survey and anecdotal evidence suggests that both investors and managers are quite focused on firms' accounting profits as a primary measure of their performance. This paper has developed and tested the implications of this claim for the impact of tax policy on firm investment decisions. I modeled a firm that places some weight on both its cash flows and its accounting profits when making investment decisions, and I showed how this assumption translates into simple modifications of canonical results from Hall and Jorgenson [1967] and Summers [1981]. I estimated the weight placed on accounting profits using an equation derived from the model that is also a straightforward extension of specifications that have featured prominently in the tax and investment literature, particularly in Desai and Goolsbee [2004]. Results would suggest that firms do indeed place a significant weight on accounting profits when making investment decisions. As a result, the long-run effective tax burden on corporate capital may be lower than it otherwise would be,

[26] I checked the seasonality of shipments by US manufacturers of nondefense capital goods excluding aircraft and parts, which are the primary data used in construction of the investment figures in the National Income and Product Accounts. Over the last 19 years, a period for which consistent data are readily available, nominal shipments of capital goods averaged less than 3% higher in the second half of the year than in the first, and only about 4% higher in the fourth quarter than in the average of the first three. Note that under current law, firms may adopt the "half-year" convention of depreciating all equipment under the standard schedule that essentially assumes that equipment is placed in service at the mid-point of the year, unless more than 40% of annual investment occurred in the fourth quarter. In this case, *all* equipment (including that from the first three quarters of the year) must be depreciated under the assumption that it was placed in service at the mid-point of the quarter in which it was placed in service. That is, the firms that must take reduced depreciation deductions for their investments late in the year may also take more generous deductions for investments early in the year, and thus these will tend to balance out.

but, in the short run, accelerated depreciation provisions may be less effective.

In truth, I view these results as a "first pass" at the question of whether the accounting system could affect firms' real investment responses to taxation. It seems hard to overstate how often accountants, businesspeople, and various other commentators repeat the claim that firms care deeply about their accounting profits. This claim has clear implications for the effectiveness of tax incentives for investment—incentives that affect accounting profits should have more impact than incentives that affect only cash flows. This paper's empirical work could be seen as the simplest possible test of whether the data on investment might be consistent with this oft-repeated claim. And, in fact, it seems that they are. In straightforward investment regressions with a long pedigree in the tax literature, it is indeed the case that accelerated depreciation has smaller effects on investment than does the investment tax credit, just as those making the claim would predict.

I find it unlikely, however, that anyone with a healthy skepticism toward empirical work would be unwaveringly convinced that the accounting system is driving these results. Although I have been unable to identify any clearly compelling alternative explanations, it is hard not to harbor some suspicion that other factors might be at work. Further research attempting to measure any impact of the accounting system on investment responses to tax policy would be most welcome.

7 Appendix 1: Descriptive statistics

Table 6: Descriptive Statistics

Variable	Median	Mean	Std. Dev.
Investment Ratio: $\frac{I}{K}$	0.220	0.341	0.403
Equipment Tax Term: $\frac{ITC+\tau z^T}{1-\tau}$	0.497	0.625	0.191
Equipment $\frac{ITC}{1-\tau}$	0.000	0.046	0.072
Equipment $\frac{\tau z^T}{1-\tau}$	0.497	0.578	0.129
Equipment $\frac{\tau z^T}{1-\tau}$, First year only	0.104	0.129	0.060
Equipment $\frac{\tau z^T}{1-\tau}$, Future years	0.398	0.450	0.130
Structures Tax Term	0.299	0.395	0.179
$\frac{Q-1}{1-\tau}$	0.529	1.521	3.093
Cash flow / K	0.262	0.280	3.571

This table contains descriptive statistics for the full sample of 128,023 observations on 12,457 unique firms that is used in regressions presented in the text. The sample is truncated at the 99th percentile of the investment, Q, and cashflow variables and at the 1st percentile of the cash flow variable. I follow prior literature in constructing these variables. The dependent variable in all regressions is the investment to capital stock ratio easily observed in Compustat,

$$\frac{I_t}{K_{t-1}} = \frac{\text{capx128}_t}{\text{ppent8}_{t-1}},$$

the ratio of reported Capital Expenditure in the current year to Property, Plant, and Equipment, Net of Accumulated Depreciation, observed at the end of the prior year.

I follow Kaplan and Zingales [1997] in constructing a measure of Q, which is intended to proxy for the increase in the value of the firm's cash flows created by a marginal dollar of capital, or λ_t/p_t. Desai and Goolsbee [2004] show that this "corporate finance Q" performs better in investment regressions than the "public finance Q" constructed a bit differently by Cummins, Hassett, and Hubbard [1994]. I construct,

$$Q_t = \frac{\text{prcc199}_t \times \text{csho25}_t + \text{at6}_t - \text{ceq60}_t - \text{txdb74}_t}{\text{at6}_t}.$$

In essence, this ratio is the market value of equity plus the book value of liabilities, excluding deferred taxes, divided by the book value of assets. This variable appears in regressions divided by $1-\tau_t$, for τ_t the current statutory tax rate, in accordance with the model presented in the text.

I again follow Kaplan and Zingales [1997] in constructing a cash flow measure,

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

This ratio is Income Before Extraordinary Items plus Depreciation and Amortization, scaled by the capital stock at the beginning of the year.

8 Appendix 2: Model derivation

Here I derive the user cost and tax-adjusted Q expressions that appear in the text. The firm solves,

$$\max_{\{I_t\}} \int_0^\infty e^{-rt} \left[\alpha BE_t + (1-\alpha) CF_t\right] dt$$

subject to,

$$\begin{aligned}
\dot{K}_t &= I_t - \delta K_t \\
\dot{K}_t^B &= pI_t - \delta^B K_t^B \\
\dot{K}_t^T &= pI_t - \delta^T K_t^T \\
\dot{D}_t &= B_t \\
D_t &\leq \bar{D}.
\end{aligned}$$

Form the Lagrangian,

$$\begin{aligned}
\mathcal{L} = \int_0^\infty e^{-rt} \Big[\, & \alpha \big[(1-\tau)[F(K_t) - p\psi(I_t, K_t) - \delta^B K_t^B - rD_t] + pI_t ITC\big] \\
& + (1-\alpha) \big[(1-\tau)[F(K_t) - p\psi(I_t, K_t) - rD_t] + \tau\delta^T K_t^T - pI_t(1 - ITC)\big]\Big] \, dt \\
& - \int_0^\infty \lambda_t (\dot{K}_t - I_t + \delta K_t) dt \\
& - \int_0^\infty \lambda_t^B (\dot{K}_t^B - pI_t + \delta^B K_t^B) dt \\
& - \int_0^\infty \lambda_t^T (\dot{K}_t^T - pI_t + \delta^T K_t^T) dt.
\end{aligned}$$

Note that,

$$\begin{aligned}\int_0^\infty \lambda_t \dot{K}_t dt &= \int_0^\infty \lambda_t \frac{dK_t}{dt} dt \\ &= \int_0^\infty \frac{d(\lambda_t K_t)}{dt} - K_t \frac{d\lambda_t}{dt} dt \\ &= \lim_{t\to\infty} \lambda_t K_t - \lambda_0 K_0 - \int_0^\infty K_t \frac{d\lambda_t}{dt} dt \\ &= -\lambda_0 K_0 - \int_0^\infty K_t \dot{\lambda}_t dt,\end{aligned}$$

where the second line follows from integration by parts and the last line from the transversality assumption, $\lim_{t\to\infty} \lambda_t K_t = 0$. Applying the same steps to $\int_0^\infty \lambda_t^B \dot{K}_t^B dt$ and $\int_0^\infty \lambda_t^T \dot{K}_t^T dt$, and ignoring the constants, $\lambda_0 K_0, \lambda_0^B K_0^B$, and $\lambda_0^T K_0^T$, we can rewrite the Lagrangian,

$$\begin{aligned}\mathcal{L} = &\int_0^\infty e^{-rt} [\ \alpha \left[(1-\tau)[F(K_t) - p\psi(I_t, K_t) - \delta^B K_t^B - rD_t] + pI_t ITC\right] \\ &\qquad + (1-\alpha)\left[(1-\tau)[F(K_t) - p\psi(I_t, K_t) - rD_t] + \tau\delta^T K_t^T - pI_t(1-ITC)\right]]\, dt \\ &+ \int_0^\infty K_t \dot{\lambda}_t + \lambda_t(I_t - \delta K_t) dt \\ &+ \int_0^\infty K_t^B \dot{\lambda}_t^B + \lambda_t^B (pI_t - \delta^B K_t^B) dt \\ &+ \int_0^\infty K_t^T \dot{\lambda}_t^T + \lambda_t^T (pI_t - \delta^T K_t^T) dt.\end{aligned}$$

The first-order conditions are,

$$0 = \frac{\partial \mathcal{L}}{\partial I_t} = e^{-rt} pITC - e^{-rt}(1-\alpha)p - e^{-rt}(1-\tau)p\psi_I(I_t, K_t) + \lambda_t + p\lambda_t^B + p\lambda_t^T, \tag{6}$$

$$0 = \frac{\partial \mathcal{L}}{\partial K_t} = e^{-rt}(1-\tau)[F'(K_t) - p\psi_K(I_t, K_t)] + \dot{\lambda}_t - \lambda_t \delta, \tag{7}$$

$$0 = \frac{\partial \mathcal{L}}{\partial K_t^B} = e^{-rt}\alpha(\tau - 1)\delta^B + \dot{\lambda}_t^B - \lambda_t^B \delta^B, \tag{8}$$

$$0 = \frac{\partial \mathcal{L}}{\partial K_t^T} = e^{-rt}(1-\alpha)\tau\delta^T + \dot{\lambda}_t^T - \lambda_t^T \delta^T. \tag{9}$$

Define z_T and z_B as the present values of future depreciation allowances for tax and book purposes, respectively,

$$z^T \equiv \int_0^\infty e^{-rs} \delta^T e^{-\delta^T s} ds = \frac{\delta^T}{r + \delta^T}$$

$$z^B \equiv \int_0^\infty e^{-rs} \delta^B e^{-\delta^B s} ds = \frac{\delta^B}{r + \delta^B}.$$

Note that

$$
\begin{aligned}
\lambda_t^B &= \alpha(\tau - 1)e^{-rt}z^B \\
\lambda_t^T &= (1 - \alpha)\tau e^{-rt}z^T
\end{aligned}
\tag{10}
$$

are solutions to the ordinary differential equations in (8) and (9).

First consider the case with no adjustment costs, that is, where $\psi = 0$. Equations (10) and (6) together imply that $\lambda_t = e^{-rt}k$ for some constant k. Equation (7) then implies K_t constant, and,

$$
\lambda_t = e^{-rt}(1 - \tau)\frac{F'(K_t)}{r + \delta} \tag{11}
$$

is a solution to (7). Plugging (11) and (10) into (6) produces the user cost equation (1) in the text. When ψ is nonzero, the first order condition (6) can be rearranged to reach the tax-adjusted Q equation (2) in the text.

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