Corporate Tax Minimization and the Effectiveness of Investment Incentives

Article · March 2008

CITATIONS
0

READS
61

2 authors:

Estelle Dauchy
New Economic School
28 PUBLICATIONS **26** CITATIONS
SEE PROFILE

Claudia Martinez
Universidad de Lima
9 PUBLICATIONS **12** CITATIONS
SEE PROFILE

Corporate Tax Minimization and the Effectiveness of Investment Tax Incentives

Estelle Dauchy

Quantitative Economics and Statistics, Ernst & Young

estelle.dauchy@ey.com

Claudia Martínez A.

Department of Economics, Centro de Microdatos, University of Chile

cmartineza@econ.uchile.cl

We are grateful to Joel Slemrod for his support in an early stage of the project. We also thank Michelle Hanlon, James Hines, and Matthew Shapiro and seminar participants at the University of Michigan and the National Bureau of Economic Research for helpful suggestions and to Michelle for numerous discussions about the interpretation of financial accounting data. The views expressed are those solely of the authors and do not necessary reflect the views of Ernst & Young LLP.

Abstract

Clarifying the relationship between corporate tax minimization and the incentive to invest is particularly important because of the size of corporate tax minimization or avoidance and the recurrent use of tax incentives as attempts to spur business investment. In particular, successful tax avoidance may undermine the effectiveness of tax incentives designed to encourage investment. In this paper, we empirically estimate

the effect of an investment tax incentive known as the bonus depreciation that was passed in 2002, and extended in 2003 using firm level data. We find a small effect of bonus depreciation on investment and evidence that tax minimization opportunities have mitigated its effectiveness.

I. 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 inter-related.[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. In this case, the availability of tax avoidance opportunities may render ineffective tax measures designed to stimulate investment.

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, in this paper we develop an integrated theoretical approach to the relationship between the tax incentive to investment and tax avoidance. We then 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 investment to the cost of capital of 0.03 over 2002-2004, and no clear evidence that tax avoidance opportunities have mitigated its effectiveness.

Due to the nature of tax minimization there is no straightforward way to measure it. In this paper we use the effective average tax rate and the sign of pre-tax-income as proxies of this behavior. Using each measure separately we can not show that the central prediction of our model is upheld in all specifications: the pattern of reaction is not clearly consistent with the notion that corporate tax avoidance reduces the effectiveness of tax incentives to invest. However, firms that have both high effective marginal tax rates and consistent positive pre-tax-income for four consecutive years are more sensitive to the changes in the cost of capital caused by bonus depreciation.

2. Corporate Tax Legal and Ilegal Avoidance

Due to the nature of tax noncompliance, getting a handle on its magnitude is not easy. Measures of the tax gap (differences in taxes paid and what should be paid) depend on the firm size.

For small corporations estimates the Internal Revenue Service (IRS) uses Tax Compliance Measurement Program data or TCMP, adjusted for underreporting unlikely

to be detected by the TCMP. The TCMP featured intensive examinations of a random sample of tax returns filed for tax years from the early 1970's until 1988. By comparing these examined returns with the original returns as filed, supplemented by other evidence, the IRS estimated the total amount of underreported income and overstated subtractions in each of these years (and projections for later years) and the total loss of tax revenue--the "tax gap".

For medium-sized corporations, the gap was calculated by estimating, based on operational (i.e., non-TCMP) audits, how much tax revenue would have been generated if the IRS examined all these corporations' tax returns. Finally, for large corporations, because the IRS routinely examines a high percentage of these companies, examination results were used as the basis of estimates of the tax gap.[2]

The IRS has made tax gap estimates for tax year 2001, but not later, based on a rough projection from the 15- to 20-year-old TCMP and other data, assuming that the compliance rates for each major component have not changed in the past two decades.[3]

Corporate underreporting in 2001 is estimated at $29.9 billion, of which corporations with over $10 million in assets make up $25.0 billion.[4] As a benchmark for comparison, estimated individual underreporting in 2001 is $148.8 billion. Compared to estimated 2001 tax year receipts paid voluntarily and in a timely fashion of $142.4 billion and $930.1 billion for corporate and individual income tax collections, respectively, the underreporting rate (calculated as underreported tax divided by receipts plus underreported tax) is 17.4 percent and 13.8 percent for corporations and individuals, respectively.

Based on data from IRS audit and appeals records matched with the tax returns and financial statements of several thousand corporations, Hanlon and Slemrod (2007)

find that corporate tax noncompliance, at least as measured by deficiencies proposed upon examination, amounts to approximately 13 percent of "true" tax liability.

The Bureau of Economic Analysis (BEA) calculates an annual measure of corporate misreporting, in order to adjust the National Income and Product Accounts (NIPA) measure of corporate profits, which is based on data from corporate tax returns as filed.[5] The NIPA estimate of corporate tax misreporting as a percentage of misreporting plus total receipts minus deductions was 13.8 percent in 2000, compared to the 17.4 percent figure based on the IRS methodology that extrapolates from two-decades-old data assuming no change in compliance rates. This series shows an increase in the misreporting rate since the mid-1990's, but puts the 2000 misreporting rate below the rates of the 1989 through 1992 period. The complete series (that begins in 1929) shows that this ratio never reached 10 percent until 1981, and peaked in 1983 at 17.9 percent.

Firm level data on tax noncompliance is not available in Compustat. We use two measures of tax minimization: the effective corporate tax rate and the presence of consistent positive pre-tax income.

3. 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:

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

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 t 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).[6] 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 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 $F(K) - \delta K$.[7]

When tax and economic depreciation are equal $\delta = d$, the first-order condition for K becomes $F' - \delta = \frac{r}{(1-\tau)(1-C_F)}$. 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.

4. The Natural Experiment: Bonus Depreciation

4.1 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.[8] In effect, businesses could write off immediately 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. [9] 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.

4.2 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 both spending increased for both short and long-lived assets during the policy, long-lived assets investment did not increased 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.

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.

5. Empirical Strategy

5.1 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.[10] The dependent variable is the difference in a three period average of investment-to-capital

ratio before and after the enactment of bonus depreciation. This is:

$$(6) \qquad E_i = 1/3\left(\sum_{t=2002}^{2004} I_{i,t}/K_{i,t-1}\right) - 1/3\left(\sum_{t=1998}^{2000} I_{i,t}/K_{i,t-1}\right),$$

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.[11]

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.[12]

Taking a three-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 three year windows increases the probability 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 Section 3 motivates how Δc depends on non-standard variables such as indicators of the extent of tax avoidance. We estimate equations of the following form:

$$(7) \qquad E_{i,j} = \beta_0 + \beta_1 \Delta c_j + \beta_2 \Delta c_j * ATR_i + \beta_3 ATR_i + \varepsilon_{i,j},$$

In equation (7), 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.[13]

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, ß$_2$ 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 (7) estimates unbiased coefficients, because the dependent variable in 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 (7) by $E_{i,\,false} = 1/3\left(\sum_{t=1998}^{2000} I_{i,t}/K_{i,t-1}\right) - 1/3\left(\sum_{t=1994}^{1996} I_{i,t}/K_{i,t-1}\right)$, which is the change in investment-to-capital ratio in the period before the bonus depreciation provision, where by definition bonus depreciation should have no effect. If we re-estimate (7) 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 (8):[14]

$$(8) \qquad E_{i,j,t} - E_{i,j,t-1} = \gamma_0 + \gamma_1 \Delta c_j + \gamma_2 \Delta c_j * ATR_{i,t-1} + \gamma_3 ATR_{i,t-1} + \lambda_{i,j},$$

If bonus depreciation has an effect beyond differences in trend, γ_1 should be significantly different from zero. If the effect depends on the magnitude of the average tax rate, our measure of tax minimization, γ_2 should be different from zero.

5.2 Other Measures of Corporate Tax Minimization

As discussed in the previous sections, there is no straightforward way to measure corporate tax minimization. The empirical specification presented in equations (6)-(8) measures it by the average effective tax rate. An alternative measure is given by the sign of pretax income. These firms have more incentives to increase investment as a response to the bonus depreciation provisions, since doing so would reduce their taxable income. Furthermore, firms with positive pretax income, on average, might be more likely to have access to the necessary funds to increase investment. [15]

Firms with high effective average tax rate (ATR) and consistent positive pretax income are more likely to be affected than firms with low ATR and/or negative pretax income. We will then show equations (6)-(8) for the whole sample, and for the sample of firms with consistent positive pretax income defined as firms with positive pretax income for four consecutive years ending in 2000. We expect a stronger effect of bonus depreciation for the later. Furthermore, if we consider the positive pretax income as a measure of low tax minimization, then we also expect a stronger effect of bonus depreciation for firms with higher ATR.

5.3 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:

$$(8) \qquad c_{a,t} = (r + \delta_a)(1 - \tau z_{a,t}) \Big/ (1 - \tau),$$

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[16].

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 5 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[17], 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

$$\Delta c_{j,t} = \sum_a w_{a,j} * \Delta c_{a,t},$$

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.[18]

We use a second source of variation in Δc based on the disparities, for some firms, between accounting and fiscal year end.[19]

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:

$$(11) \qquad \Delta c_{j,3,2003} = \frac{2}{12} * \Delta c_{j,2002} + \frac{10}{12} * \Delta c_{j,2003}$$

5.4 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 ATRs 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[20] 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.[21]

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.[22]

6. Results and Implications

6.1 Descriptive Statistics

Table 2 shows descriptive statistics for our sample of firms. Panel A includes all firms, and panel B describes firms with positive pretax income for four consecutive years. In our sample of public corporations, 4,425 firms have non missing values for the variables of interest (investment, capital and average tax) over all relevant years. Among them 2,757 have positive pretax income for four consecutive 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.

Note that firms with positive pretax income (panel B) have a higher tax rate on average (24.5), invested less than in previous period (the average difference between actual and counterfactual investment is -0.282), and even less than all firms on average. Consistently, the proportion of firms which invested more than predicted is smaller than for all firms (28.4 percent).

6.2 Results

6.2.1 Results for All Firms

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

lagged value of the average tax rate. 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 not significant effect on the interaction of ATR and Δc (althoug marginally significant for the median regression). We suspect that these results are due to the existence of outliers, even after winsorization.[23]. 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 -4.7. 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. The results show that, for example, a 10 percentage point increase in the ATR (for example from 16 percent to 26 percent) induces an increase by 1.26 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 -9.

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 null hypothesis that the previous results 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 show 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 all specifications. 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.

To address the concern presented by the false experiment, we define a new difference in the 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 the results for all firms: 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.[24] 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. In contrast, the coefficient on the change in cost of capital

induced by bonus depreciation is negative and significant, and therefore robust to the existence of different trends for firms affect by bonus depreciation.

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.[25] This implies that bonus depreciation increase the investment to capital ratio by about 0.05 percent over the period 2002-04.

6.2.2 Results for firms with consistent positive pretax income

This section explores the effect of bonus depreciation and its interaction with the effective average tax rate for firms with four consecutive years (1997, 1998, 1999 and 2000) of positive pretax income. These are the firms for which a bigger effect of bonus depreciation is expected because it is more likely they would be able to use the benefit

Table 6, 7 and 8 present the results of the basic, false experiment and difference in difference specification respectively for this sample of firms. Table 6 shows the existence of a significant effect of both the change in cost of capital (Δc) and its interaction with the average tax rate (ATR). However, Table 7 shows that as in the case of all firms, there is an effect in the false experiment.

Finally, table 8 shows the results of the difference in difference results. The change in cost of capital (Δc) has the expected negative sign and is only significant for the probability of having investment higher than in the counterfactual, but not for the investment level. The interaction of the change in the cost of capital with the average tax rate also has the expected negative sign, but is only marginally significant for the median and logit regression.

In the sample of firms with positive pre-tax-income the results found in the basic specification are not driven by the trend found in the false experiment alone, but there is an effect of bonus depreciation by itself. This implies that the direct effect of the tax

induced reduction in the cost of capital cannot be explained by differential trends between firms with consistent positive pre-tax-income that faced such a decrease.[26]

For this sample, the elasticity falls to -0.06 for the median regression. The total effect of bonus depreciation is an increase in investment-to-capital ratio of 0.09.

6.2.3 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 non-significant results. One exception is House and Shapiro (2007) who find a large supply elasticity of investment due to bonus depreciation, between ten and twenty.

In our main specification, we also find a large overall response of bonus depreciation on firm investment that implies an elasticity of 3. Furthermore, in line with the main feature of our model, we find that bonus depreciation is more effective for firms with high average effective tax rate.

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 when all firms are studied together.

For the subsample of firms with consistent positive pretax income we find the negative coefficient on the interaction between the average ETR and dc is marginally significant. This suggests that the negative impact of a low ETR on the efficacy of bonus depreciation is a larger issue in this subsample.

Our finding that the negative impact of a low ETR on the efficacy of bonus depreciation is larger for firms with consistent positive pretax income (i.e., no consistent tax loss) than for firms with consistent negative pretax book income (i.e., with tax

losses) is by itself informative about our model, and suggests that the main hypothesis can not be completely ruled out.

If consistent negative pretax book income is an indicator of the availability of tax avoidance or planning strategies, beyond that of a low average effective tax, we do find some support for an effectiveness of tax incentives that depends on firms access to these strategies. 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.

6. 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 or minimization 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 0.03-0.06. 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. Although we find some evidence that firms with more tax-minimization opportunities reacted less than

other firms, our finding that the effectiveness of bonus depreciation is larger for firms with consistent positive pre-tax income and large average tax rate is informative about our model.

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. 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.

References

Brazell, David W. and James B. Mackie III. (2000). "Depreciation Lives and Methods: Current Issues in the U.S. Capital Cost Recovery System." *National Tax Journal*, 53: 531-62.

Cohen, Darrell and Jason Cummins. (2006). "A Retrospective Evaluation of the Effects of Temporary Partial Expensing." Finance and Economics Discussion Series, Divisions of Research & Statistics and Monetary Affairs Federal Reserve Board, Washington, D.C.

Cummins, Jason G., Kevin A. Hassett, and R. Glenn Hubbard. (1994). "A Reconsideration of Investment Behavior using Tax Reforms as Natural Experiments." *Brookings Papers on Economic Activity*. 2:1-74.

Desai, Mihir and Austan Goolsbee. (2004). "Investment, Capital Overhang, and Fiscal Policy." *Brookings Papers on Economic* Activity, 2:2004.

Fraumeni, Barbara. (1997). "The Measurement of Depreciation in the U.S. National Income and Product Accounts." *Survey of Current Business*, July: 233-8.

Hanlon, Michelle. (2003). "What Can We Infer About a Firm's Taxable Income from its Financial Statements? *National Tax Journal*. December 56(4): 831-863.

Hassett, Kevin A. and R. Glenn Hubbard. (2002). "Tax Policy and Business Investment." In *Handbook of Public Economics*, Volume 3, edited by Alan J. Auerbach and Martin Feldstein, 1293-1343. Amsterdam, Elsevier.

House, Christopher L. and Matthew D. Shapiro. (2007). Temporary Investment Incentives: Theory with Evidence from Bonus Depreciation. Working Paper. University of Michigan. September.

Hulse, David and Jane Livingstone. (2004). "Incentive Effects of Bonus Depreciation." Working paper, University of Kentucky.

Huston, R. (2006). Do Increased Depreciation Allowances Truly Spur Investment? Working paper, Texas A&M University Department of Accounting,

Jorgenson, Dale (1963). "Capital Theory and Investment Behavior." *American Economic Review*. 53: 247-59.

Knittel, Matthew. (2006). "Small Business Utilization of Accelerated Tax Depreciation: Section 179 Expensing and Bonus Depreciation." *Proceedings of the National Tax Association 98th Conference on Taxation*, 273-286.

Lee, Sokbae. 2004. "Endogeneity in Quantile Regression Models: A Control Function Approach" Working paper. The Institute for Fiscal Studies. Department of Economics, University College, London. Cemmap working paper 08/04.

Manzon, Gil B. and George Plesko. (2002). "The Relation between Financial and Tax Reporting Measures of Income." *Tax Law Review* 55(2): 175-214.

Plumey, Alan, "Overview of the Federal Tax Gap", National Headquarters Office of Research, U.S. Interntal Revenue Service, Washington, DC September 20, 2004b.

Slemrod, Joel. (2001). "A General Model of the Behavioral Response to Taxation." *International Tax and Public Finance* 8 No. 2 (March, 2001): 119-128.

U.S. General Accounting Office. (1988). *IRS' Tax Gap Studies.* GAO/GGD-88-66BR. Washington, D.C..

U.S. General Accounting Office. (2003). *Challenges Remain in Combating Abusive Tax Shelters.* Testimony before the Senate Finance Committee on Finance. Washington, D.C., October 21.

U.S. General Accounting Office (2004). *Comparison of the Reported Tax Liabilities of Foreign- and U.S. Controlled Corporations, 1996-2000*. GAO-04-358, February.

U.S. Internal Revenue Service. (2004a). *Interactive Tax Gap Map.* National Headquarters Office of Research, March 31.

Table 1: Change in the Cost of Capital by industry

Industry	Average Cost of K			Average Change from 2001	
	2001	2002	2003	to 2002	to 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%
Accomodation 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%
Total	0.187	0.184	0.182	-1.70%	-2.84%

Note: The total changes in the cost of capital are not comparable to the one reported in the summary statistics (Table 3) because they do not take into account firm-specific fiscal year end.

Table 2: Descriptive Statistics

Variable	N	Mean	SD	Min	Max
A. All Firms					
Average$(I/K)_{2004}$-Average$(I/K)_{2000}$	4245	-0.265	0.846	-5.254	0.964
ATR in 2000 (3 yr. average)	4254	0.159	0.246	-0.513	0.886
$\Delta c * ATR_{2000}$ (3 yr. average)	4254	-0.004	0.056	-3.425	0.270
Δc	4255	-0.017	0.005	-0.037	-0.005
Dummy(Positive Average$(I/K)_{2004}$-Average$(I/K)_{2000}$)	4255	0.307	0.461	0.000	1.000
Dummy (Positive Pre Tax Income last 4 years)	4243	0.650	0.477	0.000	1.000
B. Firms with Positive Pre Tax Income last 4 years					
Average$(I/K)_{2004}$-Average$(I/K)_{2000}$	2757	-0.282	0.720	-4.299	1.077
ATR in 2000 (3 yr. average)	2757	0.254	0.255	-0.613	0.993
$\Delta c * ATR_{2000}$ (3 yr. average)	2757	-0.003	0.146	-4.841	5.179
Δc	2757	-0.017	0.005	-0.036	-0.005
Dummy(Positive Average$(I/K)_{2004}$-Average$(I/K)_{2000}$)	2757	0.284	0.451	0.000	1.000

The ATR is winsorized at the 2% level. It is defined as the domestic average tax rate over the last three years, including the last year. Δc is the change in cost of capital due to the bonus depreciation provision.

Table 3: Basic Specification

All Firms

All Firms

	[1] OLS	[2] IV	[3] Median Regression	[4] Logit
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.

Table 4: False Experiment

All Firms

	[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.

Table 5: Difference in Difference

All Firms

	[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.

Table 6: Basic Specification

Firms with Positive Pretax Income

	[1] Median Regression	[2] Logit[1]
Change in cost of capital *Average Tax Rate	-8.518	-12.58
	[3.38]**	[1.50]
Average Tax Rate	-0.259	-0.390905
	[4.00]**	[1.94]*
Change in cost of capital	-2.839	-8.784236
	[3.45]**	[5.06]**
n	2761	2761

[1] Marginal effects. The marginal effect of the change in cost of capital is computed with a bootstrap.

Table 7: False Experiment

Firms with Positive Pretax Income

	[1] Median Regression	[2] Logit[1]
Change in cost of capital*		
Average Tax Rate	-5.108	-16.02
	[2.03]*	[2.23]**
Average Tax Rate	-0.13	-0.373
	[2.98]**	[2.81]**
Change in cost of capital	-0.302	-3.4730
	[0.39]	[1.83]
n	2329	2329

[1] Marginal effects. The marginal effect of the change in cost of capital is computed with a bootstrap.

Table 8: Difference in Difference

Firms with Positive Pretax Income

	[1] Median Regression	[2] Logit[1]
Change in cost of capital		
*Average Tax Rate	-9.025	-14.45
	[1.55]	[1.44]
Average Tax Rate	-0.092	-0.131007
	[0.88]	[0.73]
Change in cost of capital	-1.397	-4.349
	[0.82]	[2.06]*
n	1920	1920

[1] Marginal effects. The marginal effect of the change in cost of capital is computed with a bootstrap.

[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 do not allow us to clearly distinguish between the two.

[2] This description is based on U.S. General Accounting Office (1998). One potentially important problem with these data is that the examination reports do not distinguish between adjustments that change the timing of tax liability and adjustments that change the liability in a way that will not be offset in future years. For this reason it is difficult to know the present value of the recommended adjustments from IRS examinations.

[3] The tax gap numbers are drawn from Internal Revenue Service (2004a, 204b)

[4] Underreporting is only one of the three components of the total tax gap, which is estimated to be $282.5 billion. The other two components are nonfiling and underpayment. There is no estimate for corporate nonfiling, and underpayment is a quite different issue.

[5] The BEA methodology is discussed in Petrick(2002)

[6] 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.

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

[8] 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

[9] 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.

[10] 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.

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

[12] We do not use data from 2001. It is not included in the counterfactual because firms with certain fiscal year end might 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.

[13] 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.

[14] We use $E_{i,j,t} = 1/3\left(\sum_{t=2002}^{2004} I_{i,t}/K_{i,t-1}\right) - 1/3\left(\sum_{t=1998}^{2000} I_{i,t}/K_{i,t-1}\right)$ and

$E_{i,j,t} = 1/3\left(\sum_{t=1997}^{1999} I_{i,t}/K_{i,t-1}\right) - 1/3\left(\sum_{t=1993}^{1995} I_{i,t}/K_{i,t-1}\right)$

15 Firms with tax losses have access to tax loss carry-overs, then they could also react to the temporary tax incentive.

[16] We use a nominal rate of interest of .06 to discount. This is an intermediate value for the 2002 and 2003 interest rate from the Economic Report of the President, available online: http://www.gpoaccess.gov/eop/download.html. 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).

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. 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).

[17] The capital flow table for 1997 is available on the Bureau of Economic Analysis web site at http://www.bea.doc.gov/bea/newsrel/capitalflownewsrelease.htm. We use the capital flows table, in purchasers' prices, with NIPA equipment, software, and structures categories, for 22 industries.

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

[19] 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.

[20] 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.

[21] 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).

[22] Results available upon author's requests

[23] For example the confidence interval implies that the coefficient of the interaction of dc with ATR is between -0.2 and 1.2, and -15 to -7 for OLS and IV respectively.

[24] The full marginal effect of dc in the median regression is -0.025 in the regression for all firms. The coefficient is significant at the 5\% level (the confidence intervals are between -0.047 and -0.004, and -0.06 and --0.01 respectively).

[25] 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.

[26] In order to directly compare firms with positive pretax income with other firms, we estimate a the difference in difference model in which all the relevant variables are interacted with a dummy for positive pretax income. Using this strategy, we do not find that the full effect of dc is significantly different for firms with positive pretax income. However, we do find that the effect of the interaction between the average ETR and dc is significantly larger (more negative) for firms with positive pretax income.