CORPORATE TAX MINIMIZATION AND THE EFFECTIVENESS OF INVESTMENT TAX INCENTIVES*

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INTRODUCTION AND MOTIVATION

CLARIFYING THE RELATIONSHIP BETWEEN corporate tax minimization and the incentive to invest is particularly important because of the size of corporate tax legal or illegal avoidance. Although most analyses of corporate tax legal or illegal avoidance and the impact of taxation on investment have proceeded on separate tracks, the two issues are interrelated.[1]

If tax avoidance is purely inframarginal and does not increase the probability that a corporation will enter a loss situation, then avoidance should matter only to the extent that after-tax cash flow matters. If, though, avoidance activity is not inframarginal, it may reduce the effective marginal tax rate on new investment, and therefore is complementary to the incentive to invest. In other cases, however, such as when the avoidance increases the likelihood that a corporation will be in a tax-loss situation, tax avoidance may be a substitute for investment incentives, and crowd such incentives out.

A related but separate question is how the existence of tax avoidance changes the effectiveness of tax incentives for investment. Tax avoidance can undermine the effectiveness of tax incentives to invest through two channels. First, avoidance may dampen the impact of any given statutory rate, and thus reduce the importance of any given proportional reduction in that rate. Second, avoidance may increase the probability that corporations will be in a loss situation, rendering tax incentives less likely to be effective in increasing investment.

After providing some background information on corporate tax avoidance, this paper empirically investigates, using panel data from Compustat, the interrelationship between corporate tax avoidance and the effectiveness of investment tax incentives by focusing on the 2002 and 2003 bonus depreciation provisions. We find an implied elasticity of 0.03 over 2002-2004, and no clear evidence that tax avoidance opportunities have mitigated its effectiveness.

AN INTEGRATED THEORETICAL MODEL

Since the seminal work of Jorgenson (1963), static and dynamic approaches to determining the equilibrium stock of capital take the form of a user-cost formulation.

To frame our analysis of how tax avoidance affects the tax system's impact on the incentive to invest, we begin by presenting a simple rental cost of capital model of the optimal capital stock that draws on Slemrod (2001). Consider a firm that must choose its capital stock, K, and the amount of avoidance, A, in order to maximize its after-tax profits given by:

$$\textbf{(1)}\quad F(K)-\delta K-rK \\ -\tau\left[F(K)-dK-A-C\left(F(K)-\delta K,A\right)\right] \\ -C\left(F(K)-\delta K,A\right).$$

Here $F(K)$ is output, δ is the (assumed exponential) rate of true economic depreciation, d is the (exponential) rate of depreciation allowed by the income tax system, r is the opportunity cost of funds, and τ is the tax rate imposed on taxable profits. A is the amount of avoidance the company undertakes, at a (tax deductible) cost of C. Because the opportunity cost of funds is presumed to not be deductible, the setup implicitly assumes equity financing. Note that there must be a cost to the company of avoidance, or else it would always zero out its tax liability (or, in this simple model, claim unlimited refunds for having negative taxable income).[2] It is crucial that the cost of avoidance may depend not only on the amount of avoidance, but also on the level of pretax net income. The idea is that a given level of avoidance is less costly to achieve if it is small relative to true income. Thus, it is natural to

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expect that that $C_A > 0$, $C_F < 0$, $C_{AF} > 0$, $C_{FF} > 0$, and $C_{AA} > 0$, where, for example, C_F is the derivative of C with respect to $F(K) - \delta K$.[3]

When tax and economic depreciation are equal $\delta = d$, the first-order condition for K becomes $F' - \delta = r/(1 - \tau)(1 - C_F)$. As long as C_F is negative (i.e., earning more net income lowers the cost of sheltering a given amount of taxable income), incorporating the $(1 - C_F)$ term lowers the cost of capital for investment, partially offsetting the effect of the statutory tax rate. In this case the availability of tax avoidance opportunities is equivalent to a "do-it-yourself" reduction in the marginal effective tax rate of investment.

THE NATURAL EXPERIMENT: BONUS DEPRECIATION

The Policy

In an attempt to spur business investment, the Job Creation and Worker Assistance Act, passed on March 11, 2002 created a 30 percent first-year "bonus depreciation" allowance.[4] In effect, businesses could immediately write off 30 percent of the cost of an eligible capital good, reducing the depreciable basis of the property to reflect the additional first-year depreciation deduction. The provision applied retroactively to certain business property acquired after September 11, 2001 and applied to assets purchased before September 11, 2004, and placed in service before January 1, 2005.[5] On May 28, 2003 it was increased to 50 percent and extended to December 31, 2004.

Eligible property for this special treatment included property with a recovery period (life) of 20 years or less, water utility property, certain computer software, and qualified leasehold improvements.

Two aspects of the bonus depreciation provision are worth noting. First, among qualifying property, the present value of the provision was, putting aside the possibility of taxable losses, greater for capital goods with longer depreciable lives: for longer-lived goods, the offsetting decreases in depreciation allowances from the second year onward occur farther into the future, and thus have a lower present value. Second, because the bonus depreciation provision explicitly expired (although the deadline was later extended), there was an incentive to move forward investment, which would be reflected in a lower cost of capital.

Previous Studies of the Effect on Investment of Bonus Depreciation

House and Shapiro (2007) examine quarterly data on investment by capital goods regressing forecast errors of investment against the tax depreciation rates and a dummy variable for capital goods that did not qualify for bonus depreciation. They find that the estimated coefficient on the dummy variable for not receiving bonus depreciation is negative and significant after 2002:2.

Desai and Goolsbee (2004) estimate a tax-adjusted q model on across assets, industries, and firms, and find that the bonus depreciation provisions changed the user cost only slightly, resulting in an increase in investment of only 1 to 2 percent.

Hulse and Livingstone (2004) estimate equations of capital expenditures and do not find significant differences between the interaction of the marginal tax rate and capital intensity during bonus depreciation and to non-bonus depreciation periods.

Cohen and Cummins (2006) compare the change in the growth rate of investments in long-lived and short-lived assets before, during, and after expiration of the policy. While spending increased for both short and long-lived assets during the policy, long-lived assets' investment did not increase more.

Knittel (2006) uses tax return data on small businesses that are eligible for both Section 179 expensing and bonus depreciation to investigate the take-up rate of each provision. He finds that many small businesses did not exploit the more generous depreciation allowances granted under bonus depreciation.

Finally, Huston (2006) conducts cross-assets analysis using firms' footnotes data and finds that expenditures on advantaged property were greater during bonus depreciation than before the provision's availability.

EMPIRICAL STRATEGY

Econometric Specification

Our strategy is to explain variations in corporations' investment-to-capital ratios in 2002, 2003, and 2004, relative to investment-to-capital disbursed before 2001.[6] The dependent variable is the difference in a 3-period average of investment-to-capital ratio before and after the enactment of bonus depreciation. This is:

$$\textbf{(2)}\quad E_i = 1/3\left(\sum_{t=2002}^{2004} I_{i,t} / K_{i,t-1}\right) - 1/3\left(\sum_{t=1998}^{2000} I_{i,t} / K_{i,t-1}\right).$$

The first term is the average investment in the period where we measure the effect of bonus depreciation provisions (2002 through 2004). We focus in this small window after the change because the provision was initially scheduled to expire in 2004 and to avoid potential cofounders.[7]

The second term is the counterfactual. We used previous investment as proxy for predicted investment had the bonus depreciation provisions not been adopted. If it is not a good counterfactual, then we can at least interpret the results as the impact of bonus depreciation on investment to capital change relative to previous years.[8]

Taking a 3-year average has several advantages instead of using annual values, given the data restrictions and characteristics of the law change. On the one hand, should firms take advantage of the temporary bonus depreciation provisions, they might move backward investments that were planned for years following the expiration of the provisions. On the other hand, moving forward investment might be hindered by short-term rigidities in contracts with suppliers and indivisibilities in investment. In both cases, a 3-year window increases the possibility of finding the true effect of the provisions.

The basic econometric specification is to examine the determinants of E, as a function of Δc, where Δc is the tax-induced percentage change in the cost of capital of new investment due to the bonus depreciation provisions. The model of the previous section motivates how Δc depends on nonstandard variables such as indicators of the extent of tax avoidance. We estimate equations of the following form:

$$\textbf{(3)}\quad E_{i,j} = \beta_0 + \beta_1 \Delta c_j + \beta_2 \Delta c_j * ATR_i + \beta_3 ATR_i + \varepsilon_{i,j}\ ,$$

In equation (3), Δc is the percentage change in the cost of capital for all firms i in industry j caused by the enactment of bonus depreciation, and averaged over three years: 2002, 2003, and 2004. The variable ATR is a measure of the company's effective average tax rate that takes the average of taxes paid over pretax income in three years.[9]

We expect that $\beta_1 + \beta_2 ATR_i < 0$ because, as long as investment is cost-sensitive, the bigger the decrease in the cost of capital, the higher the increase in investment relative to its forecast.

According to our model, β_2 is expected to be negative. This result would be consistent with the idea that a lower average tax—perhaps due to tax avoidance—mitigates the effect of tax incentives for investment.

If there are time-invariant firm characteristics that affect their investment behavior, specification (3) estimates unbiased coefficients, because the dependent variable in the equation is a firm level difference. However, if there are firm- or industry-specific investment trends that are correlated with the change in the cost of capital induced by the bonus depreciation provisions, the coefficients on the change of cost of capital will capture the effect of the trend as well as bonus depreciation effect.

To address this issue, we construct a false experiment, aimed at testing the existence of underlying trends. We replace the dependent variable of (3) by $E_{i,false} = 1/3(\Sigma_{t=1998}^{2000}[I_{i,t}/K_{i,t-1}]) - 1/3(\Sigma_{t=1994}^{1996}[I_{i,t}/K_{i,t-1}])$, which is the change in investment-to-capital ratio in the period before the bonus depreciation provision, whereby definition bonus depreciation should have no effect. If we reestimate equation (3) using this dependent variable and find that $\beta_1 \neq 0$ or $\beta_2 \neq 0$, there is evidence of an underlying trend associated with bonus depreciation.

Finally, to test the impact of bonus depreciation beyond any trend, we use a difference-in-difference specification, defined by equation (4):[10]

$$\textbf{(4)}\quad E_{i,j,t} - E_{i,j,t-1} = \gamma_0 + \gamma_1 \Delta c_j + \gamma_2 \Delta c_j * ATR_{i,t-1} + \gamma_3 ATR_{i,t-1} + \lambda_{i,j},$$

if bonus depreciation has an effect beyond differences in trend, γ_1 and should be significantly different from zero.

Measurement of the Change in Cost of Capital

Although the bonus depreciation provision was not written in a firm-specific way, there are two reasons why its impact on investment should have varied across firms: variations in their asset composition and fiscal year end.

We calculate the cost of capital for each asset type a at time t as follows:

$$\textbf{(5)} \quad c_{a,t} = \left(r+\delta_a\right)\left(1-\tau z_{a,t}\right) \big/ \left(1-\tau\right),$$

where r is the real opportunity cost of capital, set at .04 for all capital goods, and τ is the statutory corporate tax rate, set at .35. The value of δ_a, the rate of economic depreciation, is from Fraumeni (1997, Table 3). We compute $z_{a,t}$ as the present value of the depreciation allowances under the depreciation regime at time t.[11]

Next, we calculate the tax-induced percentage change in the cost of capital for each asset and year with respect to the cost in absence of bonus depreciation. For example, for assets like computers and peripheral equipment, which have a tax life of five years, the cost of capital decreased by 0.025 percent from 2001 to 2003. For long-lived assets (e.g., commercial buildings) the cost of capital did not change because they were not eligible for the bonus depreciation.

Using data on the mix of capital goods purchased in 1997 by sector,[12] we calculate the share $w_{a,j}$ of each type of capital asset a by sector j, and the tax induced percentage change in the cost of capital for each sector j as a weighted average of the tax-induced percentage changed in the cost of each asset, for each year $\Delta c_{j,t} = \Sigma_a w_{a,j} * \Delta c_{a,t}$.

Table 1 shows Δc varies by industry. For the year 2004, the tax-induced change in the cost of capital is the same as in 2003.[13]

We use a second source of variation in Δc based on the disparities, for some firms, between accounting and fiscal year end.[14] We compute the average change in the cost of capital for each industry-fiscal year end bundles, in each year as a weighted average of each year cost of capital change, where the weights are the number of months that each firm was exposed to each bonus depreciation. For example, for a firm with fiscal year ending in March, the corresponding change for 2003 is:

$$\textbf{(6)} \quad \Delta c_{j,3,2003} = \frac{2}{12} * \Delta c_{j,2002} + \frac{10}{12} * \Delta c_{j,2003}.$$

Other Specification Issues

Putting the contemporaneous *ATR* on the right-hand side of the investment equation is problematic for several reasons. First of all, there may be unobserved shocks that affect both the incentive to invest and the *ATR*. This makes the *ATR* correlated with the error in the investment equation, and makes the estimates inconsistent. Second, given the accelerated bonus depreciation, more investment will directly reduce the contemporaneous *ATR*s for a given amount of investment. Our solution to this problem is to use an instrument/proxy for the contemporaneous *ATR* that is not correlated with the unobserved things that affect investment. We focus on using the 2000 value of the *ATR*.

We use three methods to deal with outliers of key variables. The first one is winsorization at 2 percent[15] of the forecasted error and *ATR*. The second approach is to generate a dummy that takes the value 1 if the firm has a positive forecast error, and 0 otherwise, (i.e., it measures whether a firm's investment-capital ratio is higher or lower than the forecasted amount) and use this as dependent variable in a logit regression. The third approach is a quantile regression which minimizes deviations from the median. In both the second approach (a logit) and the third approach (quantile), we use the lagged value of *ATR* as the independent variable, instead of instrumenting for it.[16]

To test the sensitivity of the results to the choice of counterfactual years, we use three years average of investment-to-capital up to 1999 (instead of up to 2000) as counterfactual. We also used a 2-year window (instead of a 3-year window). The results are robust to these changes.[17]

RESULTS AND IMPLICATIONS

Descriptive Statistics

Table 2 shows descriptive statistics for our sample of firms. In our sample of public corporations, 4,245 firms have non-missing values for the variables of interest (investment, capital, and average tax) over all relevant years.

The continuous dependent variable (the difference between actual and predicted investment) has a mean of -0.265 (after winsorization). On average, over the 3-year period, firms invested less than predicted—only 30.7 percent of them invested more than predicted. The mean change in the cost of capital induced by bonus depreciation is by definition negative, and equals -1.7 percent. On average firms' reported current taxes represent 15.9 percent (after winsorization) of their pretax income.

Table 1
Change in the Cost of Capital by Industry[1]

	Cost of Capital			Change from 2001 to	
	2001	2002	2003	2002	2003
Agriculture, forestry, fishing and hunting	0.182	0.178	0.175	-2.08%	-3.47%
Mining	0.164	0.160	0.157	-2.66%	-4.43%
Utilities	0.137	0.135	0.133	-2.02%	-3.36%
Construction	0.201	0.198	0.196	-1.53%	-2.54%
Food, beverage, tobacco, textiles, apparel, and leather manufacturing	0.186	0.183	0.181	-1.67%	-2.78%
Wood, paper, printing, petroleum, chemical, plastics, rubber, and nonmetallic minerals manufacturing	0.195	0.192	0.190	-1.66%	-2.77%
Metal, machinery, computer, electronic, electrical equipment, transportation equipment, furniture, and miscellaneous manufacturing	0.206	0.203	0.200	-1.63%	-2.72%
Wholesale trade	0.214	0.211	0.209	-1.50%	-2.49%
Retail trade	0.157	0.156	0.154	-1.21%	-2.02%
Transportation	0.182	0.179	0.176	-1.79%	-2.99%
Couriers and warehousing	0.220	0.217	0.214	-1.56%	-2.59%
Information	0.207	0.204	0.202	-1.59%	-2.65%
Finance and insurance	0.263	0.259	0.257	-1.40%	-2.34%
Real estate and rental and leasing	0.097	0.096	0.095	-1.34%	-2.24%
Professional and technical services	0.287	0.283	0.280	-1.48%	-2.47%
Management of companies and enterprises	0.270	0.266	0.263	-1.45%	-2.41%
Administrative and waste services	0.227	0.224	0.222	-1.54%	-2.57%
Educational services	0.152	0.151	0.149	-1.21%	-2.02%
Health care and social assistance	0.177	0.174	0.172	-1.55%	-2.58%
Arts, entertainment, and recreation	0.144	0.143	0.141	-1.21%	-2.01%
Accommodation and food services	0.142	0.140	0.139	-1.23%	-2.05%
Other services, except public administration	0.157	0.155	0.154	-1.26%	-2.09%

[1]The total changes in the cost of capital are not comparable to the one reported in the summary statistics (Table 2) because they do not take into account firm-specific final year end.

Table 2
Descriptive Statistics[1]

Variable	N	Mean	SD	Min	Med	Max
Average $(I/K)_{2002\text{-}2004}$ - Average $(I/K)_{1998\text{-}2000}$	4245	-0.265	0.846	-5.254	-0.065	0.964
Average $ATR_{2002\text{-}2004}$	4254	0.159	0.246	-0.513	0.127	0.886
Dc*Average $ATR_{2002\text{-}2004}$	4254	-0.004	0.056	-3.425	-0.002	0.27
Dc	4255	-0.017	0.005	-0.037	-0.017	-0.005

[1]The ATR is winsorized at the 2 percent level. It is defined as the domestic, average tax rate over the last 3 years, including current year. Dc is the change in the cost of capital due to the bonus depreciation provision.

Results

The basic specification

Table 3 shows the marginal effect of the change in cost of capital on investment for four specifications: OLS, IV, median, and logit. OLS, median, and logit regressions use the average tax rate from 1998 to 2000. The IV regression instruments the current value of *ATR* with its 2000 value.

The results show a significant effect of the change in the cost of capital on investment, but

Table 3
Main Specification

	[1] OLS	[2] IV	[3] Median Regression	[4] Logit[1]
Change in cost of capital *				
Average Tax Rate	0.014	-13.497	-3.775	-3.437
	[0.00]	[0.32]	[1.57]	[0.44]
Average Tax Rate	0.131	0.47	-0.098	-0.154
	[0.66]	[0.48]	[1.56]	[0.85]
Change in cost of capital	-9.574	-9.462	-4.075	-6.777
	[2.10]*	[1.33]	[5.83]**	[-7.03]**
n	4268	4255	4268	4268

[1]Marginal effects. The marginal effect of the change in cost of capital is computed with a bootstrap.
*Significant at 5 percent; **significant at 1 percent.

not a significant effect on the interaction of *ATR* and Δc. We suspect that these results are due to the existence of outliers, even after winsorization.[18] To address this concern we estimate the coefficients using a Jackknife. We find the results highly sensitive to the sample randomly selected by the Jackknife strategy. This suggests, as expected, that the lack of significance of the estimators in the OLS and IV regressions is likely due to biases from the presence of outliers. For this reason, we focus the rest of the analysis in the two specifications for which the results are less affected by the presence of outliers (median and logit regressions).

For the median regression the full effect of a change in the cost of capital on firm's investment-to-capital ratio is -4.07-3.8* *ATR*, which is always negative (for positive *ATR*). At the sample average *ATR*, this full effect is -0.047. At the mean investment-to-capital ratio in the counterfactual period, this implies an elasticity of 3.

The logit regression dependent variable is a dummy equal to one if the forecast error in *I*/*K* is positive. After computing the marginal effects at the mean, we find that, for example, a 10 percentage point increase in the *ATR* (for example from 16 percent to 26 percent) induces an increase by 3.5 in the negative full effect of Δc on the proportion of firms with a positive forecast error. The full marginal effect of Δc at the average *ATR* in the logit regression is -6.7.

The false experiment

One potential drawback of the previous results is that the identification relies in the assumption of equal trends, between firms that faced a bigger decrease in their cost of capital and other firms. We test the hypothesis that the results reported in the previous section are driven by different firm- or industry-specific trends by using a "false experiment." Changes in the cost of capital due to bonus depreciation should not affect investment performed between 1998 and 2000 nor investment performed between 1994 and 1996.

Table 4 shows the false experiment's results. We find that the interaction between the change in cost of capital and the average tax rate is negative and statistically significant. In contrast, the sign and significance of the coefficients on Δc depend on the sample and specification. The first result raises doubts on the equal-trends assumption of the main specification and does not allow us to reject that the effect of the interaction term (between *ATR* and Δc) found in the main specification (Table 3) are due to different firm- or industry-specific trends and not to bonus depreciation. However, the absence of a consistent effect on Δc allows us to reject the hypothesis that the effect of the cost of capital on investment found in the previous estimations is due to different trends.

The difference in difference

To address the concern presented by the false experiment, we define a new difference in the

Table 4
False Experiment

	[1] OLS	[2] IV	[3] Median Regression	[4] Logit[1]
Change in cost of capital *				
Average Tax Rate	-26.674	-74.291	-10.738	-23.918
	[2.55]*	[2.77]**	[3.93]**	[4.10]**
Average Tax Rate	-0.548	-1.593	-0.212	-0.454
	[3.00]**	[3.13]**	[4.51]**	[4.24]**
Change in cost of capital	3.631	10.62	0.589	-0.886
	[0.84]	[1.98]*	[0.79]	[0.59]
n	3616	3610	3616	3616

[1]Marginal effects. The marginal effect of the change in cost of capital is computed with a bootstrap.
*Significant at 5 percent; **significant at 1 percent.

dependent variable, in order to eliminate any effect on investment potentially caused by differential trends. This specification allows us to test the null hypothesis that the bonus depreciation provision had no effect beyond that of the trend. The results are presented in Table 5.

Table 5 shows that Δc has a negative and significant coefficient in the logit and median specification. Then bonus depreciation has an effect on investment beyond the trend found in the false experiment.[19] The coefficient on the interaction term is negative as expected, but not significant. Then it is not possible to rule out that the interacted effect of bonus depreciation with the average tax rate found in the main specification is not driven by the trend found in the false experiment when all firms are considered.

Table 5
Difference in Difference

	[1] Median Regression	[2] Logit[1]
Change in cost of capital *		
Average Tax Rate	-1.659	-5.72
	[0.33]	[0.72]
Average Tax Rate	0.014	-0.054
	[0.16]	[-0.38]
Change in cost of capital	-2.228	-4.130
	[1.65]	[2.32]*
n	2696	2696

[1]Marginal effects. The marginal effect of the change in cost of capital is computed with a bootstrap.
*Significant at 5 percent; **significant at 1 percent.

We find that the true elasticity of investment to the cost of capital falls to -0.03 for the median regression using the full sample.[20] The total effect of bonus depreciation is an increase in investment-to-capital ratio of 0.05.

Discussion on the overall response of investment to the bonus depreciation

Most previous research investigating the effect of bonus depreciation on investment has found small and nonsignificant results. One exception is House and Shapiro (2007), who find a large supply elasticity of investment due to bonus depreciation, between 10 and 20.

In our basic specification, we also find a large overall response of bonus depreciation on firm investment that implies an elasticity of 3.

However, our robustness tests do not allow us to rule out that this significant and large demand elasticity of investment is due to firm- or industry-specific trends in investment that are also correlated with firm- or industry-asset composition.

CONCLUSION

The bonus depreciation, passed in 2002 and extended in 2003 to encourage business fixed investment, was enacted at a time when corporate tax avoidance was, according to some observers, rampant. Economic theory suggests that this kind of investment incentive might be less effective for companies whose average tax rate is low.

We use the variation in the asset composition by industry, as well as firms' variation in fiscal year, to examine how the difference between the actual and the previous investment-to-capital ratio is affected by the bonus-depreciation-induced change in the cost of capital, testing to see whether this effect is mediated by companies' average tax rates.

We find that the overall effect on investment is small but significant, and implies an elasticity of 0.03. Crucial to this result is the isolation of the bonus depreciation effect form trend effect.

More central is our result on how tax avoidance opportunities would have mitigated this positive effect of the bonus depreciation on investment. We find no robust effect for this hypothesis.

Our results must be tempered with certain caveats to be sure. For example, if "tax-savviness" varies across firms, then those firms that successfully find tax avoidance methods may also be those that learn and take advantage of bonus depreciation as one of many "creative" ways to lower tax payments. In this case firms with low tax payments will also be investing more relative to forecast, and any correlation between the average tax rate and a change in investment may not indicate the kind of causation we have interpreted.

Finally, our results and interpretation rely on the correct measurement of corporate tax minimization with low average tax rates. More work needs to be done in testing this hypothesis with other measures of tax minimization. For example, testing the differential behavior of firms with positive pretax income. Our paper suggests that future research investigating what constitutes good indicators of the availability of tax avoidance schemes is crucial for future analysis on the effect of investment incentives.

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Notes

1 In the remainder of the paper, we call tax avoidance or minimization any type of legal or illegal tax avoidance, since our empirical strategy does not allow us to clearly distinguish between the two.

2 The cost of avoidance includes expenditures made to camouflage the behavior so as to escape IRS attention, as well as the expected costs of audit and appeal and any subsequent penalties levied by the IRS.

3 Our model assumes that the penalty is tax deductible. This assumption does not change the model's implications.

4 Compustat data do not provide information about firm's investment by state, which prevents us from taking into account the likely state variation by using the apportionment formula.

5 Taxpayers who had already filed their 2001 returns before this new provision was passed could take advantage of the bonus depreciation provision by filing an amended return.

6 We use Compustat data to compute the investment-to-capital ratio: capital expenditures (item 128) for investment, and total property, plant, and equipment (item 8) for (lagged) capital stock.

7 Cummins et al. (1994) underline the importance of focusing on small periods around tax reforms to address the impact of tax changes.

8 We do not use data from 2001. It is not included in the counterfactual because firms with certain fiscal year end might have been affected by bonus depreciation in 2001. We do not include 2001 in the post bonus depreciation provision period because for firms with fiscal year ends between March and May, we cannot observe whether their bonus depreciation induced investment was reported in 2001 or after.

9 Our measure of the average tax rate (*ATR*) is the ratio of domestic taxes to domestic income. We consider only the current (i.e., excluding deferred taxes) portion of income tax expense. See Hanlon (2003) for a discussion on the use of financial statements for tax analysis.

10 We use $E_{i,j,t} = 1/3(\Sigma_{t=2002}^{2004}[I_{i,t}/K_{i,t-1}]) - 1/3(\Sigma_{t=1998}^{2000}[I_{i,t}/K_{i,t-1}])$ and $E_{i,j,t} = 1/3(\Sigma_{t=1997}^{1999}[I_{i,t}/K_{i,t-1}]) - 1/3(\Sigma_{t=1993}^{1995}[I_{i,t}/K_{i,t-1}])$.

11 We compute the real interest rate by taking the difference between the CPI inflation rate on all items from December to December (Table B-63) and the yield on corporate Aaa bonds (Table B-73). For this, we use an intermediate value for the 2002 and 2003 yield from the Economic Report of the President, available online:

http://www.gpoaccess.gov/eop/download.html. The real rate of interest is 4 percent.

The value of $z_{a,t}$ is calculated separately for each asset based on the Modified Accelerated Cost Recovery System (MACRS) schedules in place in 2001, and in 2002 and 2003 as modified by bonus depreciation. We assign assets to MACRS categories based on Brazell and Mackie (2000), House and Shapiro (2007), and "How to Depreciate Property," IRS Publication (2004). The BEA identifies 51 types of assets; we were able to find the corresponding MACRS categories for 49 of them. To compute the present value of depreciation we use the half-year convention and followed the guidelines of the mentioned IRS publication. The values for $z_{a,t}$ we calculate are almost exactly the same as calculated by House and Shapiro (2007).

12 The capital flow table for 1997 is available on the Bureau of Economic Analysis Web site at http://www.bea.gov/newsreleases/industry/capflow/capitalflownewsrelease.htm. We use the capital flows table, in purchasers' prices, with NIPA equipment, software, and structures categories, for 22 industries.

13 Section 168(k)(4) applies for property acquired after May 5, 2003, and before January 1, 2005. Therefore, $\Delta c_{j,2004} = \Delta c_{j,2003}$.

14 Investment induced by the bonus depreciation provision signed by the President on March 9, 2002 would show up in the 2001 financial statements of firms with fiscal year ending in March, April, or May. Similarly, investment induced by the bonus depreciation extension signed on May 5, 2003 should apply to a varying fraction of firms' 2002 and 2003 financial statements, depending on firms' fiscal year end. Because companies can choose their fiscal year, there is variation across firms, within a sector, in the duration of the period over which the 2002 bonus depreciation and 2003 bonus depreciation provisions apply.

15 Replacing values of the dependent variable above the 98th percentile with the 98th percentile value, and replacing values below the 2nd percentile with the 2nd percentile value.

16 When the left-hand-side variable is categorical or for median regressions, there is no agreement in the literature on the correct methodology using instrumental variables. See Lee (2004).

17 Results available upon authors' request.

18 For example the confidence interval implies that the coefficient of the interaction of Δc with *ATR* is between -0.2 and 1.2, and -15 to -7 for OLS and IV respectively.

19 The full marginal effect of Δc in the median regression is -0.025 in the regression for all firms. The coefficient is significant at the 5 percent level.

20 This elasticity is computed as the ratio of the total effect of Δc (which is -2.228-1.659*0.19=-0.025, where 0.19 is *ATR* in the counterfactual period) over the mean investment-to-capital ratio in the counterfactual period, this is 0.85.

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