INCENTIVE EFFECTS OF BONUS DEPRECIATION

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Abstract

This study examines the effect on capital expenditures of “bonus depreciation,” which was intended to stimulate such spending by allowing businesses to immediately expense a portion of the cost of qualified capital expenditures from late 2001 through 2004. After controlling for many previously documented determinants of capital expenditures, some of our results indicate that capital expenditures during bonus depreciation’s availability were greater than those during the time it was not available, consistent with the expected effect. However, other results indicate that bonus depreciation had an insignificant effect on capital expenditures. These mixed findings generally persist through several sensitivity analyses. We interpret these results as weakly supportive evidence that Congress attained its goal of stimulating capital spending.

Keywords: Tax depreciation; bonus depreciation; capital expenditures; tax incentives

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1. Introduction

Congress has often enacted tax law provisions that are intended to increase capital spending by businesses, such as the investment tax credit and accelerated depreciation deductions. Empirical research has examined these tax provisions' effect on capital spending, with results that have not always been conclusive and consistent. One possible reason for such results may be that major changes in these tax provisions have generally coincided with other tax law changes that also might be expected to affect capital spending, such as tax rate changes. Nonetheless, Congress has used favorable tax provisions with the intent of inducing capital spending,[1] so evidence of their effectiveness would be useful for tax policy makers.

This study focuses on the "bonus depreciation" provisions that were enacted as part of the 2002 and 2003 Tax Acts, which allowed businesses to immediately expense 30 and 50 percent, respectively, of the cost of qualified capital expenditures.[2] Bonus depreciation provides a unique opportunity to study the effect of tax depreciation on capital spending for several reasons. First, the 2002 and 2003 Tax Acts did not include tax rate or investment tax credit changes; bonus depreciation was the only provision that would be expected to directly affect capital spending.[3]

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[1] For example, the creation of the accelerated cost recovery system (U.S. Congress 1981), increases in the maximum amount deductible under § 179 (U.S. Congress 1993, 1996), and the conformance of alternative minimum tax depreciation recovery periods to those for regular tax purposes (U.S. Congress 1997) were all claimed to be needed to enhance capital spending, generally with the broader goal of increasing economic growth.

[2] P.L. 107-147 § 101 (Job Creation and Worker Assistance Act of 2002, referred to here as the 2002 Tax Act), which added § 168(k) to the Internal Revenue Code, and P.L. 108-27 § 201 (Jobs and Growth Tax Relief Reconciliation Act of 2003, referred to here as the 2003 Tax Act). Bonus depreciation was intended to encourage capital spending by businesses, with the hope that it would enable economic recovery (U.S. Congress 2001; Baucus 2001).

[3] Black et al. (2000) note that much of the research on the effects of taxes on capital spending has focused on circumstances where multiple tax changes occurred (e.g., changes in tax rates and depreciation rules). Bonus depreciation was the principal business-related provision in the 2002 Tax Act, accounting for more than 80 percent of its business-related tax relief (U.S. Congress 2002). The other business-related provisions included a temporary expansion of the net operating loss (NOL) carryback period from two years to five years. This expansion of the carryback period allowed many NOL firms to benefit from bonus depreciation (i.e., firms whose NOLs, in the

Second, the 2002 Tax Act was an economic stimulus bill that was enacted largely in response to the terrorist attacks of September 11, 2001. This event, whose date was made the effective date of the bonus depreciation provision, was unexpected, so businesses could not have delayed capital spending that they would have made even without bonus depreciation in order to take advantage of it. Third, bonus depreciation was allowed for both regular and alternative minimum tax purposes, thus avoiding complications that the alternative minimum tax might otherwise introduce. Fourth, bonus depreciation was available to both large and small businesses, unlike the immediate expensing available under § 179. Bonus depreciation's availability to larger, publicly-traded businesses allows richer and more readily-available data sources (e.g., Compustat) to be used, providing larger sample sizes and an enhanced ability to control for various other factors that might affect capital spending.

The empirical model of capital expenditures developed here uses quarterly data and is estimated over the years 1990-2006, with indicator variables partitioning the data into five time periods: a pre-bonus depreciation era (including recessionary and non-recessionary time periods); an era when deliberations regarding the Bill that became the 2002 Tax Act were ongoing (and for which bonus depreciation was made retroactively applicable); an era following the 2002 Tax Act's enactment; an era following the 2003 Tax Act's enactment; and a post-bonus depreciation era. If firms responded to bonus depreciation by increasing their capital spending, capital expenditures during the bonus depreciation eras would be greater than during the pre- and post-bonus depreciation eras. Some of the results indicate that bonus depreciation led to greater

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absence of any bonus depreciation, would be fully absorbed by taxable income during a five-year carryback period but not during a two-year carryback period); the bonus depreciation, in conjunction with the expanded carryback period, resulted in a larger immediate tax refund. In addition to these tax provisions, the 2002 Tax Act included a temporary expansion of unemployment benefits.

capital expenditures. However, the support for a bonus depreciation effect is limited, with other results indicating it had an insignificant effect. These findings are relatively robust through several sensitivity analyses and occur despite having included many control variables (e.g., user cost of capital, capital intensity, debt, cash flows, sales growth) in the empirical model. Overall, the results provide supportive, but weak, evidence that Congress attained its goal of stimulating capital spending by making bonus depreciation available, but they should be interpreted cautiously because of their mixed nature.

The next section of the paper describes the bonus depreciation provisions in the 2002 and 2003 Tax Acts. Following that is a discussion of the theoretical background and a review of relevant empirical studies. The method of our study is then described, and the results are presented and discussed. Finally, conclusions are drawn.

2. Bonus depreciation provisions in the 2002 & 2003 Tax Acts

The bonus depreciation provisions of § 168(k), as added by the 2002 Tax Act, allowed taxpayers to deduct 30 percent of the cost of qualified property in the year in which it was placed into service. The remaining 70 percent of the property's cost was depreciated using the rules that would have applied in the absence of bonus depreciation (e.g., modified accelerated cost recovery system).[4] Qualified property generally must have been acquired from September 11, 2001 through September 10, 2004 and placed into service by the end of 2004. Qualified property

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Similarly, in the 2003 Tax Act, bonus depreciation was the principal corporate business-related provision. The Act also temporarily expanded the § 179 deduction, but this affected few, if any, of the publicly-traded corporations studied here.

[4] For example, consider a taxpayer who acquired $1 million of qualified property that was also 5-year property for modified accelerated cost recovery system (MACRS) purposes. Without bonus depreciation, the taxpayer would have been allowed, under MACRS, to deduct $200,000 of depreciation (20 percent of $1 million) in the year of acquisition and the remaining $800,000 of the property's cost over the succeeding five years. With 30 percent bonus depreciation, the taxpayer would have been allowed to deduct $440,000 of depreciation in the year of acquisition: $300,000 (30 percent of $1 million) of bonus depreciation plus $140,000 (20 percent of the other $700,000 of cost)

generally must have been tangible personal property or purchased computer software; real estate generally did not qualify.[5] Any bonus depreciation that was allowed for regular tax purposes was also allowed for alternative minimum tax purposes, thus benefiting taxpayers regardless of their alternative minimum tax status. Furthermore, taxpayers who elected to use bonus depreciation for qualified property could use regular tax depreciation (i.e., modified accelerated cost recovery system) for alternative minimum tax purposes with respect to the other 70 percent of such property's cost.[6] The 2003 Tax Act subsequently expanded bonus depreciation from 30 to 50 percent of the cost of qualifying property. To qualify for 50 percent bonus depreciation, the property must have been acquired from May 6, 2003 through December 31, 2004 and placed into service by the end of 2004. Fifty percent bonus depreciation expired as scheduled at the end of 2004.[7]

3. Literature review

3.1. Theoretical background

Cohen et al. (2002) analyze theoretically the effect of bonus depreciation on corporations' user cost of capital.[8] They model the user cost of capital as:

$$C_s = \varphi_s \left(\frac{1-\tau Z_s}{1-\tau} \right) \left[\rho + \delta + \frac{\tau Z_{s+1} - \tau Z_s}{1-\tau Z_s} \right] \quad (1)$$

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under MACRS. The remaining $560,000 of the property's cost would have been deductible over the succeeding five years under MACRS. The taxpayer could have elected out of bonus depreciation for any property class for any year.

[5] More precisely, qualified property included MACRS property with a recovery period of 20 years or less, § 167(f)(1)(B) computer software, water utility property, and qualified leasehold improvement property. The property's original use must have been with the taxpayer; acquisitions of used property did not qualify for bonus depreciation.

[6] § 168(k)(2)(F).

[7] Fifty percent bonus depreciation was subsequently allowed for the 2008 and 2009 tax years (P.L. 110-185 and P.L. 111-5). Fifty percent bonus depreciation also was allowed in certain limited circumstances, such as taxpayers using property in areas affected by Hurricanes Katrina, Rita, or Wilma in the latter part of 2005 (P.L. 109-135) and cellulosic biomass ethanol plant property (P.L. 109-432).

[8] The user cost of capital is broader than many other cost of capital concepts, such as the financial cost of capital. The user cost of capital includes the financial cost of capital through the after-tax cost of funds (ρ in equation (1)).

where

C_S = user cost of capital in year s,

φ_S = price of new capital goods in year s,

τ = corporate marginal income tax rate,

Z_S = present value of depreciation deductions per dollar spent in year s,

ρ = after-tax cost of funds (debt and equity), and

δ = rate of physical depreciation.

Intuitively, this user cost of capital includes the cost of the capital asset (φ_S), the present value of tax savings from its depreciation deductions (τZ_S), the grossed-up tax paid on the marginal product of capital ($(1 - \tau)^{-1}$), the cost of financial capital (ρ), the subsequent loss in the asset's productive capacity (δ), and the incentive to accelerate investments from period s+1 to period s because of the bonus depreciation's temporary nature. In equilibrium, the firm will continue to engage in capital spending until the marginal product of capital equals this (marginal) user cost of capital.

It can be shown that $\partial C_S/\partial Z_S$ is negative. In other words, by allowing larger immediate depreciation deductions and thus increasing Z_S, bonus depreciation lowers the user cost of capital. *Ceteris paribus*, the firm would find it beneficial to increase its capital expenditures until its marginal revenue equals its marginal cost, assuming marginal revenue is positive but diminishing with respect to capital expenditures. Based on some assumed parameter values, Cohen et al. (2002) estimate the change in C_S as a result of the 2002 Tax Act's bonus depreciation and conclude that it could have been meaningfully large, but its size depends on the asset's life and the extent to which adjustment costs exist. Firms might have foregone bonus depreciation's tax benefits if they believed that they were exceeded by adjustment costs.[9]

If firms believed that Congress would later make bonus depreciation permanent, Z_{S+1} equals Z_S, and the last fraction in expression (1) becomes zero. $\partial C_S/\partial Z_S$ is still negative, so bonus depreciation still reduces the user cost of capital. However, the reduction when bonus depreciation is permanent is not as large as that when it is temporary, so the expected increase in capital expenditures due to bonus depreciation would be attenuated if firms believed it would be available permanently.[10] In summary, there is theoretical reason to believe that the allowance of bonus depreciation could have resulted in additional capital spending, but there are factors that could have resulted in the effect being dampened.

Additionally, the hypothesized effect of bonus depreciation on capital expenditures implied by the Cohen et al. (2002) model assumes that the firm's marginal revenue with respect to its capital expenditures did not change when bonus depreciation became available. This assumption is questionable since the economic circumstances that led Congress to enact bonus depreciation also might have changed the firm's marginal revenue. It is possible that capital expenditures decreased after bonus depreciation was enacted but that there would have been a larger decrease had bonus depreciation not been enacted. Such an outcome would be consistent with Congress' intent to stimulate capital expenditures. To strengthen the validity of our

[9] Such adjustment costs might arise because the acquired property's use must be coordinated and integrated with the firm's existing operations and because existing or additional workers need to be trained. Anecdotally, in discussion with one of the authors, the former president of a publicly-traded company said that he did not think that large corporations' capital budgeting processes were flexible enough to take advantage of a temporary tax law change.

[10] Gale and Orzag (2004) suggest that many firms may have had such beliefs. One reason for firms believing that Congress would later make bonus depreciation permanent is that Congress previously has enacted tax incentives on an ostensibly temporary basis but effectively made them permanent by repeatedly extending their availability (e.g., the credit for increasing research activities).

empirical tests, we include several variables that likely control for changes in the firm's marginal revenue.[11]

3.2. Relevant empirical studies on bonus depreciation

Some recent research has focused on the impact of bonus depreciation. Huston (2007) focused on the purchases of personal property and real property (i.e., qualified and nonqualified property) for 104 firms that separately disclosed this information in their quarterly financial statement footnotes. He found that purchases of qualified (nonqualified) property during bonus depreciation's availability were greater (less) than that prior to its availability. He also found that firms for which the temporary expansion of the net operating loss carryback period from two years to five years was most beneficial had more purchases of qualified property. Billings et al. (2008) compare the actual annual percentage change in capital spending to an estimate of the expected change in the absence of bonus depreciation (which was based on the change in the user cost of capital due to bonus depreciation and prior estimates of price elasticity) for several capital-intensive industries for 2001 through 2003 and generally find that the actual percentage changes are greater than their estimates of the expected change for firms with higher marginal tax rates but not those with lower marginal tax rates. The validity of these studies' results, as well as our results, depends on the extent to which the control variables adequately control for the amount of capital expenditures that would have occurred if bonus depreciation had not been available. As is discussed below, our study differs from these studies by including a broader set of control variables, which are based on the user cost of capital model and prior research on capital spending.

[11] The change in marginal revenue likely was negative for many firms due to the negative effects on the broader economy that the events of September 11 were expected to have (O'Brien 2001). However, the change in marginal

Key (2008) examined the price of yearling and broodmare horses during bonus depreciation's availability versus the year before and the year after its availability. She found that the price of yearlings, which qualified for bonus depreciation, was higher during its availability, but the price of broodmares, which did not qualify for bonus depreciation, was insignificantly smaller. Key did not examine the quantity of yearlings and broodmares. Miller et al. (2008) report that general aviation aircraft shipments did not significantly increase after bonus depreciation became available, although they suggest that there was a shift in the ratio of piston to turbine general aviation aircraft. Knittel (2007) found that C corporations did not claim bonus depreciation on 39 to 46 percent of the capital expenditures for which they were eligible to claim it and suggested that these percentages exceeded zero because some firms derived little tax benefit from bonus depreciation due to the presence of tax losses.[12]

House and Shapiro (2008) examine economy-wide investments in capital goods, exploiting the fact that the benefit provided by bonus depreciation differed among the assets due to differing tax depreciation lives and due to only some types qualifying for bonus depreciation. They found that bonus depreciation had a modest aggregate effect on investment, although the effect on qualified property with longer tax depreciation lives was more substantial. Cohen and Cummins (2006) also examined long-lived versus short-lived capital goods, comparing growth rates in expenditures for them before, during, and after bonus depreciation's availability. Their results' consistency with bonus depreciation's effectiveness was ambiguous. They found increased growth in spending for both types of capital goods when bonus depreciation was

revenue may have been positive for firms that produced and sold property for which their purchasers would be eligible to claim bonus depreciation, and we empirically assess this possibility in a sensitivity analysis.

[12] To compute the user cost of capital, we use Graham's (1996) simulated tax rate as the measure of firms' marginal tax rates. The simulated tax rate takes into account the presence of net operating loss carryforwards and current-year losses. Note that Knittel's results show that firms with capital expenditures qualifying for bonus depreciation did not

available, but this increase was greater for shorter-lived goods rather than for longer-lived goods. In an untabulated sensitivity analysis, Huston (2007) analyzes total capital expenditures for a broader sample of Compustat firms (rather than qualified and nonqualified capital expenditures for 104 firms disclosing it) and finds that bonus depreciation had only a marginal effect on capital spending.

3.3. Other relevant empirical studies

Several empirical studies have considered other instances of tax law changes and generally have found that they are associated with changes in business capital investment.[13] These instances often included changes in tax depreciation, but such changes coincided with other tax law changes (e.g., tax rates, investment tax credit). Cummins and Hassett (1992) and Billings and Hamilton (2002) investigate the effect on capital investment of the Tax Reform Act of 1986, which included numerous tax changes (including depreciation), and found changes in capital investment that were consistent with the changes in the user cost of capital implied by the Act's provisions. Kern (1994) looked at corporate investment after the 1981 Tax Act and found that firms benefitting the most from it had positive unexpected capital spending, but firms with small- or medium-sized benefits from the Tax Act had negative unexpected capital spending.

Rosacker and Metcalf (1993) and Plummer (2000) studied the effect of various changes in the investment tax credit (ITC) and found some support for increases (decreases) in capital investment followed increases (decreases) in the tax benefits provided by the ITC. However, Plummer's results suggest that the effect is concentrated among firms with low debt and/or

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claim it for a substantial fraction of the expenditures, but his analysis does not address whether bonus depreciation stimulated capital expenditures qualifying for it.

[13] This empirical research has usually utilized microdata (e.g., Compustat). Older empirical work generally used aggregate, time-series data, and the results of it were much more mixed (See Hassett and Hubbard (2002) for a review of these results.).

positive taxable income. Kinney and Trezevant (1993) find that firms' capital expenditures in the fourth quarter are relatively higher than in the subsequent first quarter, suggesting that depreciation tax rules can affect the short-run timing of capital expenditures.[14] In a non-U.S. setting, Black et al. (2000) find that corporate capital investment in New Zealand and Australia increased around the adoption of dividend imputation. Jugurnath et al. (2008) examine corporate investment in the U.S. before and after the Tax Reform Act of 1986 and in Australia before and after its introduction of dividend imputation. They found that the U.S. (Australian) tax changes had a negative (positive) effect on corporate investment. Cummins et al. (1996) examine the effect of tax reforms on business investment in 14 countries, and they find that, in most of the countries, such investment responded to these tax reforms consistent with theory. Gupta and Hofmann (2003) find that the state income tax burden on property, unitary tax systems, throwback rules, and fewer investment-related tax incentives are associated with decreased capital expenditures, although the economic magnitude of the effects they find are relatively small.

Surveys of business decision makers find that tax depreciation considerations are perceived as being relatively unimportant. Approximately two-thirds of the U.S. financial executives Porcano (1984) surveyed indicated that the accelerated depreciation rules in the 1981 Tax Act would not affect their firms' investments in fixed assets, and they ranked the importance of these depreciation rules tenth out of 14 tax and non-tax investment factors. Financial executives in three other industrialized countries ranked tax depreciation deductions fifth, ninth, and tenth out of 14 factors (Porcano 1987). Other surveys of executives have ranked accelerated

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[14] Given the unexpected nature of the events that led to the 2002 Tax Act and its bonus depreciation, firms were unable to take advantage of the short-run timing opportunity by deferring capital expenditures until after September

depreciation as the least important factor in new business equipment spending decisions (Rose and O'Neil 1985) and foreign subsidiary location decisions (Single 1999). Additionally, Cohen and Cummins (2006) identify four surveys where few respondents cited the 2002 and 2003 Tax Acts' bonus depreciation as affecting their capital investment decisions.

These survey results do not indicate why business decision makers respond that tax depreciation considerations are relatively unimportant for capital expenditure decisions, but one reason may be the financial reporting consequences (Neubig 2006). Under U.S. financial reporting rules (FASB 1992), temporary (i.e., timing) book-tax differences do not affect the income tax expense and effective tax rate that is reported in firms' financial statements, and bonus depreciation merely shifted the timing of firms' depreciation deductions. Firms pay close attention to the effective tax rates they report to investors, so many of them may have foregone the tax savings opportunity provided by bonus depreciation in favor of other tax-savings strategies that do reduce effective tax rates.[15]

3.4. Summary of relevant empirical studies

In summary, based on extant empirical studies, it is unclear whether tax depreciation rules affect capital spending. Archival studies often, though not always, find that tax law changes that decrease (increase) the user cost of capital are associated with increased (decreased) capital spending, and these tax law changes often include depreciation changes. However, these depreciation changes occurred concurrently with other changes, such as tax rates, making the

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10, 2001. Firms had the opportunity to accelerate capital expenditures from 2005 into the latter part of 2004 (before bonus depreciation expired), and we test for this in a sensitivity analysis.

[15] For example, imagine a firm is able to obtain federal and/or state tax credits for employing economically disadvantaged individuals and that these tax credits equal, for a given amount of spending, the present value of the tax benefits of purchasing property qualifying for bonus depreciation. The tax credits would reduce the firm's income tax expense and effective tax rate in its financial statements, but the bonus depreciation would not affect either item. Thus, the financial reporting consequences provide a stronger incentive for spending qualifying for the

effect of the depreciation changes unclear. Surveys of business decision makers suggest that favorable depreciation deductions may have little effect on capital spending decisions, and this may be due to financial reporting consequences. Survey results must be interpreted cautiously since "talk is cheap," but it does suggest that Congress may not be stimulating the capital spending that it intends when it enacts accelerated depreciation provisions.

Other research on the 2002 and 2003 Tax Acts provides mixed evidence of bonus depreciation's effectiveness. Our research method differs from that of other empirical research on bonus depreciation in the following ways. Our sample size is much larger than Huston's (2007), although this larger sample size precludes collection of firms' separate disclosures of their purchases of personal property and real property.[16] Unlike Billings et al. (2008), we use quarterly data, which allows us to more accurately partition time into various bonus depreciation and non-bonus depreciation time periods, and we include all quarters that bonus depreciation was available. The broader set of control variables, which is based on the user cost of capital model and prior research on capital spending, better controls for other factors that affected capital spending contemporaneously with bonus depreciation. Our use of firm-level data differs from the more-aggregate data that House and Shapiro (2008) and Cohen and Cummins (2006) use.[17]

4. Research design and sample

4.1. Empirical model

To test whether bonus depreciation stimulated capital spending, we use an empirical model, based on Shin and Kim (2002), that controls for previously documented determinants of

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tax credits than for spending qualifying for bonus depreciation. For more detailed discussions of book-tax differences and their financial reporting consequences, see Hanlon (2003) and Mills and Plesko (2003).

[16] In a sensitivity analysis, we estimate the percentage of qualifying capital expenditures and re-estimate our models.

[17] Dunbar et al. (2005) find smaller growth in firms' capital expenditures in 2002-2003 than in 1994-2000, although this is a univariate result and does not control for cash flows, sales growth, or other factors. Dunbar et al. focus on

capital expenditures and extend it to also include the user cost of capital and other control variables. We estimate the following empirical model:

$$CapExp_{i,t} = \alpha + ß_1 Expect_t + ß_2 30\%Bonus_t + ß_3 50\%Bonus_t + ß_4 PostBonus_t$$
$$+ ß_5 UserCost_{i,t} + ß_6 CapInt_{i,t} + ß_7 Debt_{i,t} + ß_8 CshFlws_{i,t} + ß_9 CshHldngs_{i,t}$$
$$+ ß_{10} MktBk_{i,t} + ß_{11} \Delta Sales_{i,(t-(t-4))} + ß_{12} Size_{i,t} + ß_{13} CapUtil_t + ß_{14} ChngLoan_t$$
$$+ \sum_{j=2}^{4} \eta_j QTR_{j,t} + \sum_{k=1}^{k^*} \lambda_k IND_{i,k} + \varepsilon_{i,t} \qquad (2)$$

where (#s are Compustat quarterly data items):

$CapExp_{i,t}$ = firm i's capital expenditures in quarter t (cash outflows for additions to property, plant, and equipment (#90) for quarter t divided by total assets (#44) at the beginning of quarter t).

$Expect_t$, $30\%Bonus_t$, $50\%Bonus_t$, and $PostBonus_t$ are indicator variables that, in conjunction with the intercept term, partition the data into five time eras (1 if the quarter is in the time era and 0 otherwise):

- $Expect_t$ = indicator variable for bonus depreciation expectation era (fourth quarter of 2001 or first quarter of 2002).
- $30\%Bonus_t$ = indicator variable for 30 percent bonus depreciation era (second, third, or fourth quarter of 2002 or first or second quarter of 2003).
- $50\%Bonus_t$ = indicator variable for 50 percent bonus depreciation era (third or fourth quarter of 2003 or any of the four quarters of 2004).
- $PostBonus_t$ = indicator variable for era following bonus depreciation's availability (all of 2005 and 2006).

$UserCost_{i,t}$ = firm i's user cost of capital for quarter t.

$CapInt_{i,t}$ = firm i's capital intensity for quarter t (net property, plant and equipment (#42) divided by total assets (#44), both at the beginning of quarter t).

$Debt_{i,t}$ = firm i's debt-to-equity ratio for quarter t (total debt (#51 + #45) divided by total equity (#60), both at the beginning of quarter t).

$CshFlws_{i,t}$ = firm i's cash flows for quarter t (operating cash flows (#108) for quarter t divided by total assets (#44) at the beginning of quarter t).

$CshHldngs_{i,t}$ = firm i's cash holdings for quarter t (cash (#36) divided by total assets (#44), both at the beginning of quarter t).

$MktBk_{i,t}$ = firm i's market-to-book ratio for quarter t (market value of equity (#14 × #61) plus total liabilities (#44 – #60), divided by total assets (#44), all at the beginning of quarter t).

$\Delta Sales_{i,(t-(t-4))}$ = firm i's change in sales from the same quarter one year ago (sales (#2) for quarter t minus sales for quarter t-4, divided by total assets (#44) at the beginning of quarter t).

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the ability to use deferred tax expense to detect earnings management activity in the bonus depreciation era, relative to the pre-bonus depreciation era, and find that it is reduced.

$Size_{i,t}$ = firm i's size (#2) in quarter t (natural logarithm of quarter t sales, in millions of dollars).
$CapUtil_t$ = capacity utilization rate for the month preceding the beginning of quarter t (economy-wide).
$ChngLoan_t$ = percentage change in bank loans (commercial and industrial) for the month preceding the beginning of quarter t (economy-wide).
QTR_j = three indicator variables for the second, third, and fourth quarters of the year (any year).
$IND_{i,k}$ = indicator variables for industry k (using 2-digit SIC codes).
$\varepsilon_{i,t}$ = error term.

4.2. Capital Expenditures

Following Shin and Kim (2002), capital expenditures (*CapExp*) are measured as the cash outflows for additions to property, plant and equipment (#90) divided by total assets (#44).[18] In addition to increases in property, plant, and equipment, this measure includes increases in expenditures for capital leases and increases in leaseback transactions.

4.3. Time Periods

The sample includes observations from 1990 through 2006. We divided the sample into five time periods: three eras during which bonus depreciation was available, an era that preceded bonus depreciation's availability, and an era that followed it.

4.3.1. Bonus depreciation eras

Although the 2002 Tax Act was not signed into law until March 2002 (applying retroactively to asset purchases after September 10, 2001), congressional discussions regarding an economic stimulus bill began soon after September 11, 2001, and the possibility of bonus depreciation being part of the Bill arose soon thereafter. The 2003 Tax Act, which increased bonus depreciation from 30 to 50 percent, was enacted in May of 2003, with bonus depreciation

[18] Compustat data item numbers appear in parentheses. Compustat reports year-to-date capital expenditures for #90, so we subtract the prior quarter's #90 from the current quarter's #90 to measure quarterly capital expenditures for observations in the second, third, and fourth quarters.

not being adopted until shortly before its enactment (and receiving little attention in the press before then).[19]

We define three periods where firms might have increased their capital expenditures in response to the availability of bonus depreciation. First, capital expenditures made in the second, third and fourth quarters of 2002 or in the first and second quarters of 2003 would be made with the knowledge that bonus depreciation was available for these purchases. *30%Bonus* is an indicator variable for this time period. To allow for the possibility that some firms anticipated the retroactive availability of bonus depreciation before it was actually enacted, we also include an indicator variable for this expectation period (*Expect*), which is the fourth quarter of 2001 and the first quarter of 2002. Finally, the third and fourth quarters of 2003 and all of 2004 are quarters where 50% bonus depreciation was available.[20] The indicator variable, *50%Bonus,* is used to designate these quarters.

The intercept term captures the mean *CapExp* for the era preceding bonus depreciation's availability (1990 through the third quarter of 2001) after controlling for the various control variables. The coefficients for the *Expect*, *30%Bonus*, *50%Bonus*, and *PostBonus* indicator variables capture the difference between the mean *CapExp* in each of those eras versus the mean *CapExp* for the era preceding bonus depreciation's availability. If bonus depreciation stimulated

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[19] We reviewed articles in *Tax Notes* to assess the timing of the deliberations on the 2003 Tax Act and its 50 percent bonus depreciation in particular. While bonus depreciation was mentioned in the first few months of 2003 as a possible provision in the Bill, it was not adopted as part of it until May. In addition, bonus depreciation was a relatively minor part of the Bill; much of the attention was focused on the Bill's dividend tax cut, acceleration of various changes made by the 2001 Tax Act (e.g., individual tax rate cuts), and increasing the maximum deduction under § 179. These latter three issues were controversial, and there was considerable uncertainty during much of the first few months of 2003 about the Bill's prospects of being enacted.

[20] The 2003 Tax Act's 50 percent bonus depreciation was effective for purchases after May 5, 2003, which is in the middle of the second quarter. We believe that many firms would have been unable to respond quickly to this increased incentive, so we chose to include the second quarter of 2003 in the 30 percent bonus depreciation era. Firms might have accelerated capital expenditures into the fourth quarter of 2004 to take advantage of bonus depreciation before it expired. This quarter is designated as a separate era in a sensitivity analysis, but no evidence of such acceleration is found.

capital expenditures, as predicted by theory, the coefficients for the *Expect*, *30%Bonus*, and *50%Bonus* eras would be predicted to be positive. This would indicate that capital expenditures are higher in the bonus depreciation eras than in the pre-bonus depreciation era, after controlling for other determinants of capital expenditures. In addition, the *Expect*, *30%Bonus*, and *50%Bonus* coefficients would be predicted to be greater than the *PostBonus* coefficient, indicating that capital expenditures are higher in the bonus depreciation eras than in the post-bonus depreciation era, after controlling for other determinants of capital expenditures.

4.3.2. Non-bonus depreciation eras

The non-bonus depreciation eras provide a comparison for the bonus depreciation eras and also are used to better estimate the effects of other factors on capital expenditures so that they can be controlled for during the bonus depreciation eras. The *PreBonus* era includes several quarters prior to bonus depreciation's availability (1990 through the third quarter of 2001). This era includes recessions in 1990-1991 and in 2001 (Business Cycle Dating Committee 1992, 2003), as well as the strong economic growth of the latter 1990s.[21] *PostBonus* is an indicator variable for quarters after bonus depreciation's availability (all of 2005 and 2006).

4.4. Control Variables

4.4.1 User Cost of Capital

We include as a control variable the user cost of capital (*UserCost*) because theory predicts that it affects the capital expenditure decision. Our measure of *UserCost* is similar to the one that Billings and Hamilton (2002) and Billings and Glazunov (2004) use. The Appendix provides more complete details on *UserCost*'s specification, but important aspects of it are discussed here. We measure the price of new capital goods (φ_S in equation (1)) by the price index for private fixed investment and scale it by the price index for gross output. Our measure of the corporate marginal tax rate (τ) is Graham's (1996) simulated tax rate, which accounts for many important features of the tax code.[22] The depreciation rates reported by Desai and Goolsbee (2004) are used as the measure of the rate of physical depreciation (δ).

We compute the after-tax cost of funds as $b(1 - \tau)DS + bq(1 - DS)$. Moody's seasoned Aaa corporate bond yield is used to measure the cost of debt (b). The debt share in the firm's capital structure (DS) is measured as long-term debt (#51) divided by total assets (#44). The extent to which the cost of equity exceeds the cost of debt by a risk premium can be expressed as multiple of the cost of debt (q) and is assumed to be 1.8. In addition to using the after-tax cost of funds as one of the direct components of *UserCost*, we also use it to compute the present value of depreciation deductions per dollar spent (Z_S in equation (1)), assuming the deductions are for seven-year MACRS property. In computing *UserCost*, we assume that bonus depreciation is not available (i.e., Z_{S+1} equals Z_S in equation (1)). This controls for the effect of the user cost of capital on capital expenditures in the absence of bonus depreciation, which is similar to the way that Billings and Hamilton (2002) and Billings and Glazunov (2004) control for the effect of the user cost of capital in the absence of the alternative minimum tax.

4.4.2 Other Control Variables

Based primarily on Shin and Kim (2002), measures of capital intensity, debt, cash flows, cash holdings, market-to-book ratio, change in sales, and firm size are also included in the model to control for nontax determinants of capital expenditures. It is reasonable to expect that firms that are more capital-intensive would have more capital expenditures than firms that are less

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[21] We do not include an indicator variable for the *PreBonus* era because we need to omit an indicator variable for one of the five eras.

capital-intensive, whether or not bonus depreciation is available. Capital intensity (*CapInt*; #42 divided by #44) is included in the model and is predicted to be positively related to capital expenditures. The debt-to-equity ratio has been included as a control measure in other tax-related capital expenditure models (e.g., Black et al. 2000), with the finding that higher-debt firms tend to have lower capital expenditures. We therefore predict that firms with higher debt-to-equity ratios (*Debt*; sum of #51 and #45 divided by #60) will have fewer capital investments.

Cash flows (*CshFlws*), measured as operating cash flows (#108) scaled by assets (#44), are predicted to be positively related to capital expenditures (Shin and Kim 2002; Black et al. 2000). Cash holdings (*CshHldngs*) are measured as cash (#36) scaled by assets (#44). Shin and Kim (2002) find changes in cash to be negatively related to capital expenditures, but Plummer (2000) finds unexpected cash to be positively related. We do not predict a sign for *CshHldngs*. The market-to-book ratio (book-to-market ratio) has been found to be positively (negatively) related to capital expenditures (Shin and Kim 2002; Plummer 2000; Black et al. 2000). We measure *MktBk* as the market value of equity (#14 multiplied by #61) plus the book value of liabilities (#44 minus #60), with the sum scaled by the book value of assets (#44). *MktBk* also proxies for Tobin's *q* (Shin and Kim 2002), and Billings et al. (2009) suggest that Tobin's *q* includes the market's expectation of adjustment costs. The change in sales (*ΔSales*) is measured as quarter t sales (#2) minus quarter t-4 sales, scaled by assets (#44). Shin and Kim (2002) find a positive relation between capital expenditures and change in sales, and Plummer (2000) similarly finds a positive relation with change in forecasted sales. Firm size is often included as a control variable in empirical models. Black et al. (2000) find some results suggesting a negative relation between size and capital expenditures, but Shin and Kim (2002) find that the largest firms are

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[22] We thank John Graham for providing us with his simulated marginal tax rates. See his website at:

more likely to make capital expenditures. *Size* is measured as the natural logarithm of sales (#2, in millions of dollars), but we do not predict a sign.

We include two variables to control for economy-wide factors that affect capital expenditures. The capacity utilization rate *(CapUtil*) is a measure of the economy's idle capacity. When *CapUtil* is higher (lower), firms are more (less) likely to make capital expenditures because they are less (more) likely to be able to use idle capacity to satisfy production needs. The percentage change in commercial and industrial loans and leases in bank credit (*ChngLoan*) indicates business' willingness to borrow funds and measures their optimism or pessimism regarding future prospects (Frumkin 2006).

Quarterly indicator variables (for the second, third, and fourth quarters) are included because capital expenditures have been found to be significantly greater in the fourth quarter (Shin and Kim 2002; Kinney and Trezevant 1993).[23] Industry indicator variables are also included, with industries defined using two-digit SIC codes.

Prior empirical studies of the effect of taxes on capital spending have not included variables specifically to control for marginal revenues. However, several of the control variables, drawn from prior studies, that we included likely already control for marginal revenues to some extent. The change in sales, which is measured here retrospectively, would do so if that change persists into the future. The percentage change in commercial and industrial loans and leases in bank credit would also help to control for marginal revenue if firms' revenues generated from capital expenditures are positively correlated with such percentage change. Several prior studies

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http://faculty.fuqua.duke.edu/~jgraham/taxform.html for additional information.

[23] These quarterly indicator variables are not confounded with the era indicator variables. For example, the second quarter of 2004 and the second quarter of 2005 would both have a value of one for the second quarter indicator variable and zero for the third and fourth quarter indicator variables. However, the value of the *50%Bonus* (*PostBonus*) era indicator variable would be one (zero) for the second quarter of 2004 and zero (one) for the second quarter of 2005.

use the market-to-book ratio as a measure of the extent to which the firm's investment opportunity set will yield marginal benefits in excess of marginal costs (Black et al. 2000; Plummer 2000; Shin and Kim 2002). Finally, capital intensity also may help control for marginal revenues. Firms presumably made their prior capital spending decisions such that the expected marginal revenue equaled or exceeded the user cost of capital. That is, some firms may have "needed" to make a larger amount of capital expenditures because their revenues were more dependent on them. This would be reflected in the firm's capital intensity, so controlling for capital intensity helps to control for cross-sectional differences in expected marginal revenues if these expectations persist.[24]

4.5. Sample Selection

Table 1, Panel A summarizes the sample selection process. Using quarterly Compustat data and after deleting firms with non-calendar year-end and observations with missing or negative year-to-date capital expenditures, there are 315,722 observations from 11,446 firms, with a maximum of 68 quarters per firm. Observations missing necessary Compustat data are eliminated. Observations where quarterly capital expenditures, debt in current liabilities, long-term debt, property, plant, and equipment, cash and short-term investments, stock price, or common shares outstanding are negative, as well as observations where total assets, total equity, sales in the current quarter or fourth-previous quarter are nonpositive are also eliminated. Additionally, we deleted observations whose capital expenditures are specified by Compustat as net of sales, retirements, and disposals, observations for American Depository Receipt (ADR) firms, passenger airline firms, real estate investment trusts (REITs), and observations missing

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[24] In sensitivity analyses, we attempt to more directly control for marginal revenue by including as control variables the four-quarter-ahead change in sales and the firm-specific return following September 11 and by estimating the

Graham (1996) simulated tax rate data.[25] The resulting sample consists of 117,977 observations from 6,593 firms. We evaluated influential observations using Cook's D and studentized residuals. The highest value for Cook's D is 0.0890, which does not indicate that any observations have a large influence on the parameter estimates. However, examination of the studentized residuals identifies a number of observations as having a large influence, so we eliminated observations whose studentized residuals had an absolute value larger than 2.00 (Belsley et al. 1980). The resulting sample consists of 116,050 observations from 6,566 firms. As detailed in Panel B of Table 1, the observations are from 1990 through 2006, and there are fewer observations in the earlier years compared with the later years. The number of observations across the four quarters is relatively even. Fifty two-digit SIC code indicator variables are specified (see Panel C of Table 1).[26] A firm can have up to 68 observations over the time period, but many firms have fewer than 68 observations in the sample (see Panel D of Table 1).

Table 2 provides descriptive statistics for the variables. The capital expenditures variable has a mean of 0.0150 and a median of 0.0094, which are comparable to the 0.0164 mean and 0.0117 median reported by Shin and Kim (2002) for 1984 to 1994. The *50%Bonus* era contains about one-tenth of the 116,050 observations, while the *30%Bonus* and *Expect* eras comprise 8.8 and 3.8 percent, respectively, of the sample. The user cost of capital variable has a mean (median) of 0.2930 (0.2866), which is higher than the 0.231 and 0.230 means that Billings and

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regression for a subset of firms that were likely to have produced property qualifying for bonus depreciation. The results are qualitatively similar to the main analysis' results.

[25] Passenger airlines (SIC code 4512) were greatly and negatively impacted by the events of September 11, 2001. REITs (SIC 6798) are taxed as flow-through entities and have different investment goals than most publicly traded entities. Observations in all other SIC codes are included in the sample if they meet the other sample selection criteria. Observations are required to have Graham's (1996) simulated tax rate available in order to calculate the user cost of capital.

[26] Two-digit SIC codes with fewer than 300 observations and observations missing a two-digit SIC code were included in Other.

Hamilton (2002) and Billings and Glazunov (2004), respectively, report for 1987-1993.[27] The mean (median) of the cash flows variable is 0.0107 (0.0258), which is comparable to Shin and Kim's (2002) reported mean (median) of 0.0149 (0.0234). The means (medians) of the cash holdings and market-to-book variables of 0.1701 and 2.0814 (0.0689 and 1.4243) are higher than the 0.1288 and 1.6342 (0.0584 and 1.2926) amounts that are reported by Shin and Kim (2002).

Correlations are presented in Table 3. Although many are statistically significant, few are large in magnitude.[28] The correlation between *CapExp* and *CapInt* is 0.4901, indicating that, as we predict, firms with high capital intensity have higher capital expenditures. With the exception of the two indexes, *CapUtil* and *ChngLoan*, the correlations of each of the four era indicator variables with *CapExp* and the control variables are relatively weak. At 0.6208, the two indexes are highly correlated with each other. *CapUtil* and *ChngLoan* are negatively correlated with *Expect*, *30%Bonus*, and *50%Bonus*, and these correlations exceed 0.30 in absolute value (except for the -0.1419 correlation between *ChngLoan* and *50%Bonus*). These strong correlations support inclusion of the two indexes as control variables. *UserCost*'s negative correlation with *CapInt* (-0.3803) does affect the regression coefficient for *UserCost*, which is discussed more fully below.

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[27] The higher mean for *UserCost* is partially due to our use of a risk premium (q) of 1.8 versus the 1.5 that Billings and Hamilton (2002) and Billings and Glazunov (2004) use, and it is partially due to Desai and Goolsbee (2004) depreciation rates tending to be higher than Hulten and Wykoff (1981) depreciation rates (see the Appendix for discussion of these aspects of *UserCost*'s specification).

[28] Only 21 percent of the correlations presented in Table 3 are greater than 0.15 in absolute value.

5. Results

5.1. Main Analysis

Table 4 presents the results of estimating equation (2).[29] The table presents the results both with and without the era indicator variables. In both sets of results, all of the coefficients for control variables with predicted signs are in the predicted direction and significant, with two exceptions.[30] The coefficient for *UserCost* is significantly positive, contrary to expectations.[31] *Debt* has the expected sign but is not significant in either set of results. For the control variables without predicted signs, *CshHldngs* is significantly positive, which is consistent with Plummer (2000), and *Size* is significantly positive, which is consistent with Shin and Kim (2002). The second- and third-quarter indicator variables are also significantly positive.

The coefficients for the *Expect*, *30%Bonus*, and *50%Bonus* indicator variables are the main focus of our analysis. Theory predicts that capital expenditures are greater during the three bonus depreciation eras than during the two non-bonus depreciation eras. This would result in a positive coefficient for *Expect*, *30%Bonus*, and *50%Bonus*, indicating greater capital

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[29] We estimate the model using OLS estimation. We investigated estimating the model using a cross-sectionally correlated time-wise autoregressive model (Billings and Hamilton 2002), but the model did not reach convergence. Several of our control variables likely control for cross-sectional correlation to some extent (e.g., *CapUtil*, *ChngLoan*, industry indicator variables). As an untabulated sensitivity analysis directed at autoregression, we included one-quarter lagged residuals as an additional control variable and the results were mostly similar to those reported in the last three columns of Table 4.

[30] We describe significance levels less than or equal to 0.01 as significant and significance levels less than or equal to 0.05 but greater than 0.01 as marginally significant. Several of the regression variables, including the three bonus depreciation era indicator variables, have predicted signs, making one-tailed t-tests of their coefficients appropriate. However, we report their t-tests' significance levels on a two-tailed basis so that we can concisely describe as significant a coefficient that is opposite its predicted direction but large in absolute value with respect to its standard error (rather than describing it as insignificant but being significant if a two-tailed test were used, which is more technically correct but also more verbose).

[31] Untabulated results show that, if *CapInt* is dropped from the model, *UserCost*'s coefficient becomes significantly negative, consistent with expectations. However, when so doing, the adjusted R^2 is 0.2633, which is about one-quarter less than the main analysis' 0.3456 adjusted R^2, and the results become somewhat less supportive of an effect of bonus depreciation on capital expenditures. Given *CapInt*'s use in prior research and its strong explanatory power here, we believe it is important to retain *CapInt* as a control variable to avoid biasing the era indicator variables' coefficients and to better control for other factors that affected capital expenditures concurrently with bonus depreciation's availability.

expenditures during these three eras than during the *PreBonus* era. It would also result in the three bonus depreciation coefficients being greater than the *PostBonus* coefficient, indicating greater capital expenditures during bonus depreciation's availability than during the *PostBonus* era.

Table 4 shows that the *Expect* coefficient is significantly positive, indicating greater capital expenditures in that era compared to the *PreBonus* era. However, the *30%Bonus* era is not significantly different than zero (i.e., *PreBonus* era), and the *50%Bonus* era is marginally significantly negative. The *PostBonus* coefficient is significantly negative. In untabulated F-tests, we find that *Expect* and *30%Bonus* are significantly greater than *PostBonus*, but *50%Bonus* is insignificantly different than *PostBonus*. The largest bonus depreciation effect reported in Table 4 is the difference between the *Expect* (0.00149) and *PostBonus* (-0.00068) eras. The 0.00217 difference indicates that, *ceteris paribus*, capital expenditures were greater in the *Expect* era than in the *PostBonus* era by 0.217 percent of total assets. While this difference may seem small, it is 14 (23) percent of the mean (median) *CapExp* reported in Table 2.

These results provide some evidence that bonus depreciation had a positive effect on capital expenditures. However, the support is limited, even after controlling for many other determinants of capital expenditures documented by other studies. When comparing the bonus depreciation eras to the preceding non-bonus depreciation (i.e., *PreBonus*) era, capital expenditures are significantly greater only in the *Expect* era. When the comparison is between the bonus depreciation eras and the *PostBonus* era, the *Expect* and *30%Bonus*, but not the *50%Bonus*, eras have significantly greater capital expenditures. Because of the mixed nature of the main analysis' results, we conducted several sensitivity analyses and report their results below.

5.2. Sensitivity Analysis

Our first two sensitivity analyses address the possibility that the main analysis did not adequately control for changes in marginal revenues that firms derived from their capital expenditures. Although several of the control variables likely control for these changes to some extent, they may not have adequately done so during bonus depreciation's availability due to unique circumstances at that time. We attempt to control for marginal revenue changes more directly by including as additional control variables firm-specific returns surrounding the events of September 11, 2001 and prospective changes in sales.

Return917 equals the raw CRSP return for September 17, 2001 for all quarters after the third quarter of 2001, and it equals zero for all prior quarters.[32] The mean (median) of *Return917* is -0.0454 (-0.0471) for observations after the third quarter of 2001 (zero for observations prior to the fourth quarter of 2001). The CRSP value-weighted (equal-weighted) market return for September 17 is -0.0507 (-0.0424). *Return917* is positive for 17 percent of the observations after the third quarter of 2001, suggesting that the events of September 11 were expected to positively affect a nontrivial proportion of firms. The results of re-estimating the regression with *Return917* included are reported in Table 5. As expected, *Return917*'s coefficient is significantly positive, indicating that firms with more positive (negative) returns on September 17 tended to have higher (lower) capital expenditures after that time. As in the main analysis, the *Expect* coefficient is significantly positive, and the *30%Bonus* coefficient is still insignificantly different than zero.

[32] That is, for a particular firm i which had a September 17 return of r, *Return917* equals zero for all quarters prior to the fourth quarter of 2001 and r for all later quarters. After their normal closing on September 10, 2001, the U.S. stock markets did not re-open until September 17. Firms for which a September 17 CRSP return was unavailable had all of their quarterly observations deleted for this sensitivity analysis, so the number of observations for it is only 78,606. We also tried specifying *Return917* so that it was the September 17 return times Φ^n, where n was the number of quarters after the fourth quarter of 2001. This specification allows the effect of *Return917* on capital expenditures to gradually decrease over time. The results when Φ was set to 0.95, 0.90, and 0.85 were very similar to those for *Return917* reported in Table 5.

50%Bonus is now significantly negative. Untabulated F-tests find that *Expect* and *30%Bonus* are significantly greater than *PostBonus* and that *50%Bonus* is insignificantly different than *PostBonus*, all of which are similar to the main analysis. Thus, the results are mostly unchanged when *Return917* is included.

In the second sensitivity analysis, we included as a control variable, *FutChngSls*, the prospective change in sales (quarter t+4 sales minus quarter t sales, divided by total assets at the beginning of quarter t).[33] This attempts to better control for changes in marginal revenue by using actual changes in future revenues as a measure of expected changes in future revenues (i.e., perfect foresight). The results of re-estimating the regression with *FutChngSls* are reported in Table 5. The *FutChngSls* coefficient is significantly positive, consistent with capital expenditures increasing as future revenues increase. The other results are similar to those of the main analysis. *Expect* is significantly higher than *PreBonus* and *PostBonus*, and *30%Bonus* is significantly higher than *PostBonus* but insignificantly different than *PreBonus*. *50%Bonus* is significantly less than *PreBonus*, and an untabulated F-test finds that it is still insignificantly different than *PostBonus*. Thus, the inclusion of *FutChngSales* only slightly changes the results.[34]

In the next sensitivity analysis, we specified the fourth quarter of 2004 as a separate era (*50%Bonus2*) and respecified the *50%Bonus* era to end with the third quarter of 2004 (*50%Bonus1*). Similarly, we also specified the first quarter of 2005 (*PostBonus1*) as a separate era and respecified the *PostBonus* era to start with the second quarter of 2005 (*PostBonus2*).

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[33] We winsorized *FutChngSls* at the first and ninety-ninth percentiles to mitigate outliers' influence. Because four-quarter-ahead sales are not available for all observations, only 100,243 observations are included in this analysis.

[34] As an additional sensitivity analysis, we identified four-digit SIC codes that, in our judgment, were likely to have produced property qualifying for bonus depreciation because its availability may have stimulated a firm's capital expenditures through increased demand for its product. We re-estimated the regression for this subset of 20,898 observations. The untabulated results show that *Expect* does not significantly differ from *PreBonus* but is significantly greater than *PostBonus*. *30%Bonus* and *50%Bonus* are significantly less than *PreBonus* but are not significantly different from *PostBonus*.

These additional eras test if firms accelerated capital spending from the first quarter of 2005 to the fourth quarter of 2004 in response to bonus depreciation's expiration at the end of 2004. In untabulated results, *50%Bonus2* is insignificantly different than *PostBonus1*, inconsistent with firms accelerating capital expenditures to take advantage of bonus depreciation before it expired. *50%Bonus2* also is insignificantly different from *PreBonus* and *PostBonus2*, and *50%Bonus1* is insignificantly different from *PostBonus2* but significantly less than *PreBonus*.[35]

The next sensitivity analysis focused on the specification of *CapExp*. Recall that bonus depreciation was available only for qualified property, which generally did not include real estate, but our specification of *CapExp* included all capital expenditures. Desai and Goolsbee (2004) report that spending for equipment is approximately 80 percent of nonresidential investment, which mitigates our concern that *CapExp* is misspecified. Nonetheless, given its importance to this study, we narrow the specification of *CapExp* to exclude real property by calculating the percentage of gross property, plant, and equipment (PPE) that is comprised of machinery and leases and multiplying it by *CapExp*. This assumes that the ratio of qualified property to nonqualified property is the same among capital expenditures as it is among PPE. The sample size for this analysis is reduced to 75,733 observations since Compustat does not provide information on PPE's composition for all firms. The results of estimating equation (2) after respecifying *CapExp* this way are shown in Table 5 and, with two exceptions, are similar to those for the main analysis. *50%Bonus* becomes marginally significantly greater than *PostBonus*,

[35] As an alternative test of bonus depreciation's effect on capital expenditures, we subtracted an expected *CapExp* from the actual *CapExp* during the bonus depreciation eras. Expected *CapExp* was calculated by estimating the regression with only the *PreBonus* and *PostBonus* eras' observations and applying the resultant coefficient estimates to observations' actual variable values. Untabulated results show that the mean unexpected *CapExp* is significantly positive in the *Expect* and *30%Bonus* eras and insignificantly different from zero in the *50%Bonus* era, somewhat consistent with the regression results reported above.

but it becomes significantly less than *PreBonus*.[36] The adjusted R^2 of 0.2279 is about one-third less than the main analysis' adjusted R^2 of 0.3456, indicating that greater emphasis should be given to the main results than to the results of this sensitivity analysis.

Although our results on the total sample are not always supportive of bonus depreciation stimulating capital expenditures, bonus depreciation may have had a stronger effect on capital expenditures for some subsamples. In addition, despite our use of a broad set of control variables, our empirical model may not adequately control for other factors that affect capital expenditures and that vary systematically with respect to the five eras. We investigate these possibilities by using a difference-in-difference design, in which we classify observations as at-or-above-median or below-median with respect to *Size*, then with respect to *CapInt*, and finally with respect to *MktBk*. The empirical model is modified by including an indicator variable for observations whose classification variable is greater than or equal to the median for that variable for the full sample and interactions of this indicator variable with the *Expect*, *30%Bonus*, *50%Bonus*, and *PostBonus* era indicator variables. When classifying with respect to a particular variable (e.g., *Size*), this specification is econometrically equivalent to estimating a separate intercept term for at-or-above-median and below-median *Size* observations in each of the five eras (total of ten intercept terms). For convenience, we describe at-or-above-median observations as higher and below-median observations as lower.

Table 6 reports the results of this sensitivity analysis. For the model that partitions observations with respect to the median of *Size* (and similarly for the other two models), the

[36] As an additional sensitivity analysis, we deleted observations for which the annual change in land and building, as a percentage of capital expenditures, exceed 0.50 in absolute value. The untabulated results show bonus depreciation coefficients that are similar to the main analysis' results, except that *30%Bonus* is marginally significantly greater than *PostBonus* (rather than significantly greater) and *50%Bonus* is significantly less than *PreBonus* (rather than insignificantly different).

coefficients for the four era indicator variables for lower-*Size* observations (0.00190, 0.00078, 0.00005, and -0.00087) estimate, for such observations, the difference between *CapExp* in those eras versus the *PreBonus* era. The *PreBonus* indicator variable's coefficient for higher-*Size* observations (-0.00027) estimates the difference in *CapExp* for the *PreBonus* era between higher- and lower-*Size* observations, and the coefficients for the *Expect*, *30%Bonus*, *50%Bonus*, and *PostBonus* indicator variables for higher-*Size* observations (-0.00111, -0.00171, -0.00140, and 0.00005) can be interpreted in a similar manner.

The model specification with separate era indicator variables for higher-*Size* (i.e. larger) versus lower-*Size* (i.e., smaller) observations is motivated by adjustment costs. Firms' ability to respond to bonus depreciation may have been hampered by the need to coordinate and integrate newly-acquired property with their existing operations. If such adjustment costs tend to be lower for smaller firms, their capital expenditures would be expected to respond more strongly to bonus depreciation because of their greater agility and nimbleness. The *Size* columns in Table 6 report the results of this model specification and indicate that capital expenditures for larger firms were not significantly different than those for smaller firms in the *PreBonus* (-0.00027) and *PostBonus* eras (0.00005). However, capital expenditures, which are scaled by total assets, for larger firms were marginally significantly less than those for smaller firms during the *Expect* (-0.00111) era and were significantly less during the *30%Bonus* (-0.00171), and *50%Bonus* (-0.00140) eras. Results of untabulated F-tests indicate that the difference between smaller and larger firms during the *30%Bonus* (-0.00171) and *50%Bonus* eras (-0.00140) are significantly greater differences in absolute value than the differences during the *PreBonus* (-0.00027) and *PostBonus* (0.00005) eras. The difference during the *Expect* era (-0.00111) is insignificantly different (marginally significantly different) than that during the *PreBonus* (*PostBonus*) era.

These results indicate that bonus depreciation had a greater effect on smaller firms' capital expenditures than on those of larger firms, consistent with adjustment costs being greater for larger firms than for smaller firms.

The next model specification compares firms with higher versus lower capital intensity. Recall that *CapInt* is strongly and positively associated with *CapExp* in the main analysis, so higher *CapInt* firms are predicted to have higher capital expenditures than lower *CapInt* firms. One might expect that a bonus depreciation effect would be more pronounced among lower-*CapInt* firms, who are less motivated to make capital expenditures in the absence of bonus depreciation than are higher-*CapInt* firms. Alternatively, one might argue that bonus depreciation effects would be stronger among higher-*CapInt* firms because they have more capital expenditures that could respond to bonus depreciation. Given these conflicting arguments, we do not make predictions about the manner in which the difference between higher- and lower-*CapInt* firms will vary across the eras. The capital intensity columns in Table 6 report the results of this model specification. For the *PreBonus* (0.00267), *50%Bonus* (0.00181), and *PostBonus* (0.00511) eras, higher-*CapInt* firms had significantly higher *CapExp* than lower-*CapInt* firms, but there was no significant difference in the *Expect* (0.00070) and *30%Bonus* (-0.00027) eras. Untabulated F-tests find that higher- versus lower-*CapInt* differences in the *PreBonus* and *PostBonus* eras are significantly greater than those in the *Expect*, *30%Bonus*, and *50%Bonus* eras. This indicates that capital expenditures of lower-*CapInt* firms responded more strongly to bonus depreciation than those of higher-*CapInt* firms, consistent with the argument that bonus depreciation was more effective among lower-*CapInt* firms because they would otherwise have been less motivated to make capital expenditures.

The model specification that compares observations of firms with lower- versus higher-*MktBk* firms is motivated by the argument of Billings et al. (2009) that firms with lower adjustment costs tend to have higher market-to-book ratios because the market factors these lower costs into its valuation of such firms. Thus, one would expect to see capital expenditures of higher-*MktBk* firms to exceed those of lower-*MktBk* firms and for this excess to be larger during the bonus depreciation eras than during the non-bonus depreciation eras. The market to book columns in Table 6 report the results of this model specification and indicate that *CapExp* is significantly greater for higher *MktBk* firms than for lower *MktBk* firms in all eras (i.e., 0.00515, 0.00363, 0.00340, 0.00277, and 0.00309 are significantly greater than zero). However, this excess is smaller during the *Expect*, *30%Bonus*, and *50%Bonus* eras than during the *PreBonus* era, inconsistent with the larger expected excess. The difference in *CapExp* for the *Expect* (0.00363) and *30%Bonus* (0.00340) are greater than that for the *PostBonus* (0.00309) era, but untabulated F-test results indicate that these coefficients do not significantly differ.

As an additional analysis with respect to capital intensity, we also re-estimated the regression with only the observations in SIC codes 2000 through 3999, which are the SIC codes Shin and Kim (2002) use in their capital expenditures model. The untabulated results are similar to the main analysis' results, except that *50%Bonus* is significantly less than *PreBonus* and significantly greater than *PostBonus* (rather than marginally significantly less and insignificantly different). Overall, the main analysis' results provide stronger evidence of bonus depreciation stimulating capital expenditures than the two sensitivity analyses that focus on capital intensity.

5.3. Discussion of results

Although we interpret our results as providing some support that bonus depreciation's availability stimulated capital spending, we recognize that the support is limited and not always supportive. One possibility for this outcome is an omitted variable that is a determinant of capital expenditures and that is correlated with our era indicator variables. The likelihood of this possibility is mitigated by our use of previously documented determinants of capital expenditures as control variables. Similarly, another possibility is the presence of some factor that uniquely dampened capital expenditures during the bonus depreciation eras, thus masking the stimulatory effect of bonus depreciation. The likelihood of this possibility is mitigated by the fact that a stronger bonus depreciation effect was not found after controlling for *Return917* and *FutChngSls* nor with a difference-in-difference design with respect to *CapInt* and *MktBk* (though a significant bonus depreciation effect was found with respect to *Size*).

A third possibility is that the price of capital goods increased in response to bonus depreciation, which would have had the effect of decreasing capital spending at the same time that bonus depreciation's tax benefits had the effect of increasing it (Davis and Swenson 1993; Key 2008). The data we use does not provide the price of firms' capital goods, so we are unable to assess this possibility. A fourth possibility is that bonus depreciation provided little or no immediate financial reporting benefit since the accelerated depreciation merely created additional taxable temporary differences that would not have reduced income tax expense pursuant to FAS 109 (cf. Neubig 2006). Prior research suggests that firms will sometimes incur tax costs (or forego tax savings) in order to obtain financial reporting benefits (Shackelford and Shevlin 2001), so firms may have focused their tax planning efforts on strategies that would lower their effective tax rates or provide other financial reporting benefits. A fifth possibility is that some firms may have expected future increases in tax rates, so they were not responsive to bonus depreciation's availability. This possibility is consistent with Knittel's (2007) finding that firms did not claim bonus depreciation on many of their capital expenditures for which they were eligible to claim it. A sixth, though not necessarily final, possibility is that the stimulus provided by bonus depreciation was relatively small, making it difficult to empirically detect an effect on capital expenditures (Desai and Goolsbee 2004). If true, this explanation would be consistent with the mixed nature of our results.

6. Conclusion

Congress has used tax incentives many times, and in many forms, over the years to try to induce businesses to increase their capital spending. The bonus depreciation that Congress enacted in 2002 and 2003 was yet another attempt to attain this goal. Prior research has studied the effects of tax incentives on capital spending, often finding that they do have their intended effect. However, such research has not focused on depreciation tax incentives per se because changes in them had always occurred simultaneously with other tax factors, such as investment tax credits and corporate tax rates. There is reason to believe that depreciation tax incentives may not lead to increased capital spending. Business executives claim in surveys that tax depreciation is a relatively unimportant factor when making capital expenditure decisions, firms might not respond to such tax incentive since, under U.S. financial reporting rules, they will not reap a reduced income tax expense and effective tax rate in their financial statements, the price of capital goods may have increased due to bonus depreciation, and the stimulus provided by bonus depreciation may have been insufficiently large.

The purpose of this study is to examine the effect of bonus depreciation on firms' capital expenditures. This change in tax depreciation was unique because it was not accompanied by changes in investment tax credits, corporate tax rates, or other factors that would be expected to directly affect business capital spending. We estimate a model of capital expenditures that includes as explanatory variables indicator variables for bonus depreciation's availability, as well as a number of control variables to allow for the possibility that bonus depreciation dampened a decline in capital spending. After including these control variables, we expect that capital expenditures will be greater during bonus depreciation's availability than before or after it. We find some evidence consistent with this expectation, but we also find some evidence of an insignificant effect. These results weakly indicate that bonus depreciation stimulated capital spending and suggests that Congress may be furthering its goal of stimulating capital spending when enacting depreciation tax incentives, but the mixed nature of the results mean that such a conclusion should be reached cautiously.

Appendix
Specification of User Cost of Capital *(UserCost)*

To control for the user cost of capital on capital expenditures in the absence of bonus depreciation, note that the user cost of capital specification in equation (1) simplifies to the following (i.e., if Z_S equals Z_{S+1}):

$$C_S = \varphi_S \left(\frac{1 - \tau Z_S}{1 - \tau} \right) (\rho + \delta) \tag{A.1}$$

where

C_S = user cost of capital in year s,
φ_S = price of new capital goods in year s,
τ = corporate marginal income tax rate,
ρ = after-tax cost of funds (debt and equity), and
δ = rate of physical depreciation.

Our empirical specification of *UserCost* is similar to that of Billings and Hamilton (2002) and Billings and Glazunov (2004). The following paragraphs provide details on the specification of *UserCost*'s components.

φ_S – Price of New Capital Goods

We measure the price of new capital goods using the price index for private fixed investment and dividing it by the price index for gross output by industry. Both indexes are retrieved from the U.S. Bureau of Economic Analysis (http://www.bea.gov/). We assigned each observation to one of four groups: (1) information processing equipment and software (SIC codes 3500 to 3599), (2) industrial equipment (SIC codes 3600 to 3699), (3) transportation equipment (SIC codes 3800-3999), and (4) other equipment (all other SIC codes). We used the price index for private fixed investment (NIPA Table 5.3.4) for an observation's group for the preceding quarter to measure the numerator of φ_S. We then used the price index for gross output for the preceding year for the NAICS code corresponding to an observation's SIC code to measure the denominator of φ_S (this index is available only on an annual basis).

τ – Corporate Marginal Income Tax Rate

We use Graham's (1996) simulated tax rate as the measure of the corporate marginal income tax rate (τ). Graham performs simulations using Compustat data to estimate firms' marginal tax rates, and he accounts for many important features of the tax code, including uncertainty about future taxable income, deferred taxes, the progressivity of the statutory tax schedule, net operating loss carryforwards and carrybacks, certain tax credits, and the alternative minimum tax.[37] Graham and Mills (2008, p. 386) conclude that "the simulated financial statement MTR . . . is the best financial statement-based tax rate in terms of most closely approximating" a simulated marginal tax rate based on actual tax return data. The simulated tax rate is available on only an annual basis, so the rate for the preceding year was used for all four quarters of a year.[38]

δ – Rate of Physical Depreciation

The depreciation rates reported by Desai and Goolsbee (2004) are used as the measure of the rate of physical depreciation (δ). We use these depreciation rates instead of the Hulten and Wykoff (1981) depreciation rates that prior research often use because they are more recent and are available for a broader range of industries.

ρ – After-Tax Cost of Funds (Debt and Equity)

We compute the after-tax cost of funds as $b(1 - \tau)DS + bq(1 - DS)$. Moody's seasoned Aaa corporate bond yield for the month preceding the quarter is used to measure the cost of debt

[37] See http://faculty.fuqua.duke.edu/~jgraham/taxform.html for more information on Graham's simulated tax rates.

(b). The debt share in the firm's capital structure (DS) is measured as long-term debt (Compustat quarterly #51) divided by total assets (quarterly #44), both at the beginning of the quarter. The cost of equity exceeds the cost of debt by a risk premium (b + rp). Thus, the cost of equity can be expressed as bq = b + rp so that q = (b + rp) / b, where b is the cost of debt, rp is the risk premium, and q is the cost of equity as a multiple of b. During our sample period, b varied between 5.0 percent and 9.6 percent. If the risk premium (rp) is assumed to be eight (four) percentage points, then $1.8 < q < 2.6$ ($1.4 < q < 1.8$), so we use a q of 1.8 to calculate the cost of equity.

Z_S – Present Value of Depreciation Deductions per Dollar Spent

In addition to using the after-tax cost of funds as one of the direct components of *UserCost*, we also use it to compute the present value of depreciation deductions per dollar spent (Z_S in equation (A.1)), assuming the deductions are for seven-year MACRS property. In computing Z_S, we assume that bonus depreciation is not available to control for the effect of the user cost of capital on capital expenditures in the absence of bonus depreciation, which is similar to the way that Billings and Hamilton (2002) and Billings and Glazunov (2004) control for the effect of the user cost of capital in the absence of the alternative minimum tax. We do not take into account bonus depreciation when computing Z_S to avoid having this component of *UserCost* control for the effect of bonus depreciation on capital expenditures.

Numerical Examples of UserCost Calculation

Table A.1 provides two numerical examples of the calculation of *UserCost*: the observation whose *UserCost* is closest to the mean *UserCost* for the 116,050 observations in the

[38] Use of the lagged tax rate avoids endogeneity between the marginal income tax rate and capital expenditures (Graham et al. 1998). Graham's simulated tax rate for 2002 takes into account the five-year carryback that was allowed for NOLs that year.

sample and the observation whose *UserCost* is the maximum for the sample. Note that several factors contribute to the 0.8911 maximum *UserCost* being about three times as large as the 0.2930 mean *UserCost*. First, φ_S is 2.13 times as large (2.167791 versus 1.019198), which is mostly due to a much higher price index in the early 1990s for information processing equipment and software than in later years. Second, the interest rate (i.e., cost of debt) is about 40 percent higher for the maximum *UserCost* observation than for the mean *UserCost* observation (9.56 percent versus 6.77 percent), which causes the third term of the *UserCost* calculation to be 24 percent larger (0.169491 + 0.186 versus 0.101300 + 0.186). Third, the 0.34000 tax rate for the maximum *UserCost* observation is much more than the 0.00348 tax rate for the mean *UserCost* observation, which causes the second term of the *UserCost* calculation (i.e., the fraction) to be 16 percent larger. The three terms in the *UserCost* calculation are multiplicative, not additive, so the effect of each term being larger for the maximum observation than for the mean observation is magnified. Thus, taken together, the differences in the three terms cause *UserCost* to be 3.04 times larger for the maximum observation than for the mean observation (2.13 × 1.16 × 1.24).

The mean *UserCost* for our sample of 0.2930 is higher than the 0.231 and 0.230 means that Billings and Hamilton (2002) and Billings and Glazunov (2004), respectively, report for 1987-1993. Note that *UserCost* is more sensitive to φ, the price of new capital goods, than it is to τ, the tax rate.[39] For example, if φ equals one, τ equals the sample median of 0.1571, and Z_S, ρ, and δ equal the values in Table A.1 for the mean *UserCost* observation, *UserCost* equals 0.2985. If φ increases by 10 percent to 1.10, *UserCost* increases to 0.3283, a 10 percent increase.

[39] φ for information processing equipment and software decreases steadily and substantially through our sample period of 1990 to 2006. The higher values of *UserCost* in our sample (including the maximum value described in Table A.1) are attributable to these higher values for φ in the early 1990s.

However, if τ increases by 10 percent to 0.1728, *UserCost* increases to 0.2998, a 0.5 percent increase.

Table A.1
Numerical Examples of *UserCost* Calculation

Observation	Mean *UserCost* GVKEY #62612 2002, 1st quarter SIC code = 3829	Maximum *UserCost* GVKEY #14630 1990, 4th quarter SIC code = 3576
φ_S – price of new capital goods:		
• Numerator – price index for private fixed investment (100.813 is index for 2001-Q4 for industrial equipment; 175.719 is index for 1990-Q3 for information processing equipment and software) Source: www.bea.gov/national/nipaweb (NIPA Table 5.3.4, year 2000=100)	100.813	175.719
• Denominator – price index for gross output by industry (98.914 is index for 2001 for manufacturing; 81.059 is index for 1989 for all industries Source: www.bea.gov/industry/gpotables (year 2000=100)	98.914	81.059
• ρ – ratio of numerator and denominator	1.019198	2.167791
τ – corporate marginal income tax rate (Graham's simulated tax rate for preceding year)	0.00348	0.34000
Z_S – present value of depreciation deductions per dollar spent (based on 7-year MACRS percentages, discounted using ρ (detailed below))	0.791501	0.696592
ρ – after-tax cost of funds (debt and equity) = b(1 – τ)DS + bq(1 – DS): • b = cost of debt (Moody's seasoned Aaa corporate bond yield for month preceding beginning of quarter (Source: http://research.stlouisfed.org/fred2/data/AAA.txt) • τ = corporate marginal income tax rate (see above) • DS = debt share in firm's capital structure; long-term debt (Compustat quarterly data item #51) divided by total assets (Compustat quarterly data item #44); both for preceding quarter • q = cost of equity as a multiple of the cost of debt (assumed to be 1.8)	b = 0.0677 τ = 0.00348 #51 = 1.640 #44 = 4.339 DS = 0.377967 ρ = 0.101300	b = 0.0956 τ = 0.34000 #51 = 2.735 #44 = 115.131 DS = 0.023756 ρ = 0.169491
δ – depreciation rate (depreciation rates reported by Desai & Goolsbee (2004); mean and maximum observations happen to have the same depreciation rate)	0.186	0.186

UserCost:

- Observation closest to mean *UserCost*: $1.019198 \times \frac{1 - (0.00348 \times 0.791501)}{1 - 0.00348} \times (0.101300 + 0.186) = 0.2930$
- Observation with maximum *UserCost*: $2.167791 \times \frac{1 - (0.34000 \times 0.696592)}{1 - 0.34000} \times (0.169491 + 0.186) = 0.8911$

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Table 1
Description of Sample

	Number of Firms	Number of Observations
Panel A: Sample selection		
Compustat quarterly observations for 1990-2006 with calendar year-end and with positive or zero year-to-date capital expenditures	11,446	315,722
Less: No corresponding observation in previous quarter or fourth-previous quarter		(43,448)
Less: Year-to-date capital expenditures less than previous quarter's year-to-date capital expenditures (2nd, 3rd & 4th quarters only)		(6,655)
Less: Observations missing data, nonpositive total assets, negative debt in current liabilities, negative long-term debt, nonpositive total equity, nonpositive sales in current or fourth-previous quarter, negative property, plant & equipment, negative cash and short-term investments, negative stock price, or negative common shares outstanding		(80,951)
Less: Capital expenditures specified by Compustat as net of sales, retirements, and disposals		(14,851)
Less: American Depository Receipt firms, SIC 4512 (passenger airlines), and SIC 6798 (REITs)		(4,403)
Less: Observations with no Graham simulated tax rate data		(47,437)
	6,593	117,977
Less: Influential observations with Studentized Residuals > 2.0		(1,927)
Final sample	6,566	116,050

Panel B: Number of observations by year and quarter

Year	# of obs.	Year	# of obs.	Quarter	# of obs.
1990	4,614	1999	8,804	1st	31,708
1991	4,670	2000	8,356	2nd	28,945
1992	4,843	2001	8,917	3rd	28,258
1993	5,228	2002	8,742	4th	27,139
1994	5,636	2003	7,300		116,050
1995	6,155	2004	7,650		
1996	5,200	2005	7,661		
1997	7,447	2006	6,851		
1998	7,976		116,050		

Table 1 (cont.)
Description of Sample

Panel C: Number of observations by two-digit SIC code

2-digit SIC	# of obs.	2-digit SIC	# of obs.
01 (agriculture – crops)	320	42 (motor freight transportation)	1,400
10 (metal mining)	1,406	44 (water transportation)	743
13 (oil & gas extraction)	5,368	47 (transportation services)	488
14 (mining – nonmetallic)	356	48 (communications)	3,638
15 (building construction)	424	49 (electric, gas & sanitary services)	2,379
16 (heavy construction)	522	50 (wholesale – durable)	3,089
20 (food & kindred prod.)	2,157	51 (wholesale – nondurable)	1,412
22 (textile mill products)	809	54 (food stores)	436
23 (apparel, etc.)	815	55 (automotive dealers & gas stations)	372
24 (lumber & wood prod.)	783	58 (eating & drinking places)	1,702
25 (furniture & fixtures)	642	59 (miscellaneous retail)	1,366
26 (paper, etc. products)	1,746	61 (non-depository credit institutions)	813
27 (printing, publish., etc.)	1,689	62 (security & commodity brokers)	1,253
28 (chemicals, etc. prod.)	10,833	63 (insurance carriers)	2,886
29 (petroleum refining)	1,018	64 (insurance agents, etc.)	714
30 (rubber, etc. products)	1,623	65 (real estate)	922
31 (leather & leath. prod.)	377	67 (holding & other invest. offices)	1,133
32 (stone, clay, glass, etc.)	1,043	70 (hotels, etc.)	645
33 (primary metal)	2,250	73 (business services)	10,836
34 (fabricated metal)	2,344	78 (motion pictures)	344
35 (mach. & computers)	7,338	79 (amusement & recreation services)	1,203
36 (electronic, etc. equip.)	7,669	80 (health services)	2,461
37 (transportation equp.)	2,819	82 (educational services)	296
38 (measuring instrmnts.)	7,633	87 (engineering, acct., etc. services)	2,462
39 (misc. manufacturing)	1,427	Other	8,904
40 (railroad transportat.)	742		116,050

Table 1 (cont.)
Description of Sample

Panel D: Number of observations per firm

Number of Obs.	Number of Firms	Total # of obs.	Number of Obs.	Number of Firms	Total # of obs.	Number of Obs.	Number of Firms	Total # of obs.
1	429	429	24	140	3,360	47	20	940
2	383	766	25	70	1,750	48	29	1,392
3	391	1,173	26	60	1,560	49	19	931
4	391	1,564	27	82	2,214	50	17	850
5	245	1,225	28	75	2,100	51	29	1,479
6	266	1,596	29	66	1,914	52	40	2,080
7	263	1,841	30	73	2,190	53	8	424
8	257	2,056	31	79	2,449	54	15	810
9	153	1,377	32	94	3,008	55	31	1,705
10	174	1,740	33	58	1,914	56	23	1,288
11	183	2,013	34	48	1,632	57	18	1,026
12	196	2,352	35	73	2,555	58	14	812
13	152	1,976	36	65	2,340	59	14	826
14	139	1,946	37	43	1,591	60	22	1,320
15	144	2,160	38	40	1,520	61	19	1,159
16	177	2,832	39	47	1,833	62	15	930
17	99	1,683	40	58	2,320	63	17	1,071
18	112	2,016	41	49	2,009	64	24	1,536
19	134	2,546	42	27	1,134	65	19	1,235
20	135	2,700	43	32	1,376	66	20	1,320
21	79	1,659	44	28	1,232	67	27	1,809
22	88	1,936	45	28	1,260	68	66	4,488
23	106	2,438	46	29	1,334		6,566	116,050

Table 2
Descriptive Statistics [a]

Variable [b]	Description	Mean	Stnd. Dev.	Median	Min.	Max.
CapExp	Capital expenditures	0.0150	0.0173	0.0094	0.0000	0.2138
Expect	Q4-2001 to Q1-2002	0.0379	0.1909	0.0000	0.0000	1.0000
30%Bonus	Q2-2002 to Q2-2003	0.0877	0.2828	0.0000	0.0000	1.0000
50%Bonus	Q3-2003 to Q4-2004	0.0963	0.2949	0.0000	0.0000	1.0000
PostBonus	Q1-2005 to Q4-2006	0.1250	0.3308	0.0000	0.0000	1.0000
UserCost	User cost of capital	0.2930	0.0700	0.2866	0.0706	0.8911
CapInt	Capital intensity	0.2925	0.2491	0.2177	0.0000	0.9894
Debt	Debt-to-equity ratio	2.3875	225.453	0.4015	0.0000	75970.4
CshFlws	Cash flows	0.0107	0.1593	0.0258	-5.1584	3.3939
CshHldngs	Cash holdings	0.1701	0.2197	0.0689	0.0000	1.0000
MktBk	Market-to-book ratio	2.0814	2.4325	1.4243	0.0233	151.317
ΔSales	Change in sales	0.0234	0.1281	0.0147	-5.0811	5.0755
Size	Firm size	3.5793	2.4037	3.6381	-6.9078	11.3916
CapUtil	Capacity utilization rate	0.8047	0.0307	0.8115	0.7360	0.8506
ChngLoan	%Δ in comm. bank loans	0.0028	0.0067	0.0038	-0.0153	0.0161
GrhmTax	Graham’s tax rate	0.1722	0.1586	0.1571	0.0000	0.3950

[a] Based on 116,050 observations. Descriptive statistics for the three quarterly and 50 industry indicator variables are omitted for brevity.

[b] #s are Compustat quarterly data items.

CapExp = cash outflows for additions to property, plant, and equipment (#90) divided by total assets (#44).

Expect = 1 if the quarter is the 4th quarter of 2001 or the 1st quarter of 2002 and 0 otherwise.

30%Bonus = 1 if the quarter is the 2nd, 3rd, or 4th quarter of 2002 or the quarter is the 1st or 2nd quarter of 2003 and 0 otherwise.

50%Bonus = 1 if the quarter is the 3rd or 4th quarter of 2003 or the quarter is in 2004 and 0 otherwise.

PostBonus = 1 if the quarter is in 2005 or 2006 and 0 otherwise.

UserCost = user cost of capital.

CapInt = net property, plant and equipment (#42) divided by total assets (#44).

Debt = total debt (#51 + #45) divided by total equity (#60).

CshFlws = operating cash flows (#108) divided by total assets (#44).

CshHldngs = cash (#36) divided by total assets (#44).

MktBk = market value of equity (#14 × #61) plus total liabilities (#44 – #60), divided by total assets (#44).

ΔSales = sales (#2) for quarter t minus sales for quarter t-4, divided by total assets (#44).

Size = natural logarithm of quarterly sales (#2), in millions of dollars.

CapUtil = capacity utilization rate.

ChngLoan = percentage change in bank loans (commercial and industrial).

GrhmTax = Graham’s (2006) simulated tax rate.

Table 3
Pearson Correlation Coefficients [a,b,c]

	CapExp	*Expect*	*30%Bonus*	*50%Bonus*	*PostBonus*	*UserCost*	*CapInt*	*Debt*
Expect	-0.0360							
30%Bonus	-0.0681	-0.0615						
50%Bonus	-0.0502	-0.0648	-0.1012					
PostBonus	-0.0399	-0.0750	-0.1172	-0.1234				
UserCost	-0.1446	-0.0113	-0.0760	-0.1598	-0.2194			
CapInt	0.4901	-0.0150	-0.0222	-0.0402	-0.0852	-0.3803		
Debt	-0.0023	-0.0006	0.0094	-0.0008	-0.0007	-0.0092	0.0060	
CshFlws	0.1601	-0.0065	-0.0125	-0.0008	-0.0103	0.0181	0.1779	-0.0004
CshHldngs	-0.1248	0.0235	0.0406	0.0695	0.0912	0.1044	-0.3815	-0.0045
MktBk	0.0522	-0.0197	-0.0440	0.0291	0.0542	0.0581	-0.1525	-0.0023
ΔSales	0.0826	-0.0711	-0.0444	0.0280	0.0272	0.0143	-0.0344	-0.0034
Size	0.0923	-0.0074	-0.0099	-0.0001	0.0373	-0.0419	0.1475	0.0020
CapUtil	0.1258	-0.4046	-0.5399	-0.3783	-0.0174	0.1726	0.0590	-0.0054
ChngLoan	0.0688	-0.3021	-0.3525	-0.1419	0.3085	-0.0157	-0.0116	-0.0040
GrhmTax	0.0816	-0.0299	-0.0575	-0.0427	-0.0415	0.2060	0.0682	-0.0056

	CshFlws	*Csh Hldngs*	*MktBk*	*ΔSales*	*Size*	*CapUtil*	*Chng Loan*
CshHldngs	-0.2612						
MktBk	-0.2144	0.3291					
ΔSales	0.0545	-0.0106	0.1048				
Size	0.3639	-0.4198	-0.1819	0.0975			
CapUtil	0.0160	-0.0986	0.0223	0.0775	0.0089		
ChngLoan	-0.0046	-0.0091	0.0545	0.0716	0.0251	0.6208	
GrhmTax	0.2765	-0.2036	-0.0736	0.0594	0.3769	0.1050	0.0491

[a] Based on the final sample of 116,050 observations. Correlations with the three quarterly and 50 industry indicator variables are omitted for brevity.
[b] All correlations greater than 0.0115 in absolute value are significant at less than the 0.0001 level.
[c] See Table 2 for a description of the variables.

Table 4
Main Analysis – Regression Results [a]

	Exp.	w/o Bonus Depreciation Variables			With Bonus Depreciation Variables		
	Sign	Coeff.	t-statistic	p-value	Coeff.	t-statistic	p-value
Intercept term		-0.04634	-32.06	<.0001	-0.04628	-17.48	<.0001
Era indicator variables:							
Expect	+				0.00149	4.78	<.0001
30%Bonus	+				0.00007	0.30	0.7635
50%Bonus	+				-0.00051	-2.42	0.0154
PostBonus	?				-0.00068	-4.19	<.0001
Control variables:							
UserCost	–	0.01150	13.41	<.0001	0.00961	10.59	<.0001
CapInt	+	0.03087	122.27	<.0001	0.03070	120.76	<.0001
Debt	–	-0.00000	-1.55	0.1209	-0.00000	-1.55	0.1209
CshFlws	+	0.00750	25.80	<.0001	0.00757	26.05	<.0001
CshHldngs	?	0.00543	22.36	<.0001	0.00553	22.73	<.0001
MktBk	+	0.00082	44.35	<.0001	0.00082	44.51	<.0001
ΔSales	+	0.00883	26.90	<.0001	0.00897	27.29	<.0001
Size	?	0.00038	18.09	<.0001	0.00039	18.39	<.0001
CapUtil	+	0.05239	28.07	<.0001	0.05297	16.45	<.0001
ChngLoan	+	0.01900	2.30	0.0215	0.03699	4.04	<.0001
Second Qtr.	?	0.00148	12.86	<.0001	0.00156	13.35	<.0001
Third Qtr.	?	0.00118	10.09	<.0001	0.00129	10.81	<.0001
Fourth Qtr.	+	0.00326	27.75	<.0001	0.00329	27.92	<.0001
		F-statistic = 972.11			F-statistic = 915.80		
		Adjusted R^2 = 0.3452			Adjusted R^2 = 0.3456		
		n = 116,050			n = 116,050		

[a] The dependent variable is capital expenditures (*CapExp*). See Table 2 for a description of the variables. Coefficients for the 50 industry indicator variables are omitted for brevity.

Table 5
Supplemental Analysis – Regression Results [a]

	Main Analysis		With *Return917* [b]		With *FutChngSls* [c]		Qualified Cap. Exp. [d]	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Intercept term	-0.04628	-17.48	-0.03937	-12.83	-0.04602	-16.13	-0.03653	-14.31
Era indicator variables:								
Expect	0.00149	4.78	0.00106	3.14	0.00149	4.53	0.00075	2.52
30%Bonus	0.00007	0.30	-0.00046	-1.71	-0.00003	-0.11	0.00004	0.15
50%Bonus	-0.00051	-2.42	-0.00100	-4.28	-0.00067	-2.99	-0.00056	-2.73
PostBonus	-0.00068	-4.19	-0.00125	-6.70	-0.00092	-4.44	-0.00098	-6.24
Control variables:								
Return917 [b]			0.00464	6.01				
FutChngSls [c]					0.00797	18.23		
UserCost	0.00961	10.59	0.00800	7.11	0.01006	10.34	0.01403	15.15
CapInt	0.03070	120.76	0.03202	102.43	0.03042	108.21	0.02041	78.12
Debt	-0.00000	-1.55	-0.00000	-1.40	-0.00000	-1.37	-0.00000	-2.94
CshFlws	0.00757	26.05	0.00985	26.25	0.00854	25.60	0.00392	14.82
CshHldngs	0.00553	22.73	0.00494	17.11	0.00557	20.90	0.00437	18.94
MktBk	0.00082	44.51	0.00082	38.28	0.00082	41.13	0.00064	37.35
ΔSales	0.00897	27.29	0.00860	21.08	0.00820	22.65	0.01009	28.93
Size	0.00039	18.39	0.00018	7.17	0.00035	15.09	0.00016	7.70
CapUtil	0.05297	16.45	0.04708	12.54	0.05227	15.08	0.04055	13.06
ChngLoan	0.03699	4.04	0.04051	3.92	0.03786	3.78	0.01086	1.23
Second Qtr.	0.00156	13.35	0.00161	11.82	0.00156	12.43	0.00109	9.64
Third Qtr.	0.00129	10.81	0.00125	9.04	0.00129	10.05	0.00086	7.47
Fourth Qtr.	0.00329	27.92	0.00330	24.40	0.00331	26.26	0.00227	20.00
F statistic	915.80		693.25		774.29		334.73	
Adjusted R^2	0.3456		0.3746		0.3441		0.2279	
n	116,050		78,605		100,243		75,733	

[a] The dependent variable is capital expenditures (*CapExp*). See Table 2 for a description of the variables (other than *Return917* and *FutChngSls*). Coefficients for the 50 industry indicator variables are omitted for brevity.
[b] *Return917* is the September 17, 2001 firm-specific return for quarters after the third quarter of 2001 and is zero for quarters before the fourth quarter of 2001.

[c] *FutChngSls* is quarter t+4 sales minus quarter t sales, divided by total assets.
[d] *CapExp* is specified as estimated qualified capital expenditures, which is the percentage of gross property, plant, and equipment comprised of machinery and leases, multiplied by *CapExp*.

Table 6
Supplemental Analysis – Regression Results [a]

	Main Analysis		Size[b]		Capital Intensity[c]		Market to Book[d]	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Intercept term	-0.04628	-17.48	-0.04630	-17.49	-0.04616	-17.48	-0.03878	-14.76
Era indicator variables – observations less than the median (all observations for the main analysis):								
Expect	0.00149	4.78	0.00190	5.05	0.00244	6.61	0.00155	4.34
30%Bonus	0.00007	0.30	0.00078	2.74	0.00146	5.22	0.00044	1.63
50%Bonus	-0.00051	-2.42	0.00005	0.21	-0.00012	0.47	0.00004	0.14
PostBonus	-0.00068	-4.19	-0.00087	-4.05	-0.00160	-8.23	-0.00018	-0.78
Era indicator variables – observations greater than or equal to the median:								
PreBonus			-0.00027	-1.84	0.00267	17.25	0.00515	45.50
Expect			-0.00111	-2.55	0.00070	1.58	0.00363	8.51
30%Bonus			-0.00171	-5.71	-0.00027	-0.90	0.00340	11.96
50%Bonus			-0.00140	-4.83	0.00181	6.16	0.00277	10.22
PostBonus			0.00005	0.19	0.00511	19.23	0.00309	12.48
Control variables:								
UserCost	0.00961	10.59	0.00949	10.44	0.00908	10.02	0.00762	8.46
CapInt	0.03070	120.76	0.03069	120.74	0.02652	76.71	0.03078	122.27
Debt	-0.00000	-1.55	-0.00000	-1.50	-0.00000	-1.42	-0.00000	-1.46
CshFlws	0.00757	26.05	0.00755	25.92	0.00748	25.81	0.00701	24.32
CshHldngs	0.00553	22.73	0.00548	22.51	0.00575	23.65	0.00392	16.10
MktBk	0.00082	44.51	0.00083	44.78	0.00083	44.96	0.00051	26.12
ΔSales	0.00897	27.29	0.00893	27.14	0.00906	27.62	0.00768	23.51
Size	0.00039	18.39	0.00047	15.25	0.00036	17.19	0.00028	13.31
CapUtil	0.05297	16.45	0.05286	16.42	0.05290	16.46	0.04337	13.57
ChngLoan	0.03699	4.04	0.03734	4.08	0.03842	4.20	0.03552	3.91
Second Qtr.	0.00156	13.35	0.00156	13.35	0.00156	13.38	0.00150	12.91
Third Qtr.	0.00129	10.81	0.00129	10.80	0.00129	10.87	0.00122	10.33
Fourth Qtr.	0.00329	27.92	0.00329	27.95	0.00330	28.09	0.00336	28.82
F statistic	915.80		853.35		864.17		900.86	
Adjusted R^2	0.3456		0.3459		0.3488		0.3583	
n	116,050		116,050		116,050		116,050	

[a] The dependent variable is capital expenditures (*CapExp*). See Table 2 for a description of the variables. Coefficients for the 50 industry indicator variables are omitted for brevity.
[b] Analysis that estimates separate era indicator variable coefficients for observations greater than or equal to the 3.6381 median of *Size* versus those less than the median *Size* for the 116,050 observations in the main analysis.
[c] Analysis that estimates separate era indicator variable coefficients for observations greater than or equal to the 0.2177 median of capital intensity (*CapInt*) versus those less than the median *CapInt* for the 116,050 observations in the main analysis.
[d] Analysis that estimates separate era indicator variable coefficients for observations greater than or equal to the 1.4243 median market-to-book ratio (*MktBk*) versus those less than the median *MktBk* for the 116,050 observations in the main analysis.