

Preliminary Draft  
Not for Quotation

**Dividend Taxes, Partial Expensing and Business Fixed Investment:  
The Case of the Bush Tax Cuts**

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## **1. Introduction**

In 2002, U.S. fiscal policy toward investment took an activist turn. In response to a recession eventually declared by the NBER to have begun in March, 2001, the further pressure put on the economy by the attacks of September 11 later that year, and a sharp drop in business fixed investment following the collapse of the 1990s' stock market bubble, Congress passed legislation introducing "bonus depreciation" for qualifying investment, generally investment with a depreciation lifetimes no greater than 20 years. Under the provisions of the 2002 legislation, investment occurring during a three-year period starting on September 11, 2001, 30 percent of investment expenditures could be written off immediately, rather than according to regular depreciation schedules. The next year saw the bonus depreciation provisions expanded to cover 50 percent of each qualifying purchase, and extended to cover investment through the end of 2004. Although there were some attempts to extend bonus depreciation even longer, the 2003 changes to the program were the last and the provisions expired at the end of 2004.

Although there had been other proposals for investment incentives in recent years, the bonus depreciation episode represented the first major change in the tax provisions affecting business fixed investment since the Tax Reform Act of 1986, which reduced the corporate tax rate, altered depreciation schedules and eliminated the investment tax credit. Between then and 2002, the corporate tax rate varied little (rising from 34 percent to 35 percent in 1993) and depreciation schedules were relatively stable. Thus, the adoption of bonus depreciation provides a new opportunity to consider the impact of tax provisions on business fixed investment.

Several additional factors make the early 2000s an interesting period to study tax policy's impact on investment. First, as the bonus depreciation provisions applied to some but not all investment, there was substantial variation in the change in investment incentives. This variation

has been used by House and Shapiro (2006), who found that the policy noticeably increased investment in types of capital that benefited substantially from bonus depreciation. Second, the provisions were adopted following a period during which substantial overinvestment may have occurred in many sectors, suggesting that investment incentives might have been less effective during the period. This overhang hypothesis was challenged by Desai and Goolsbee (2004), who found that the presence of an investment “overhang” had little power in explaining subsequent investment, and also seems at odds with the findings of House and Shapiro.

Several other factors make the 2002-4 period interesting as well. One is the temporary nature of the provisions. While the legislative history of investment incentives in the United States makes any references to “permanent” provisions problematic, bonus depreciation was explicitly temporary and hence may reasonably have been viewed as more temporary than earlier tax changes announced to be permanent. In addition, given the historically extreme collapse in investment in the preceding years, a rational investor could well have foreseen that some investment incentives would be enacted, so that investment even prior to 2002 might have been influenced.<sup>1</sup> Third, the provisions changed while in effect, so we have a further opportunity to consider the evolution of expectations and the ability of firms to respond. Finally, and of considerable importance, the 2003 changes in bonus depreciation were accompanied by other provisions having potentially significant effects on investment, a reduction in the maximum tax rates on dividends and capital gains to 15 percent.

The 2003 dividend tax cut was particularly large, as capital gains had previously been subject to a favorable tax rate of 20 percent while dividends were taxed as ordinary income at rates as high as 35 percent. While dividend tax rates have change in the past, previous changes,

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<sup>1</sup> Auerbach (2003) estimated an ordered probit based on annual data starting in the early 1950s to explain, based on investment patterns and other macroeconomic conditions, when tax provisions changed that substantially increased or decreased the user cost of capital. The model predicted a reduction in 2002 with probability close to 1.0.

such as those included in the Tax Reform Act of 1986, were associated with other changes in tax rates on individual investors, which would have affected investment through other channels as well. The 2003 change in dividend taxation is thus unique in providing an opportunity to isolate the effects of changes in the taxation of dividends.

Evidence from 2003 suggests that firm dividend policy responded, with the results being clearest with respect to an increase in the initiation of dividends among firms that had previously not paid them (Chetty and Saez 2005). But there is no evidence to date on the extent to which these changes increased investment. While there is little argument that accelerated depreciation allowances should increase the incentive to invest (leaving aside the timing effects associated with anticipated and temporary provisions), the effects predicted for a dividend tax cut are less clear.

Under what is commonly called the “traditional” view of dividend taxation, the dividend tax raises the cost of capital faced by firms, and hence a reduction in the dividend tax rate should encourage investment. But an alternative or “new” view suggests that among mature firm already paying dividends, the impact on the cost of capital will be mitigated and perhaps eliminated by the fact that investment financed through retained earnings comes from after-dividend-tax dollars. Thus, a dividend tax cut would increase future after-tax returns, but also increase the current after-tax cost of investment.<sup>2</sup> Evidence on patterns of investment among dividend paying firms suggests that least some firms use retained earnings as a marginal source of finance (Auerbach and Hassett 2003), and results looking specifically at the effects of the 2003 legislation suggested that the impact on firm values among dividend paying firms was not consistent with the traditional view (Auerbach and Hassett 2006, 2007). Thus, there is reason to

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<sup>2</sup> Indeed, given that the 2003 dividend tax cut as passed was to apply only through 2008, the after-tax cost might have been expected to rise by more than the future after-tax returns, some of which would come after the dividend tax cut expired.

believe that the dividend tax cuts of 2003 had limited effects on the incentive to invest among some mature firms but that firms not using retained earnings as a source of finance – mature firms more likely to issue shares and, especially, immature firms not paying dividends at all<sup>3</sup> – would have been encouraged to invest. Indeed, at least one perspective on the increased dividend payments in 2003 is that they came partially at the expense of investment. A recent paper suggests that mature dividend-paying firms might be *discouraged* from investing by a dividend tax cut, if there is an agency problem that leads firm managers to invest more than shareholders would wish (Chetty and Saez 2007).

In this paper, we consider the combined effects of the 2004 bonus depreciation and the 2003 dividend tax cuts on business fixed investment, using a methodology developed by Auerbach and Hassett (1991) and Cummins, Hassett and Hubbard (1994) that utilizes cross-section variations in the effects of tax reforms on the user cost of capital to estimate the effects of tax policy on investment. Like Cummins *et al.* we focus primarily on the firm as a unit of observation. We do so in order to assess the effects not only of asset-related bonus-depreciation provisions, but also the impact of the dividend tax cut, the impact of which should vary according to other attributes of firms.

The next section of the paper reviews our methodology. Section 3 discusses our data set and the construction of some of the variables used in our analysis. Section 4 provides our empirical results. Our main findings are (1) that bonus depreciation did have an important impact on investment, and (2) that the overall impact in 2003 and 2004 was weaker for mature, dividend-paying firms, precisely those for whom one might have predicted a smaller additional impact on investment from the 2003 dividend tax cuts, and stronger for firms that did not pay

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<sup>3</sup> Firms not yet paying dividends would be influenced by a dividend tax cut because they anticipate paying dividends in the future.

dividends or were immature. In Section 5, we offer some concluding comments and suggestions for future research.

## 2. Methodology

To discuss our methodology, we begin with a review of the theory of how investment incentives affect investment. The role of current tax provisions and expectations can be described using the standard Hall-Jorgenson user of cost of capital, which provides a measure of the required gross, before-tax return to capital and hence a measure of the incentive to use capital in production. For a constant tax system, the user cost is:

$$(1) \quad c = \frac{q}{p} \left( \rho + \delta - \frac{\Delta q}{q} \right) \frac{1 - k - \tau z}{1 - \tau}$$

where  $p$  is the price of output,  $q$  is the price of new capital goods,  $\rho$  is the nominal discount rate,  $\delta$  is the exponential rate at which capital actually depreciates,  $k$  is the investment tax credit,  $\tau$  is the corporate tax rate, and  $z$  is the present value of depreciation allowances per dollar of capital purchased. According to this theory, taxation affects the incentive to invest in a straightforward manner, with increases in the corporate tax rate raising the cost of capital (assuming that  $z < 1$ ) and increases in the investment tax credit or the present value of depreciation allowances lowering the cost of capital. If one modifies the assumptions to incorporate changes in tax policy, the user cost of capital becomes:

$$(2) \quad c = \frac{q}{p} \left( \rho + \delta - \frac{\Delta[q(1 - \Gamma)]}{q(1 - \Gamma)} \right) \frac{1 - \Gamma}{1 - \tau} = \frac{q}{p} \left( \rho + \delta - \frac{\Delta q}{q} \right) \frac{1 - \Gamma}{1 - \tau} + \frac{q}{p} \frac{\Delta \Gamma}{1 - \tau}$$

where  $\Gamma$  equals the sum of the investment tax credit and the present value of tax savings from depreciation deductions.<sup>4</sup>

According to expression (2), the price of capital goods is effectively the underlying price,  $q$ , multiplied by a factor that accounts for the tax benefits associated with the purchase of capital,  $\Gamma$ . The presence of the additional term on the right-hand side of (2) means that there are now two ways in which tax policy may affect investment. First, as already discussed, it can affect the overall level of desired capital, given a constant tax regime. Second, if the regime is expected to change, it may encourage firms to alter the timing of their capital purchases.

So far, the model assumes instantaneous capital stock adjustment, which clearly is inadequate as a basis for explaining actual investment behavior. Theoretical models that incorporate adjustment costs commonly assume that the cost of adjustment rises at an increasing rate with the level of capital expenditures, implying that it is desirable for the firm to spread the expenditures over time. Moreover, expectations of future changes in the incentive to use capital in production lead to immediate changes in investment, in order to minimize the adjustment costs incurred in closing the gap between the current and future desired capital stocks.

As shown in Auerbach (1989) and Auerbach and Hassett (1992), optimal investment behavior in the presence of convex adjustment costs, which gives rise to Tobin's  $q$  theory of investment, may also be characterized by a partial adjustment investment process in which the desired capital stock at date  $t$  varies inversely with the weighted average of the current and expected future user costs of capital based on expression (2):

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<sup>4</sup> This sum equals  $k + \tau z$  if  $\tau$  is constant over time. If  $\tau$  is expected to change over time, then the present value of tax savings from depreciation deductions is not the simple product of the current value of  $\tau$  and the present value of depreciation deductions,  $z$ .

$$(3) \quad c_t^K = E_t \sum_{s \geq t} w_{s-t} c_s$$

where the weights,  $w_i$ , sum to unity and decline exponentially, at a rate that is inversely related to the size of adjustment costs; the more sluggish the investment response, the more the future matters.

Expression (3) for the weighted sum of user costs has some straightforward implications. If the user cost suddenly changed today – for example, because of the adoption of bonus depreciation – and this change were expected to last indefinitely, then the weighted average is simply the new current value (because the weights add to unity). However, if today’s change in the user cost is not expected to persist – for example, because the change in tax law is expected to be temporary as would likely have been the case during the bonus depreciation episode – then the user cost relevant for current investment must reflect this anticipation. Generally, this will encourage even more current investment than if the incentive were expected to be permanent.

A key motivation of our original paper based on the methodology used here (Auerbach and Hassett (1991)) was that the expectation in equation 3 may be very difficult to proxy with observable macro variables, but that tax reforms offer a way around this, since expectations about future tax variables may be observable around tax reforms. In 1986, for example, corporate tax rules were changed in a manner that was highly visible, and the change was billed as being “permanent” so that a reasonable firm might well have assumed (correctly, in retrospect) that the expected future tax variables on the right hand side of equation 3 would equal their 1986 values indefinitely. Assuming that firms expectations are thus observable we developed an econometric approach (that was subsequently also employed in Cummins, Hassett and Hubbard (1994)) that identifies the investment response to the user cost of capital under the assumption that the tax expectations are observable.

We argued then that this approach might be especially useful in the cross section since cross section variation in the user cost of capital during a tax reform might be unintended, and thus, truly exogenous. We began using aggregate asset-level data, and regressed investment for each asset class on lagged values of variables (including investment itself) that would be expected to help predict investment. The next step was to regress the corresponding value of the forward-looking user cost of capital, from expression (3), on the same lagged regressors. From each pair of regressions, one obtains unpredicted residuals for investment and the user cost of capital. If firms knew that tax changes occurred (because they read about them in the newspaper, for example) but these tax changes were difficult to predict with linear projection techniques, then the investment forecast errors in the cross section would be negatively correlated with the user cost forecast errors. This was exactly the pattern that we found.

We also provided a proof that a regression of the investment residual against the user-cost residual can capture the underlying structural parameters of the investment model, under the assumption of rational expectations about tax policy. Both our paper and Cummins, Hassett and Hubbard (1994) focus on periods of tax reform, when the signal-noise ratio would be expected to be highest, and both papers find a clear negative correlation in these surprises.

In this paper, we return to our roots, as it were, and estimate exactly the same model employed in our original paper. This allows us to test, out of sample, the specification and model definitions relied upon back then. Indeed, we make only one change. Following Cummins, Hassett and Hubbard (1994), we estimate our model with the broader set of firm-level data drawn from Compustat.

In our earlier work on the dividend tax cut (Auerbach and Hassett 2006, 2007) we found indirect evidence that the dividend tax change could possibly have influenced investment

significantly by making equity finance cheaper, that is, by reducing  $r$  for a select set of firms. In particular, we found that firms that are “immature” – those that have never paid a dividend – saw larger share price increases in response to the dividend tax cut than did firms that had previously paid a dividend. This observation suggests the existence of an interaction between the response to the dividend tax cut and partial expensing.

Suppose for simplicity that regular depreciation allowances have a present value of economic depreciation, so that

$$(4) \quad \Gamma = \tau \frac{\delta}{r + \delta}.$$

Ignoring  $\Delta\Gamma$  for the moment, so that  $c = (r + \delta)(1 - \Gamma)/(1 - \tau)$ , it follows that for bonus depreciation fraction  $\alpha$ , the user cost equals:

$$(5) \quad c = \frac{r(1 - \alpha\tau)}{(1 - \tau)} + \delta$$

That is, bonus depreciation reduces the discount rate equally for all firms, regardless of their value of  $\delta$ . Put another way, it reduces the user cost proportionally most for firms with a lower value of  $\delta$ . Since a reduced discount factor through the dividend tax cut also effectively reduces  $r$ , it works in precisely the same way, so the two effects complement each other: those with the biggest proportional reduction in  $c$  from bonus depreciation have the biggest proportional reduction in  $c$  from the dividend tax cut.

There are two additional factors that complicate this analysis. First, we have ignored the

$\Delta\Gamma$  term in the user cost of capital, which equals  $-\frac{\tau\alpha}{(1-\tau)}\frac{r}{r+\delta}$  when bonus depreciation is in

effect but expected to disappear. Note, however, that this term is larger for smaller values of  $\delta$ , so it provides an even stronger reason for there to be a larger impact for firms with small values of  $\delta$ . This makes sense, given that timing is more important for long-lived assets.

Second, we have ignored the fact that the longest lived assets, i.e., structures, don't qualify for bonus depreciation. This could potentially weaken the relationship across firms between the size of  $\delta$  and the proportional reduction in the user cost. However, under reasonable assumptions, the posited relationship should still hold. For example, if firms have roughly the same shares of structures and equipment, but with the lifetimes of equipment varying across firms, then firms with lower overall values of  $\delta$  will also experience larger proportional reductions in the user cost from bonus depreciation.

Thus, even with complicating factors taken into account, we would expect that a reduction in the cost of funds,  $r$ , would reinforce the cross-firm pattern of incentives provided by bonus depreciation. We investigate whether such a prediction is consistent with the data by exploring whether the responsiveness to partial expensing is larger for firms that would be expected to have the biggest response of  $r$  to the dividend tax reduction, that is, we investigate whether immature firms have bigger estimated user cost elasticities.

### **3. Data**

#### ***A. Description of Tax Changes***

Figure 1 details the tax changes that we study, regarding the timing of the change and the information available to the public concerning likely future events. Thirty percent partial expensing first passed the house on October 10, 2001, but did not formally become law (albeit

retroactively to September 11, 2001) until March 9, 2002. On Christmas day of that year, the *New York Times* reported that the President Bush would seek to lower the dividend tax in 2003. On May 28, 2003 the maximum tax on dividends and capital gains was lowered to 15 percent and partial expensing was increased to 50 percent. The partial expensing expired on the last day of 2004.

For reference, the chart also includes data for Manufacturers Orders of Nondefense Capital Goods Excluding Aircraft over the same period. The aggregate data confirm that partial expensing was introduced after an enormous decline in investment activity and that the steady increase of aggregate investment continued until partial expensing was repealed at the end of 2004. This is, of course, only suggestive of a possible influence of tax policy, as many other factors changed as well over this time period.

The impacts of tax changes on the user cost of capital have been studied separately in Cohen, Hansen, and Hassett (2002) and Carroll, Hassett and Mackie (2003). The former found that the annual user cost for equipment investment was reduced by partial expensing by about 1.3 percent for 3-year assets, 2.8 percent for 5-year assets, and 4.2 percent for 7-year assets. These reductions increased dramatically in the expiration year, due to the anticipated loss of tax benefits on new investment (see expression (2) above). The latter paper found that the dividend tax reduction likely provided an aggregate user cost reduction of similar size.

The timing of these changes suggests a number of significant differences between this episode and TRA86. Two decades ago, a sweeping change was made to the user cost that was intended to be permanent and could reasonably be expected to last at least for several years. In the recent episode, there were a number of periods wherein expectations are likely to have been far muddier. First, in late 2001, there was a period where partial expensing could have been

expected to apply retroactively. House and Shapiro (2006) have already found that there appears to have been an anticipatory run-up in investment. In 2002, firms likely had little inkling that partial expensing would be increased from 30 percent to 50 percent in 2003. If they did anticipate the increase, then the impact of the tax policy is very ambiguous, as firms might well have sought to delay investment until 2003, when the bigger bonus would be available. Thus, the right measure of the user costs for 2001 and 2002 are difficult to ascertain, and the perfect-foresight values we have used in previous analysis may be ill-suited for these years. Therefore, we focus in the present analysis on the years 2003 and 2004, years in which bonus depreciation in its ultimate form had already been implemented.<sup>5</sup> An additional advantage to beginning our analysis in 2003 is that the period conforms to one in which the dividend tax cut was also in effect.

### ***B. Description of Data Used During Estimation***

We now provide a brief discussion of our data sources and construction, with further details given in the Appendix. We take our firm level data from Compustat, which provides detailed data for publicly traded U.S. firms. Following Desai and Goolsbee (2004), our measure of investment is capital expenditures, which include purchases of equipment and structures. From this, we estimate firm level depreciation rates and capital stocks following the perpetual-inventory procedure used by Salinger and Summers (1983) and others. Our dependent variable is simply constructed from the ratio of capital expenditures to the firm level capital stock.

To construct our user cost variable, we draw on our own estimates of the impact of partial expensing by asset, and then use BEA data detailing the allocation of assets across industries to

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<sup>5</sup> In future work, we hope to examine behavior in 2001 and 2002 more closely, considering the potential impact of different specifications of the user cost of capital.

estimate a tax effect for each industry. The industry classifications in the BEA data vary in their depth, but provide a high level of detail at a fairly low level of aggregation. These user cost changes are then merged by industry with the firm-level data, and firm-level user costs are constructed by combining this tax data with the firm-level estimates of depreciation rates.

As in Auerbach and Hassett (1991), our first stage regressions fit the investment-capital ratio and the user cost on twice lagged values of the investment-capital ratio, the ratio of cash flow to capital, the price of capital goods relative to GDP, the price of oil, and a measure of the real return on capital. Details for these variables are available in the data appendix. The two first-stage regressions are run for each firm-year combination, covering the sample period available for that firm for all prior years. This ensures that the “surprises” in the two key variables (the investment-capital ratio and the cost of capital) are conditioned on information available at the time.

We delete observations for which the investment-capital ratio is greater than 5. In addition, all regressions were run using STATA’s robust regression command, which deletes observations when influence diagnostics indicate that they are excessively influential.

#### **4. Results**

Table 1 presents our basic results, the cross-section regression results for our full sample of Compustat firms for the years 2003 and 2004. Recall that these results are obtained by regressing residuals from each firm’s investment-capital equation on the corresponding residual from its user cost equation. For each year, we present two columns of estimates, based on different measures of the user cost: the *perfect-foresight* user cost (labeled “CSperfect”), calculated based on the actual tax changes that occurred from the current year to the next (see expression 2), and the *forward-averaged perfect-foresight* user cost (labeled “CK”), calculated

by weighting (according to expression 3) current and future values of the perfect-foresight user cost, weighing each successive year's value at half the previous one (and setting all user costs after 2004 equal to 2005's value). In principal, the forward-weighted user cost is the appropriate measure to use, but as the appropriate discount factor to use for future years is uncertain, one may interpret the first specification as a sensitivity analysis with respect to this parameter.

For 2003, the user cost in both specifications is significant and negative, the sign that theory predicts. The coefficients are also of roughly the same size as in earlier analyses based on this methodology. For 2004, the first specification exhibits a significant, negative impact of similar magnitude as for 2003, but the theoretically preferred specification no longer does, with the coefficient on CK now essentially equal to zero.

Before drawing any strong conclusions from the results in Table 1, though, it is important to remember that there is considerable heterogeneity among firms in the Compustat universe being considered. If the impact of the user cost predicted by theory differs among firms in the sample, then estimates based on the full sample that do not take this heterogeneity into account will be biased in an unpredictable manner. Thus, we now consider a variety of sample splits along lines suggested by theory.

Table 2 repeats the estimates in Table 1, with the sample split into *mature* firms – those that have paid a dividend at least once in the current or prior years – and *immature* firms – those that have not paid a dividend in the current or prior years.<sup>6</sup> Recall that we expect the 2003 dividend tax cut to reinforce the impact of bonus depreciation on investment, i.e., that the impact of user cost differences should be larger among firms that experience a reduction in the cost of funds due to the 2003 dividend tax cut.. As discussed above, based on our previous research we

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<sup>6</sup> Similar results as those reported below were obtained dividing the sample simply according to whether the firm paid a dividend in the current year.

would predict that immature firms are more likely to be in this category. Consistent with this prediction, the user cost coefficient for both specifications (CSperfect and CK) and both years (2003 and 2004) is larger in absolute value for immature firms than for mature firms, is negative in all instances and always significant for immature firms. Thus, once firms are separated into groups based on the predicted response to the user cost, the estimated responses are more consistent with our theory.

Table 3 provides another sample split, this one also motivated by our previous research on the impact of the 2003 dividend tax cut. Immature firms are more likely to experience a reduction in the cost of equity capital than mature firms, because the former are likely to expand their equity base – and future dividend payments – through issues of new equity. The same logic should apply to mature firms that, for a variety of possible reasons, are more likely than other mature firms to go to the external equity market. Table 3 uses the bivariate probit specification of our earlier papers (Auerbach and Hassett 2003, 2006, 2007) to predict a firm’s likelihood of issuing new equity and of repurchasing equity.<sup>7</sup> We classify firms approximately into thirds according to each marginal probability distribution, labeling those in the bottom third as having a low probability and those in the top third as having a high probability. We then look at the high- and low-probability groups separately, leaving out the middle group in each case to reduce the noise of our sample separation process.

The results in the upper panel of Table 3, for new share issues, are again consistent with our theoretical predictions. While the user cost coefficient is always negative, firms with a high probability of issuing new shares have a much larger coefficient in both years. Differences in the probability of repurchasing, on the other hand, have no obvious impact when the sample is split

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<sup>7</sup> More details on the probit specification are provided in these papers. Our approach here is identical except that we omit as an explanatory variable the number of analysts following a given firm. The remaining coefficients are quite consistent with those of our earlier papers.

in this dimension; as we have no reason to expect a difference, this result is consistent with our expectations.

Our last sample split is provided in Table 4. A key phenomenon earlier in the decade was the prominence of net operating losses among C corporations, particularly among the non-financial companies we study here.<sup>8</sup> Although losses have subsided in recent years, they were still important as late as 2003. While firms experiencing losses in a given year may expect to extract some of the tax benefit by carrying losses forward or back, the loss offset is imperfect because losses carried forward lose interest and may expire. Hence, firms experiencing losses may be less sensitive to corporate tax changes.

Because we have access only to corporate financial statements, we can measure a firm's tax status on its actual tax return only imperfectly. We classify a firm as being currently not taxable if it does not have a positive tax expense for the current year, and classify all other firms as taxable. In Table 4, we repeat Table 2's split of mature and immature firms, but break these firms down further by tax status, as just defined. To the extent that we are accurate in our characterization of tax status, we would expect coefficients of larger absolute value for taxable firms. Again, our results are generally consistent with this prediction, with one case in which the coefficient is very marginally more negative for non-taxable firms. However, the standard errors are large here, with only one coefficient significant – and of the wrong sign. Note, by the way, that the fact that non-taxable firms have negative coefficients on the user cost (with one exception) is not surprising, leaving aside these coefficients' lack of significance, because the impact of the dividend tax cut should still be present, especially among immature firms.

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<sup>8</sup> Auerbach (2007) finds that the ratio of losses to income for U.S. nonfinancial companies reached historically high levels in the recession years 2001 and 2002.

It is worth noting, again, that the user cost coefficients reported in the preceding tables here are quite close to those reported in Auerbach and Hassett (1991), and Cummins, Hassett and Hubbard (1994). Across a wide range of specifications and tax reforms, coefficients in those earlier studies were generally in the range of  $-.6$  to  $-.7$ , about the same central tendency in our tables.

## **5. Conclusions**

Using panel data on publicly traded U.S. firms, we have investigated the extent to which investment responded to partial expensing and the dividend tax reduction. We find that investment did increase more following the tax changes for those firms that saw larger user cost reductions, and that the investment increase was most sizable and significant for those “immature” firms that saw the largest share price responses in response to the dividend tax reduction.

Our results suggest that those sectors that benefited most from dividend tax reduction and partial expensing because of the types of capital they rely upon saw the biggest response to it. As these estimates are based on cross sectional differences, it is not, strictly speaking, possible, to draw conclusions concerning the aggregate impact of these policies on investment. Our results could be consistent with a sizable aggregate effect or with a significant reallocation that occurred, without much of an impact on aggregate investment.

## Data Appendix:

The firm specific depreciation rates and capital stock are calculated following Cummins, Hassett and Hubbard (1994). We solve for  $\delta$  from the equation<sup>9</sup>:

$$K_T = K_0(1 - \delta)^T + (1 - \delta)^{T-1}I_1 + \dots + I_T$$

where  $K_T$  is Compustat variable DATA8 (Property, Plant and Equipment (Net)) and  $I_T$  is Compustat variable DATA30 (Property, Plant and Equipment - Capital Expenditures). The variables are expressed in constant 1997 dollars. We then use the estimated value of  $\delta$  to estimate the firm's capital stock following Salinger and Summers (1983).

The firm-specific cost of capital was calculated using equations (1) and (2) in the text, where we set  $\rho = 0.05$ , calculated  $\delta$  as explained above and weighted the  $\Gamma$  term calculated by asset and weighted using industry capital stocks as provided on the BEA's website.<sup>10</sup>

The industry weights were constructed as follows. Let  $i$  index asset class,  $j$  industry and  $t$  time. The weights  $s_{ijt} = \frac{K_{ijt}}{\sum_{i \in j} K_{ijt}}$  represent the share of the asset class  $i$  in the total capital stock of industry  $j$  at time  $t$ . (While the level of aggregation of the industry capital stock data varies, the vast majority<sup>11</sup> of industries are covered at the 3-digit NAICS level.) We then use the weights to construct the industry value of  $\Gamma$  as  $\Gamma_{jt} = \sum_{i \in j} s_{ijt} \Gamma_{it}$  and use the  $\delta_{ij}$  to calculate the firm level user cost of capital.

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<sup>9</sup>  $\delta$  was calculated in Matlab using a grid search on the interval [0,1] with step 0.001 and convergence criterion  $0.001 * K_T$ . For the small number of firms with  $\delta > 1$ , we set  $\delta = 1$ .

<sup>10</sup> <http://www.bea.gov/national/FA2004/Details/Index.html>

<sup>11</sup> 81 percent of the BEA industry data are at the 3-digit NAICS code level, 13 percent at the 2-digit level and the rest at the 4-digit level.

The first stage in the “surprise regressions” following Auerbach and Hassett (1991) regressed the variable of interest (i.e.  $I/K$  or the relevant user cost of capital) on a constant, a time trend, the twice-lagged own investment-capital ratio, the own relative capital goods price, the lagged real interest rate and an oil price series (West Texas Intermediate<sup>12</sup>).

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<sup>12</sup> available at <http://research.stlouisfed.org/fred2/series/OILPRIC>

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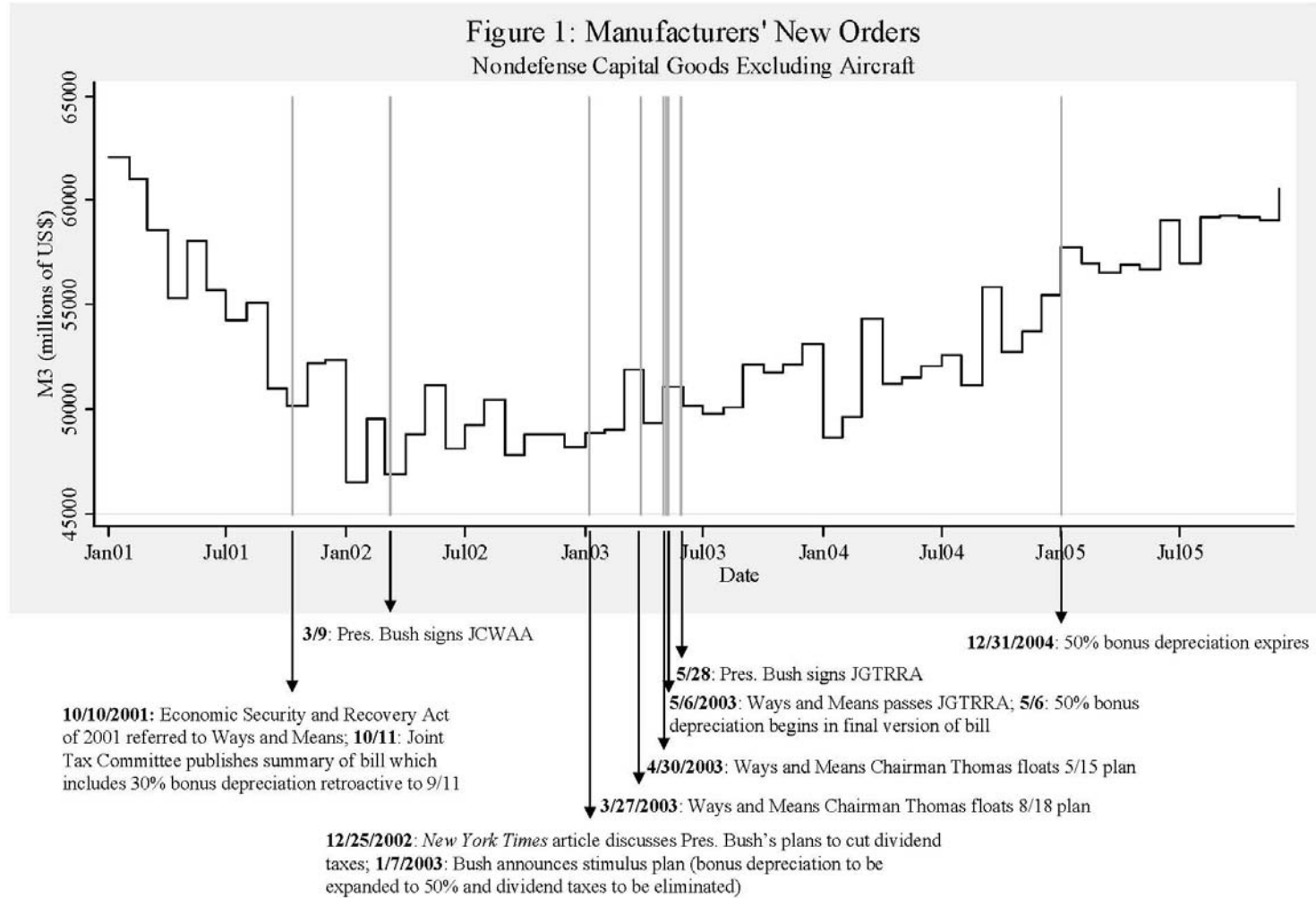
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Figure 1: Manufacturers' New Orders  
Nondefense Capital Goods Excluding Aircraft



Source: Manufacturer's Shipments, Inventories, and Orders (M3) Survey

**Table 1. Full Sample Regressions, 2003 and 2004**  
(Dependent Variable I/K surprise)

	2003		2004	
Constant	-0.001 [0.008]	0.002 [0.008]	0.009 [0.008]	0.038 [0.008]**
CSperfect	-0.636 [0.153]**		-0.545 [0.057]**	
CK	-0.346 [0.134]**		0.028 [0.049]	
# of obs.	3454	3457	3439	3440
R-squared	0.0050	0.0019	0.0261	0.0001

Standard Errors in parentheses

\* = .05 significance

\*\* = .01 significance

**Table 2. Mature/Immature Sample Regressions, 2003 and 2004**  
 (Dependent Variable I/K surprise)

**Mature Firms**

	<b>2003</b>		<b>2004</b>	
Constant	-0.019 [0.006]**	-0.019 [0.007]**	0.002 [0.007]	0.002 [0.006]
CSperfect	-0.327 [0.152]*		-0.056 [0.095]	
CK		-0.230 [0.135]		-0.072 [0.085]
# of obs.	1642	1644	1687	1686
R-squared	0.0028	0.0018	0.0002	0.0004

**Immature Firms**

	<b>2003</b>		<b>2004</b>	
Constant	0.050 [0.021]*	0.048 [0.023]*	0.093 [0.026]**	0.117 [0.026]**
CSperfect	-0.806 [0.386]*		-0.784 [0.195]**	
CK		-0.620 [0.312]*		-0.311 [0.123]*
# of obs.	1730	1732	1666	1667
R-squared	0.0025	0.0023	0.0096	0.0038

Standard Errors in parentheses

\* = .05 significance

\*\* = .01 significance

**Table 3. Share Issue and Repurchase Sample Splits, 2003 and 2004**  
(Dependent Variable I/K surprise)

**New Share Issue Probability**

	2003		2004	
	High	Low	High	Low
Constant	-0.034 [0.015]*	-0.014 [0.013]	-0.024 [0.020]	-0.003 [0.011]
CK	-0.856 [0.267]**	-0.339 [0.310]	-1.022 [0.262]**	-0.164 [0.179]
# of obs.	529	527	539	541
R-squared	0.0191	0.0023	0.0276	0.0016

**Repurchase Probability**

	2003		2004	
	High	Low	High	Low
Constant	-0.029 [0.013]*	-0.035 [0.014]*	0.01 [0.013]	-0.01 [0.014]
CK	-0.568 [0.294]	-0.520 [0.239]*	0.019 [0.174]	-0.212 [0.173]
# of obs.	529	527	540	539
R-squared	0.0070	0.0089	0.00002	0.0028

Standard Errors in parentheses

\* = .05 significance

\*\* = .01 significance

**Table 4. Mature/Immature Sample Regressions, by Tax Status, 2003 and 2004**  
 (Dependent Variable I/K surprise)

**Mature Firms**

	<b>2003</b>		<b>2004</b>	
	<b>Taxable</b>	<b>No Tax</b>	<b>Taxable</b>	<b>No Tax</b>
Constant	-0.02 [0.007]**	-0.016 [0.018]	0.001 [0.007]	0.041 [0.025]
CK	-0.249 [0.157]	-0.165 [0.301]	-0.113 [0.090]	1.065 [0.290]**
# of obs.	1344	297	1452	232
R-squared	0.0019	0.0010	0.0011	0.0555

**Immature Firms**

	<b>2003</b>		<b>2004</b>	
	<b>Taxable</b>	<b>No Tax</b>	<b>Taxable</b>	<b>No Tax</b>
Constant	0.025 [0.028]	0.086 [0.039]*	0.106 [0.032]**	0.127 [0.053]*
CK	-0.587 [0.407]	-0.628 [0.534]	-0.395 [0.285]	-0.195 [0.424]
# of obs.	1063	664	1095	566
R-squared	0.0020	0.0021	0.0018	0.0004

Standard Errors in parentheses

\* = .05 significance

\*\* = .01 significance