Investment Ramifications of Distortionary Tax Subsidies*

James R. Hines Jr.
University of Michigan and NBER

Jongsang Park
University of Michigan

June, 2012

Abstract

This paper examines the investment effects of tax subsidies for which some assets and not others are eligible. Distortionary tax subsidies concentrate investments in tax-favored assets, thereby reducing the expected pre-tax profitability of investment and reducing payoffs to bondholders in the event of default. Anticipation of asset substitution encourages lenders to require covenants in bond contracts, which only imperfectly address asset substitution and impose their own distortions on the investment process. The result is that borrowing is made more expensive, which in turn discourages investment. Borrowing rates can react so strongly that aggregate investment may rise very little, or even fall, in response to higher tax subsidies. Bonds issued by U.S. firms in risk of default after the 2002 introduction of bonus depreciation for U.S. equipment investment contained many more covenants than in other periods, a pattern that reversed when bonus depreciation was discontinued after 2004; furthermore, it appears that firms at risk of default borrowed very little during that period.

JEL Codes: H25, G31, G33.

*The authors thank Austin Nichols for outstanding research assistance, and Alan Auerbach, David Cutler, Kathryn Dominguez, Rachel Griffith, Takeo Hoshi, Ronen Israel, Uday Rajan, Matt Shapiro and Joel Slemrod for helpful comments on an earlier draft, and Michael Roberts for generously providing us with the Dealscan-Compustat Link data.

1 Introduction

Governments frequently use tax policies to encourage certain activities and discourage others. Higher rates of taxation generally reduce aggregate business investment, but it is common for certain assets to receive preferential tax treatment designed to enhance their attractiveness to investors. In the United States, the prevailing view of such preferences is decidedly skeptical; nevertheless, the current U.S. tax code offers special incentives for foreign investment, investment in R&D, and other restricted categories of activity. In the years before 1987, the use of special incentives was considerably more widespread.

This essay examines the impact of tax incentives that are limited to specific categories of investments. The results indicate that, if there is a chance that firms will default on their debts, these tax incentives have significantly smaller effects on aggregate investment than they do when firms are certain not to default. Indeed, there are plausible circumstances in which higher tax subsidy rates may reduce total investment by firms receiving the incentives. The reason is that tax preferences for specific activities indirectly discourage others by worsening the conflict of interest between shareholders and bondholders. Bondholders do not benefit from investment tax incentives, since the state of the world about which they are most concerned - bankruptcy - is one in which tax incentives are valueless since firms have no tax liabilities.

If a firm loses money and is unable to pay off its debts, bondholders may be able to claim the firm's assets (net of its operating losses and any costs associated with bankruptcy). Conflict of interest stems from anticipation of this possibility, since shareholders, who control firms, invest in assets to maximize returns in those states of the world in which they, and not bondholders, are the residual claimants. Optimizing equity investors allocate resources between assets so as to equalize after-tax marginal returns. Bondholders prefer that firms equalize before-tax marginal returns, since such a rule maximizes the value of the firm if in default. Since the bond market anticipates that shareholder-controlled firms invest to maximize after-tax returns, borrowing rates rise in response to the introduction of specific investment tax incentives. Higher interest rates, in turn, reduce profits and make investment more costly. It is possible that interest rate reactions are so powerful that firms reduce total investment in response to greater incentives.

The agency problems between bondholders and shareholders generate inefficient outcomes that could be avoided if borrowers and lenders had perfect information about present and future conditions and could use enforceable and complete debt contracts specifying the types of investments firms are permitted to undertake. An efficient contract would appropriately weight the interests of both bondholders and shareholders. In practice it is not possible to draft perfectly efficient bond contracts; instead, bonds may have covenants containing rather crude restrictions on the disposition of funds by borrowers, or the financial circumstances in which loans may be called. The model analyzed in the paper assumes that lenders do not have sufficient information to write bond covenants that avoid the agency problems created by tax incentives, and the empirical work examines the use of bond covenants in practice.

As an alternative, the agency problems created by debt contracts could be avoided by financing firms entirely by equity, but doing so means relinquishing the tax benefits of debt described by Modigliani and Miller (1963) and Stiglitz (1973), and foregoing access to an important market for funds.

The apparent little power of tax incentives to stimulate aggregate investment spending is one of the puzzles of the empirical investment literature.[1] Part of the solution may lie in the noisiness of investment data, empirical specifications that are insensitive to decision making lags and adjustment costs, the importance of cash flow and other omitted variables, and the endogeneity of capital asset prices to investment demand.[2] This essay considers an additional possibility: that standard empirical specifications incorrectly capture the impact of tax incentives on the demand for capital. Since corporate borrowing rates reflect the bond market's anticipation of behavior that is endogenous to tax incentives, it is inappropriate to treat interest rates on corporate debt as exogenous in evaluating the effects of tax policies on investment.

Jorgenson-style cost of capital calculations imply that tax incentives for investments in specific assets affect the composition of new investment and increase the total volume of investment. These implications depend on an assumed zero probability of bankruptcy. The model in this essay implies that if there is a chance that investors will default on their debts, then these two phenomena - significant asset substitution and rapidly rising total investment - should not both accompany higher distortionary tax subsidies.

There is an extensive literature on the inability of some firms - typically, those in tax loss situations - to benefit from the availability of tax deductions or tax credits.[3] Most of these situations reflect the tax law's asymmetric treatment of profits and losses. This problem is typically treated as one in which firms that act in the interest of their shareholders react little to tax subsidies if there is a substantial probability of having tax losses. There is, however, a potentially much more powerful implication of the asymmetric treatment of profits and losses that stems from the inability of creditors of bankrupt firms to use their accumulated tax credits. Neither of these implications is important if owners of unprofitable firms can benefit from tax incentives by effectively selling them to profitable firms through takeovers or sale-leaseback operations. In practice, unprofitable firms seldom benefit from tax credits;[4] this essay analyzes cases in which investors anticipate that tax credits have no value to firms with tax losses.

---

[1]Hassett and Hubbard (2002) and Chirinko (1993) survey this literature. Edgerton (2010) is a recent effort to estimate the investment impact of tax incentives on investment, one that reports only small effects from the introduction of bonus depreciation for U.S. equipment investment. Djankov et al. (2010), in a cross-country study using an entirely different methodology, draws the conclusion that tax burdens significantly affect investment levels.

[2]See, for example, Auerbach and Hassett (1992), Cummins et al. (1994), Goolsbee (1998), and House and Shapiro (2008).

[3]See, for example, Auerbach (1983), Auerbach (1986), Auerbach and Poterba (1987), Majd and Myers (1987), Mintz (1988), Altshuler and Auerbach (1990), Graham (1996), Graham (2000) and Edgerton (2010).

[4]Auerbach and Reishus (1991) and Gilson (1990) note the infrequency with which defaulting firms are acquired by profitable entities, and Hotchkiss (1995) documents the subsequent poor financial performance of bankrupt firms that undergo reorganization.

It is well established that bond prices are correlated with a firm's profitability,[5] but the distinction between pre-tax and after-tax profitability has heretofore received scant if any attention in empirical studies of bond pricing. The provision of extremely generous depreciation allowances for U.S. equipment investment, but not for other investment, during 2002-2004 encouraged firms to distort the composition of investment in favor of tax-preferred assets.[6] Detailed evidence of bond covenants from time periods prior to 2002, the 2002-2004 period, and after 2004 confirm that borrowing contracts during the bonus depreciation period were more likely than at other times to contain significant restrictions. These covenants were concentrated among contracts involving borrowers with precarious financial situations and whose assets were concentrated among equipment investments that were the focus of the tax-induced distortion. Corporate borrowing fell during the bonus depreciation period, with the decline concentrated among financially precarious firms whose assets were concentrated in equipment investment.

Section 2 of the paper analyzes the properties of a simple model in which certain assets receive favorable tax treatment. Section 3 considers extensions of the model. Section 4 examines evidence from bond contracts before, during, and after the 2002-2004 bonus depreciation period. Section 5 is the conclusion.

2 Model

In order to clarify the issues raised by distortionary tax incentives, it is useful to analyze a model in which management acts in the interest of shareholders and there is no conflict between the interests of shareholders and the interests of bondholders in the absence of taxation. More general treatments of the investment problem would consider situations in which there are interactions between various agency problems, including those introduced by taxation.

2.1 Framework

Consider a firm that invests in two assets, K_1 and K_2, prior to the realization of a stochastic shock to its output. For simplicity the model has only two periods; the firm chooses K_1 and K_2 in the first period, while the state of the world is revealed and contracts are closed in the second. The firm's (reduced-form) production function is $y(K_1, K_2)\theta$ in which $y(\cdot)$ is a deterministic function and $\theta \in [0, \infty]$, is the realization of the shock. The production function is taken to be concave and homothetic, which rules out unusual outcomes stemming simply from output scale effects. Output is assumed to be verifiable to all investors. θ is distributed according to a known density function $g(\theta)$.

Firms are assumed to be risk-neutral, in the sense that managers maximize expected profits

[5] See, for example, Kwan (1996).

[6] House and Shapiro (2008) offer evidence that U.S. firms significantly increased their investment in classes of equipment that received the greatest increase in tax benefits during 2002-2004, relative to investment in other classes of equipment.

without regard to the correlation between θ and the market return. Alternatively, one can think of θ as reflecting purely idiosyncratic shocks to a firm's production function.

Assets 1 and 2 each depreciate at one-period rate δ.[7] The firm's investments are financed by a combination of owner's equity (E) and bonds (B) held by unrelated parties. Aggregate firm capital is denoted $K \equiv K_1 + K_2$; the firm's capital constraint is the requirement that $K \leq E + B$.

The shock, θ, is realized at the start of the second period. The realization of θ influences both the pre-tax profitability of the firm and its tax liability. There are three possible outcomes in the second period. The first possibility is that the firm is profitable and has positive tax liability. If so, the firm pays corporate taxes at rate τ on its output net of interest charges and depreciation. In addition, and this is the focus of the subsequent analysis, the firm receives a tax credit of c for every unit of K_1 it installs. The second possibility is that the firm has tax losses (and therefore no tax liability) but is not in default. The third possibility is that the firm's revenues are so low that it defaults on its debt obligations.

The tax credit is assumed to be nonrefundable if the firm has tax losses. Nonrefundability is at the heart of the agency problem, since the bondholders, who are residual claimants on the firm's assets in the event of default, receive no benefits from the tax credit because default is also a state in which the firm has no tax obligations.

Aggregate production is a function of K, the total capital stock, and its allocation between assets 1 and 2. Since the production function is homothetic, the interasset allocation of capital is independent of the scale of output, being instead a function of the relative cost of the two assets as determined by c. It is useful to introduce the following quasi-reduced form notation for output: $Q(K,c)\theta$, in which $Q(K,c) = y\left[K\sigma_1(c), K(1-\sigma_1(c))\right]$ and $\sigma_1 \equiv K_1/K$ is the firm's share of credit-eligible capital.

A firm that borrows in the first period must redeem its debt, along with any agreed-upon interest, in the second period, unless the firm defaults, in which case bondholders are entitled to seize control of the firm and its assets. $r(B,K,c)$ denotes the required payment (in non-bankruptcy states) to debtholders in the second period, representing interest $[r(B,K,c) - B]$ plus repayment of debt principle (B). As the notation indicates, interest rates are functions of total borrowing, total investing (and thereby implicitly the equity contributions of shareholders), and the incentives created by the tax system. Figure 1 depicts the sequence of events. In the first period, investors commit E of equity to the firm, after which the firm borrows B in the bond market. The firm then selects K_1 and K_2.

Shareholders of profitable, taxpaying firms receive:

$$\left\{Q(K,c)\theta - \left[r(B,K,c) - B\right] - \delta K\right\}(1-\tau) - B + K + cK\sigma_1.$$

[7] As a general matter, assets depreciate at differing rates - and in particular, the history of U.S. experience with investment tax credits is that tax-favored assets tend to have higher depreciation rates. This issue is important in interpreting the empirical work presented in section 4. Depreciation rates are assumed to be equal in this section in order to consider a situation in which there is no conflict of interest between shareholders and bondholders in the absence of special tax incentives.

The term in braces is the firm's sales revenue, minus the sum of its depreciation charges and interest payments. Depreciation for tax purposes is assumed to equal economic depreciation. The second term in the expression (-B) reflects the repayment of debt principle. Finally, investors have claims on the firm's capital stock and receive the tax credits associated with investing in K_1.

It is possible that the firm's earnings will be sufficient to cover its required payment of $r(B, K, c)$ to bondholders but insufficient to generate positive tax liability, either because the firm incurs losses or because its tax credits ($cK\sigma_1$) equal or exceed its tax liabilities.[8] Since the firm pays no taxes, shareholders receive:

$$Q(K, c)\theta + (1 - \delta)K - r(B, K, c).$$

The third possibility is that the firm's losses are so great that bondholders cannot be fully paid off; instead, bondholders receive the firm's assets (net of operating losses and bankruptcy costs) and shareholders receive nothing in the second period.

Shareholder expected profits (π^e) are:

$$\begin{aligned} \pi^e = \quad & \{[Q(K, c)\theta_1 - r(B, K, c) - \delta K](1 - \tau) - B\tau + K + (cK\sigma_1)\} \, p_1 \\ + \quad & \{Q(K, c)\theta_2 - r(B, K, c) + (1 - \delta)K\} \, p_2 \end{aligned} \tag{1}$$

in which p_1 denotes the support of the distribution of θ over which the firm has positive tax liability and θ_1 is the average value of θ within that region. Similarly, p_2 denotes the support of the distribution of θ over which the firm meets its debt obligations but has no tax liability; θ_2 is the average value of θ within that region. For notational simplicity it is convenient to treat θ as though it has a point distribution taking the value θ_1 with probability p_1, the value θ_2 with probability p_2, and the value θ_3 with probability p_3, in which $p_1 + p_2 + p_3 = 1$ and p_3 is the probability of default.[9] p_1 is defined to equal the probability of θ falling in the range that:

$$\tau \{Q(K, c)\theta - [r(B, K, c) - B] - \delta K\} - cK\sigma_1 > 0.$$

p_2 is defined to equal the probability of falling in the range that:

$$\tau \{Q(K, c)\theta - [r(B, K, c) - B] - \delta K\} - cK\sigma_1 \leq 0,$$

$$Q(K, c)\theta + (1 - \delta)K - r(B, K, c) \geq 0.$$

Expected returns as defined in (1) are operating returns that make no allowance for the cost

[8] This statement assumes that taxpayers are entitled to use tax credits to offset 100% of their tax liabilities. In practice, many countries (including the United States) limit the extent to which certain kinds of tax credits can be so used. Explicitly incorporating such restrictions would change the analysis very little.

[9] Note that, since θ takes nonnegative values, $\theta_1 \geq \theta_2 \geq \theta_3 \geq 0$. The appendix analyzes the model in a setting in which θ is distributed continuously, making the probability of default (as well as p_1 and p_2) endogenous to tax polices and to investment decisions of firms. The results are identical to those described in the text (in which θ is distributed discretely).

of invested equity (E). Denote the opportunity cost of equity (measured in second period units) by ρ. The firm chooses K_1, K_2, B, and E to maximize:

$$\pi^e - \rho E \tag{2}$$

subject to:

$$E + B \geq K \tag{3}$$

The first-order condition corresponding to maximizing (2) over the choice of K, subject to (3), is:

$$\frac{\partial Q}{\partial K}\left[p_1\theta_1(1-\tau) + p_2\theta_2\right] + \left[(1-\delta) - \frac{\partial r}{\partial K}\right]\left[p_1(1-\tau) + p_2\right] + p_1\tau + p_1\sigma_1 c = \lambda \tag{4}$$

in which $\lambda \geq 0$ is the lagrange multiplier corresponding to the value of the constraint (3). In addition, there are two first order conditions corresponding to alternative sources of finance:

$$\frac{\partial r}{\partial B}\left[p_1(1-\tau) + p_2\right] - p_1\tau = \lambda \tag{5}$$

which must be satisfied for firms issuing positive amounts of debt, and

$$\rho = \lambda \tag{6}$$

for firms with positive equity. In equilibrium, firms using both debt and equity must be indifferent between them (as in Miller (1977) and DeAngelo and Masulis (1980)). Market equilibrium is characterized by firms with internal debt-equity ratios that generate probabilities of bankruptcy making them indifferent at the margin between the two sources of finance. In order to evaluate the role of tax parameters in influencing the cost of debt (and therefore also equity) finance, it is necessary to consider the nature of equilibrium in the bond market.

2.2 Bond Market Equilibrium

Interest rates on risky debt reflect the requirement that lenders receive risk-adjusted normal returns. Bondholders receive $r(B, K, c)$ if the firm is solvent in period two, and receive less if the firm is insolvent. Bondholders of bankrupt firms are entitled to seize their assets, though the process of doing so typically entails some costs. Recognizing these costs, shareholders and bondholders of firms in default often prefer to settle their claims without recourse to formal bankruptcy proceedings. A simplified characterization of default is that bondholders receive in period two the firm's assets, net of its operating losses, and net of associated bankruptcy costs. Lenders are assumed to know B and K, but not to be able to contract over the breakdown of K into K_1 and K_2. Denoting the required certainty-equivalent rate of interest by $\overline{r}$, bond market equilibrium requires that

$$(1+\overline{r})B = (p_1+p_2)r(B,K,c) + p_3\left[Q(K,c)\theta_3 + (1-\delta)K\right] \tag{7}$$

in which the first term on the right side of (7) is the payoff to bondholders in non-bankruptcy states, and the second term is the payoff in bankruptcy. For the purpose of this expression, any bankruptcy costs are assumed to be incorporated in the relevant value of θ_3. Differentiating (7),

$$\frac{\partial r}{\partial K} = \frac{-p_3}{1-p_3}\left[\frac{\partial Q(K,c)}{\partial K}\theta_3 + (1-\delta)\right] \tag{8}$$

and

$$\frac{\partial r}{\partial B} = \frac{1+\overline{r}}{1-p_3}. \tag{9}$$

Equation (9) reflects that additional borrowing yields bondholders (in aggregate) no additional returns in bankruptcy states, since bondholders receive simply the value of the firm (minus bankruptcy costs), which is unaffected by the amount of capital raised on the debt market.

By contrast, (8) illustrates that new investment reduces interest rates, since with B held constant, any additional investment is financed with equity. Equity-financed investments reduce the severity of bankruptcy outcomes from the standpoint of bondholders, though the extent to which new investments reduce interest rates is a function of differences between shareholder and bondholder interests induced by nonzero values of c.

2.3 Investment Implications

Combining (4), (5), (8) and (9),

$$\frac{\partial Q(K,c)}{\partial K}\left[p_1\theta_1(1-\tau) + p_2\theta_2 + \frac{p_3\left[p_1(1-\tau)+p_2\right]}{p_1+p_2}\theta_3\right] = \frac{(\overline{r}+\delta)\left[p_1(1-\tau)+p_2\right]}{p_1+p_2} - c\sigma_1 p_1. \tag{10}$$

This equation is standard in the Hall-Jorgenson analysis of investment, since if p_1=1 and $p_2 = p_3 = 0$, then it simply implies that $\frac{\partial Q(K,c)}{\partial K}\theta_1 = (\overline{r}+\delta-c\sigma_1)/(1-\tau)$. In that setting, changes in c have direct impact on the marginal product of capital and an implied effect on capital demand. Earlier studies analyze the importance of $p_2 > 0$ in reducing the impact of c on investment. In the setting described by (10), however, $p_3 > 0$ has much greater potential to affect the impact of c on capital demand than does $p_2 > 0$.

Since the influential work of Hall and Jorgenson (1967), it is customary to evaluate the investment effects of tax policies by calculating tax-induced changes in the cost of capital. In equation (10), the cost of capital appears as $\frac{\partial Q(K,c)}{\partial K}$, the tax-induced marginal product of capital.

Decomposing the effect of c on $\frac{\partial Q(K,c)}{\partial K}$,

$$\frac{d\left[\frac{\partial Q(K,c)}{\partial K}\right]}{dc} = \frac{\partial^2 Q(K,c)}{\partial K^2}\frac{dK}{dc} + \frac{\partial^2 Q(K,c)}{\partial K \partial c} \tag{11}$$

in which the first term on the right side of (11) is the change in the cost of capital due to interactions between changes in investment levels and the concavity of the production function, and the second term on the right side is the change in the marginal product of capital induced by substitution of K_1 for K_2. Since the effect of c on output, holding K fixed, stems from induced changes in the composition of capital inputs, it follows that

$$\frac{\partial Q(K,c)}{\partial c} = \left[\frac{\partial y}{\partial K_1} - \frac{\partial y}{\partial K_2}\right] K \frac{d\sigma_1}{dc}. \tag{12}$$

It is straightforward to establish, in a manner similar to the derivation of (4), that the firm's profit-maximizing choice of K_1 and K_2 satisfies:

$$\frac{\partial y}{\partial K_1} - \frac{\partial y}{\partial K_2} = \frac{-cp_1}{p_1\theta_1(1-\tau) + p_2\theta_2}. \tag{13}$$

Since the right side of (13) is independent of K, it follows that (12) implies:

$$\frac{\partial^2 Q(K,c)}{\partial K \partial c} = \left[\frac{\partial y}{\partial K_1} - \frac{\partial y}{\partial K_2}\right] \frac{d\sigma_1}{dc}. \tag{14}$$

Totally differentiating (10) yields:

$$\frac{d\left[\frac{\partial Q(K,c)}{\partial K}\right]}{dc} = \frac{-p_1\left(\sigma_1 + c\frac{d\sigma_1}{dc}\right)}{p_1\theta_1(1-\tau) + p_2\theta_2 + \frac{p_3[p_1(1-\tau)+p_2]}{p_1+p_2}\theta_3}. \tag{15}$$

Then rearranging (11), and imposing (14), (13) and (15) implies:

$$\frac{\partial^2 Q(K,c)}{\partial K^2}\frac{dK}{dc} = \frac{p_1 c\frac{d\sigma_1}{dc}}{p_1\theta_1(1-\tau) + p_2\theta_2} + \frac{p_1\left(\sigma_1 + c\frac{d\sigma_1}{dc}\right)}{p_1\theta_1(1-\tau) + p_2\theta_2 + \frac{p_3[p_1(1-\tau)+p_2]}{p_1+p_2}\theta_3}. \tag{16}$$

It is useful to define a measure, f, of the extent to which the firm's output is expected to come in default states:

$$f \equiv \frac{p_3\theta_3\left[p_1(1-\tau) + p_2\right]}{\left[p_1\theta_1(1-\tau) + p_2\theta_2\right]\left[p_1 + p_2\right]}.$$

If default is impossible (p_3=0) then f=0. If p_2=0 then $f = p_3\theta_3/p_1\theta_1$, so f may exceed unity at sufficiently high default probabilities. Then letting

$$\eta \equiv \frac{\partial\sigma_1}{\partial c}\frac{c}{\sigma_1}$$

define the elasticity of the share of capital of type one in the firm's capital stock with respect to the tax credit, (16) becomes:

$$-\frac{\partial^2 Q(K,c)}{\partial K^2}\left[p_1\theta_1(1-\tau)+p_2\theta_2\right](1+f)\frac{dK}{dc}=p_1\sigma_1(1-f\eta). \tag{17}$$

Concavity of the production function implies that $\frac{\partial^2 Q(K,c)}{\partial K^2}<0$, so $(1-f\eta)<0$ means that $\frac{dK}{dc}<0$. Higher tax credit rates reduce investment if $f\eta>1$, which arises if substantial fractions of output come in default states of the world and if firms substitute strongly toward tax-preferred assets in response to higher tax credits. These two conditions are jointly necessary, since if f=0, then default is impossible and there is no agency cost associated with shareholder control of the firm, while if η=0, then firms do not respond to tax credits by substituting assets in a way that is costly to bondholders.

It is noteworthy that, from its definition, η=0 if $\frac{d\sigma_1}{dc}=0$ or c=0, so either of these conditions is sufficient to guarantee that $\frac{dK}{dc}>0$. If $\frac{d\sigma_1}{dc}=0$ then firms do not substitute one capital good for another in response to relative price changes. If c=0 then bondholders are unharmed by asset substitution, since pretax marginal products of different capital types are equal.

The term $(1-f\eta)$ in (17) is the factor by which excessive asset substitution reduces the investment impact of specific tax subsidies.[10] In order to evaluate the magnitude of this factor, it is useful to replace η in with a more commonly-estimated parameter, ϵ, the elasticity of substitution between K_1 and K_2. The substitution elasticity is:

$$\epsilon\equiv\frac{d(K_1/K_2)}{d(c_1/c_2)}\frac{c_1/c_2}{K_1/K_2}$$

in which c_1 is the user cost of capital goods of type one and c_2 is the user cost of capital goods of type two. From its definition, $\sigma_1=\frac{K_1}{K_1+K_2}=\frac{K_1/K_2}{1+(K_1/K_2)}$. Furthermore, homotheticity of the production function implies that $\frac{d(K_1/K_2)}{dc}=\frac{d(K_1/K_2)}{d(c_1/c_2)}\frac{d(c_1/c_2)}{dc}$, since ratios of factor inputs are affected by relative costs but not by output levels. Consequently,

$$\frac{d\sigma_1}{dc}=\frac{\frac{d(K_1/K_2)}{d(c_1/c_2)}\frac{d(c_1/c_2)}{dc}}{\left[1+(K_1/K_2)\right]^2}=\frac{\epsilon\sigma_1(1-\sigma_1)\frac{d(c_1/c_2)}{dc}}{c_1/c_2} \tag{18}$$

From the standard Hall-Jorgenson formula, the user cost of capital of type one, for an investment financed by equity, is: $c_1=(r^e+\delta)(1-c-\tau z)/(1-\tau)$, in which r^e is the appropriately-adjusted required rate of return on equity investment, and z is the present discounted value of depreciation allowances. It is appropriate to use this expression because firms are indifferent at the margin between financing investments with debt and with equity. It follows that $c_1/c_2=(1-c-\tau z)/(1-\tau z)$, which in turn implies that $\frac{d(c_1/c_2)}{dc}=-1/(1-\tau z)$. Finally, the

[10]Since p_1 premultiplies the right side of (17), the term $(1-f\eta)$ captures the effect of asset substitution conditional on potential unprofitability. Previous studies of investment tax incentives when $p_1<1$ implicitly assume that $p_2=1-p_1$, and therefore $p_3=0$, so it is necessary to adjust their calculations by $(1-f\eta)$ when $p_3>0$.

present value of economic depreciation allowances is given by $z = \frac{\delta}{\overline{r}+\delta}$ (Hall and Jorgenson (1971)). These substitutions yield:

$$\eta = \frac{-\epsilon(1-\sigma_1)c}{1-c-\frac{\tau\delta}{\overline{r}+\delta}}. \tag{19}$$

High values of f and c, and large negative values of ϵ, conspire greatly to reduce $\frac{dK}{dc}$. For example, if $f = 1, \sigma_1 = 0.2, c = 0.3, \tau = 0.45, \delta = .10, \overline{r} = 0.05$, and ϵ =-1, then $(1 - f\eta)$ =0.4. With otherwise the same parameters but ϵ=-2, $(1 - f\eta)$ =-0.2. At higher absolute values of ϵ, asset substitution means that small increments to c will be accompanied by significant shifting of investment into tax-favored assets with relatively low pre-tax marginal products. Higher values of f likewise reduce $\frac{dK}{dc}$. While calculations can illustrate the possibility that investment falls with higher levels of c, the more general point is that it is necessary to adjust standard cost of capital formulas by the factor $(1 - f\eta)$ in order to capture the incentives created by the tax system.

2.4 Implications for Profitability

The same considerations that reduce the investment impact of specific tax credits also reduce the effect of higher tax credits on profitability. Indeed, identical terms appear in both the profitability and investment equations. Higher tax credit rates raise borrowing costs as lenders anticipate substitution into tax-preferred assets. If this effect is sufficiently large, it can overwhelm the direct effect of tax credits on profitability.

Differentiating the bond market equation (7) produces:

$$(p_1 + p_2)\frac{\partial r(B, K, c)}{\partial c} + p_3\theta_3\frac{\partial Q(K, c)}{\partial c} = 0, \tag{20}$$

which, together with (12) and (13), implies:

$$\frac{\partial r(B, K, c)}{\partial c} = K\frac{d\sigma_1}{dc}cp_1\frac{p_3\theta_3}{[p_1\theta_1(1-\tau) + p_2\theta_2]\,[p_1 + p_2]} \tag{21}$$

From (1) and the envelope theorem, the effect of c on expected profits is:

$$\frac{d\pi^e}{dc} = -\frac{\partial r(B, K, c)}{\partial c}\,[p_1(1-\tau) + p_2] + K\sigma_1 p_1. \tag{22}$$

Then combining (21) and (22) yields:

$$\frac{d\pi^e}{dc}\frac{1}{K} = p_1\sigma_1(1 - f\eta) \tag{23}$$

the right side of which is identical to the right side of (17). The same moral hazard costs associated with higher tax credit rates that reduce investment also reduce expected profitability. Since investors must be indifferent between holding riskless government debt and risky corporate bonds, the costs or benefits of distortionary tax incentives are borne entirely by shareholders.

Figure 2 illustrates the equivalent (and much more easily depicted) effect of tax credits on the cost of producing a given quantity of output. The two solid lines in the figure reflect after-tax relative prices of K_1 and K_2 before and after the introduction of a credit for purchases of K_1. For simplicity consider the case in which $p_2 = 0$, so that the firm is either taxable or bankrupt. The distance between the points at which the two budget lines, tangent to the same isoquant, intersect the vertical axis equals the cost reduction for which the tax credit is responsible if the firm is taxable. The dotted line in Figure 2 is constructed to be parallel to the original price line while intersecting the input combination that maximizes expected returns to shareholders after introduction of the tax credit. The distance between the points at which this line and the original budget line intersect the vertical axis equals the extent to which pre-tax input costs rise due to substitution induced by the tax credit. If the product of this higher cost and the probability of default exceeds the product of the after-tax cost reduction and the probability of being taxable, then the tax credit raises expected after-tax costs. This is possible because, with p_2=0, the input combination that maximizes shareholder value is independent of the probability of default and the value of θ in default states; consequently, shareholders have excessive incentives to substitute K_1 for K_2. If the probability of bankruptcy is sufficiently great, and the two inputs are highly substitutable, then the costs associated with asset substitution may exceed the direct benefits of receiving tax credits.

2.5 Relation to other Agency Cost Models

The cost of the inefficiency generated by incentives to overinvest in tax-preferred assets (to the detriment of bondholders) is ultimately borne by shareholders, who are unable to commit their firms not to do so, and who therefore must pay higher interest rates. This result is similar in spirit to earlier work on incentives to distort the portfolio of investments financed using incomplete debt contracts. The option aspect of an equity claim implies that there are situations in which firms serve the interests of shareholders by making risky investments with negative expected present values and by foregoing safe investments with positive present values.[11] Lenders, who understand these incentives, demand higher interest rates in response. The incentive to overinvest in risky assets is perhaps somewhat subtler than the incentive to overinvest in tax-preferred assets, though it is similar in that the conflicting interests of shareholders and bondholders distort behavior and drive up interest rates in response. The bonus depreciation provisions introduced in 2002, the focus of the empirical analysis in Section 4, are noteworthy in this respect, as it is well known that longer-lived assets benefit significantly more from bonus depreciation than do shorter-lived assets. To the extent that longer-lived assets are believed to be used for riskier investment projects, therefore, this investment subsidy program could be expected to aggravate this asset-substitution problem.

[11] Jensen and Meckling (1976) and Green (1984) analyze the incentives to undertake risky investments, Myers (1977) considers the role of debt overhang in discouraging safe investments, and Gertner and Scharfstein (1991) evaluate these incentives in the context of U.S. reorganization law.

Incomplete debt contracts that distort investment decisions may simultaneously serve to correct other inefficiencies. There is considerable attention devoted to the use of debt to discipline managers and thereby reduce some of the agency problems between shareholders and managers.[12] Debt used for this purpose nevertheless becomes more costly when some assets but not all receive preferential tax treatment.

3 Extensions to the Model

This section considers four issues related to the model analyzed in section 2. The first is the ability of shareholders and bondholders to design contracts that reduce the agency costs that otherwise arise due to incomplete contracting. The second is the legal process that accompanies default, and the associated possibility that bondholders may not be able to recover the full value of a firm's assets in the face of determined opposition by shareholders. And the third is the potential incompleteness of tax carryforwards and carrybacks in settings with more than two periods.

3.1 Bond covenants

In principle, bondholders have available to them information that could be used to avoid some of the agency problems described in section 2. The model in section 2 posits that lenders are unable to observe the investment mix chosen by borrowers. Another possibility is that lenders could attach covenants to bond contracts that specify the types of investments borrowers are permitted to undertake. Optimally-chosen covenants would then be endogenous to the tax treatment of different assets, limiting the extent of permitted substitution into tax-preferred investments.

There are several well-known difficulties that such arrangements encounter in practice.[13] The first stems from the difficulty of recontracting in stochastic environments. Borrowers will want to change their investment plans over time based on new information. If strictly enforced, covenants prevent efficient adaption to changing circumstances and thereby reduce the interest rates that borrowers are willing to pay. If not strictly enforced, then - in the absence of symmetric information between borrowers and lenders - covenants will not prevent excessive substitution into tax-preferred investments. A second difficulty with bond covenants is that, in the presence of informational asymmetries, lenders will generally not have sufficient information to be able to write efficient covenants. Lenders may suspect that borrowers will adjust the composition of their investments in favor of assets that are eligible for tax credits, but do not know what fraction of the capital stock such assets would represent in the absence of tax incentives. A third difficulty with bond covenants has to do with their enforcement. Covenant violations can lead to renegotiation or termination of bond contracts, but dramatic remedies are costly to all parties and may increase the chance of an even costlier subsequent default. Partly for this reason, it is common for lenders

[12]See, for example, Grossman and Hart (1982), Dewatripont and Tirole (1994), and Hart and Moore (1995).
[13]See, for example, Smith and Warner (1979), McDaniel (1986), and Berlin and Loeys (1988).

to waive at least some violations of covenant provisions.[14] From an ex ante standpoint, the potential costs associated with verifying compliance with covenant provisions and assessing damages for noncompliance reduces the desirability of attaching an excessive number of such restrictions to bond contracts, except in circumstances in which covenants are desperately needed.

Despite these difficulties, it is possible for bondholders to impose restrictions on borrowers that attenuate some of the effects analyzed in section 2. For example, borrowing rates could be made contingent on the fraction of tax-preferred assets in which a borrower invests. This type of restriction would change somewhat the solution derived in section 2 without changing its character unless such contracts could be applied perfectly. In practice, bond covenants typically do not have the kind of detailed provisions that would be required to tailor investment optimally, instead making their terms contingent on readily measured features of borrower behavior.[15]

As noted by Smith and Warner (1979), and empirically demonstrated by Bradley and Roberts (2004), borrowing rates tend to be lower when financial debt covenants are included in loan contracts, controlling for observable risks. This is consistent with the covenant hypothesis that borrowers receive favorable borrowing rates in return for accepting debt covenants. Therefore, the analysis in Section 2 about the impact of investment credits on borrowing rates carries implications for financial debt covenants, which are extensively explored in Section 4. Financial debt covenants specify one or more accounting index and the thresholds of each variable at the inception of a loan. Each quarter, lenders examine the borrower's financial reports to determine whether the borrower's reported index exceeds the threshold. Upon violation of a financial debt covenant, a borrower is considered in technical default, in which case the lender can demand immediate repayment of a loan. Dichev and Skinner (2002) report that this extreme event rarely happens - instead, the loan terms are typically renegotiated, including the loan covenants. During this process, however, lenders may intervene the borrower's operating decisions by limiting the borrower's ability to make new investments, acquire other firms, or engage in other – possibly value-enhancing – actions. Dichev and Skinner (2002) also find that financial debt covenants are set relatively tight, and technical defaults occur quite frequently (in a typical quarter, about 15-20% of outstanding loans are in technical default), which implies that financial debt covenants provide lenders with at least a partial control over borrower actions that reflect moral hazard.

3.2 Default and bankruptcy

The model presented in section 2 contains a stylized treatment of the consequences of default. In the model, firms that are unable to meet contractual debt obligations become the property of bondholders; this ownership transfer does not otherwise affect the value of the ongoing concern. In practice, firm value may be adversely affected by the displacement of previous owners and by costs incurred during bankruptcy proceedings - and anticipation of such loss in value influences

[14] See, for example, Chen and Wei (1993) and Beneish and Press (1993).

[15] See the evidence reported by Smith and Warner (1979), Kalay (1982), McDaniel (1986), Lehn and Poulsen (1991), and Beneish and Press (1993).

negotiations between defaulting firms and their creditors. Consequently, creditors of financially distressed firms may accept terms in which they are paid less than the value of existing assets.[16]

It is possible to reinterpret the model's parameters to incorporate renegotiation and bankruptcy costs, as well as value transfers between bondholders and shareholders triggered by default. Costs associated with renegotiation and bankruptcy are reflected in reduced values of θ_3. In the model's risk-neutral setting, the prospect of rent transfers from bondholders to shareholders of distressed firms is captured by higher than actual values of θ_2 and corresponding lower values of θ_3. Such changes do not alter the model's properties and implications, though they do affect its empirical application.

3.3 Timing of tax credits

In the two-period model analyzed in section 2, profitable firms receive the benefits of tax credits at the same time that uncertainty is resolved and bondholders are paid. In practice, certain tax credits are available when investments are made and prior to the resolution of uncertainty. There are two significant features of this difference. The first is that it is possible for firms that are ultimately unprofitable to benefit from tax credits if the credits are received enough years prior to subsequent losses that the tax law does not permit the losses to be carried back against the credits. Under U.S. law, net operating losses can be carried back only two years for tax purposes. Hence if an unprofitable firm's losses do not begin in earnest until more than two years after its initial investment, the firm benefits from any first-year credits.

There is a second aspect of tax credits received in the first year of an investment, which is that cash need not be disposed of in ways that are satisfactory to bondholders. In the absence of restrictions, credits received from tax-favored investments may be paid to shareholders as dividends or else invested in ways that benefit shareholders and not bondholders. If the firm defaults within the period of allowable carrybacks, the tax credit takes on the feature of a loan from the government that (from the standpoint of bondholders) shareholders are free to squander. Anticipating this, the bond market demands higher interest rates on loans to firms receiving up-front tax credits. Alternatively, lenders can insist on covenants that restrict the ability of borrowers to pay dividends, but such restrictions introduce other inefficiencies and are often not included in bond contracts.[17]

To formalize these ideas, suppose that n years elapse between initial investment and the

[16] Ang et al. (1982) document the administrative costs of corporate bankruptcies and subsequent liquidations. Franks and Torous (1989), Franks and Torous (1994), Eberhardt et al. (1990), and Weiss (1990) offer evidence of the costs associated with recontracting and reorganization of firms in financial distress, and of value acquisition by shareholders in reorganizations.

[17] Black and Scholes (1973) discuss the endogeneity of bond prices to anticipated dividend payout behavior. Smith and Warner (1979) report that only 23% of the bonds they examine (issued in 1974-75) restrict dividend payments; Kalay (1982) indicates that virtually all of the bond issues he analyzes have covenants limiting dividends; and McDaniel (1986) finds that, of the outstanding bonds of Fortune 100 companies in 1984, only 35% restrict dividend payments, and Lehn and Poulsen (1991) report that, of the bonds they examine, 33% of those issued in 1986 and 45% of those issued in 1989 contain covenants restricting dividend payments. Interestingly, Kalay (1982) finds that most of the firms in his sample pay fewer dividends than their bond covenants permit.

resolution of uncertainty (in the second period). A profitable firm receives a tax credit of $c\beta^{-n}\sigma_1 K$ in the first period, in which $\beta = \frac{1}{1+d} > 0$ is the firm's discount factor, and d its annual rate of discount, so the tax credit is worth $c\sigma_1 K$ in second-period terms. If the firm incurs a loss in the second period, then it is eligible to claim a refund for (nominal) taxes paid earlier. The fact that the firm received the tax credit in the first period reduces its second period refund by $c\beta^{-n}\sigma_1 K$. Consequently, the tax credit is worth $c(1-\beta^{-n})\sigma_1 K$ in present value to a firm that is ultimately unprofitable. $n = \infty$ corresponds to situations in which default occurs beyond the time limit for tax carrybacks.

Consider the case in which a firm receiving a tax credit in the first period allocates a fraction γ of the credit to its shareholders (in the form of dividends), with $(1-\gamma)$ remaining within the firm and therefore accessible to bondholders in the case of default in the second period. In this setting, shareholders benefit from tax credits even if the firm ultimately defaults. Hence, this modification changes equation (1) to:

$$\begin{aligned} \pi^e \quad = \quad & \{[Q(K,c)\theta_1 - r(B,K,c) - \delta K]\,(1-\tau) - B\tau + K + cK\sigma_1\}\,p_1 \\ & + \left\{Q(K,c)\theta_2 - r(B,K,c) + (1-\delta)K + c(1-\beta^{-n})\sigma_1 K\right\}p_2 \\ & + \{\gamma c K\sigma_1\}\,p_3. \end{aligned} \tag{24}$$

Equation (7) is likewise affected, since bond market equilibrium must satisfy:

$$(1+\bar{r})B = (p_1+p_2)r(B,K,c) + p_3\left[Q(K,c)\theta_3 + (1-\delta)K + c(1-\gamma-\beta^{-n})\sigma_1 K\right] \tag{25}$$

Imposing (24) and (25) changes the expression that appears on the right sides of equations (17) and (23); for example, (23) becomes:

$$\begin{aligned} \frac{d\pi^e}{dc}\frac{1}{K} \quad = \quad & \left[p_1 + (1-\beta^{-n})p_2 + \gamma p_3\right]\sigma_1(1-f\eta) \\ & + \sigma_1\frac{p_1(1-\tau)+p_2}{p_1+p_2}(1-\gamma-\beta^{-n}). \end{aligned} \tag{26}$$

The right side of equation (26) exhibits features similar to those of the right sides of (17) and (23). If $n = 0$ and $\gamma = 0$ then of course they are identical. If $n = \infty$ and $\gamma = 0$ then the right side of (26) becomes: $(p_1+p_2)\sigma_1(1 + \frac{p_1(1-\tau)+p_2}{(p_1+p_2)^2} - f\eta)$, so a somewhat larger value of $f\eta$ is required for higher levels of c to be associated with reduced investment and profitability. If $\gamma = (1-\beta^{-n})$, then the right side of (26) becomes $\left[p_1 + (1-\beta^{-n})(p_2+p_3)\right]\sigma_1(1-f\eta)$, and again $f\eta$ =1 is the critical value at which the effect of c on investment and profitability changes sign. What these scenarios illustrate is that the implications of (17) and (23) apply generally to settings in which tax credits are received prior to the resolution of investment uncertainty.

4 Bond Covenants and Borrowing around the Bonus Depreciation Era

This section considers evidence of the behavior of U.S. firms before, during, and after the 2002-2004 bonus depreciation experience. Congress in March 2002 enacted legislation permitting firms to take 30 percent bonus depreciation for equipment investments in assets with depreciable lifetimes of 20 years or less; firms were also entitled to take normal first-year accelerated depreciation on the remaining 70 percent of their basis in new equipment assets. The March 2002 bonus depreciation provision applied retroactively to investments made on or after 11 September 2001; and in May 2003 the bonus amount was increased to 50 percent, a provision that expired at the end of 2004. Bonus depreciation offers a very generous tax incentive for equipment investment, particularly for long-lived equipment for which depreciation deductions would otherwise have a significantly lower present value. As a result, firms can be expected to substitute relatively tax-favored investments for relatively tax-disfavored investments during the bonus depreciation period.

Bondholders have very little interest in firms taking advantage of bonus depreciation to improve their after-tax returns by investing in qualifying long-lived equipment assets, since expected returns to bondholders are maximized by firm actions that maximize the present value of expected pretax profits. Consequently, lenders have incentives to impose greater restrictions on loans during the bonus period than they do at other times; while these restrictions may entail greater costs of impeding efficient ex post decision making and triggering costs associated with recontracting, they address the greater moral hazard introduced by bonus depreciation. As a result of these costs, and the residual inefficiency in investment asset composition due to incentives created by bonus depreciation, firms are also less apt to find it worthwhile to finance their new investments with loans from third parties. The propositions that new loans are more likely to come with restrictions and that there will be fewer new loans are both testable with the available data.

4.1 Data

Data on loan covenants are collected by Dealscan, which is maintained by Thompson Reuters LPC. Dealscan contains detailed information on private debt, including identities of lender and borrowers, loan types, loan maturities, loan inception date, and covenants. Dealscan collects the great majority of loan data from SEC filings, from newspapers, or through LPC's relationships with major banks. Chava and Roberts (2008) and Carey and Hrycray (1999) report that Dealscan coverage includes more than 50-75% of the value of all commercial loans since 1995. Starting in 1993, Dealscan began to include detailed covenant information, which is the most important element in the dataset for our analysis.

Dealscan data are matched with Compustat for borrower information through the company codes from Dealscan-Compustat Link Data created by Michael Roberts. Since the focus of the empirical work is the restrictiveness of new loans, company codes and loan inception dates from Dealscan are matched with company codes and year-quarters from Compustat. The analysis excludes financial firms (SIC codes 6000-6999), as a result of which there remain 6149 firms in the sample. Restricting attention to the years surrounding the 2002-2004 bonus depreciation period - 1999 to 2007 - further reduces the number of firms in the sample to 5064.

The Dealscan data include counts of different types of debt covenants - financial debt covenants, prepayment covenants, dividend covenants, and secured covenants. The focus of the empirical work is on financial debt covenants used by lenders to constrain borrower operations. Other types of debt covenants are typically used to limit the ability of borrowers to distribute resources in a way that is not recoverable by lenders. Dealscan provides 17 different accounting indexes used with financial debt covenants, including current ratio, net worth, EBITDA, and capital expenditure. Table 1 presents summary statistics of firms for which there are both Dealscan and Compustat data, and, for comparison, statistics of Compustat firms.

The left panel of Table 1 presents summary statistics for Compustat firms that have at least one loan reported in Dealscan, while the right panel is for all Compustat firms. The mean and medians across all variables are quite similar, except for mean values of q - which has an extremely high variance. As a general matter, firms for which there are both Dealscan and Compustat data are larger in size, older, and financially stronger than average firms in Compustat. This is consistent with the data collection procedure of Dealscan, since the SEC 10-K filings that serve as the primary source for Dealscan require mandatory reporting only for larger loans.

Among Dealscan-Compustat firms there is a 9.5% chance that at least one loan is reported in a given quarter. Approximately half of these loans (49.9%) have at least one financial covenant attached. The mean number of any financial covenants attached to a loan is 1.43; the mean number of capital expenditure covenants is 0.17; and the mean number of EBITDA covenants is 0.3714.

4.2 Loan Covenants and Bonus Depreciation.

The extent to which loans bear covenant restrictions can be measured four ways, the first of which is simply the number of all financial covenants attached to a loan. Greater numbers of covenants typically offer lenders greater control over borrowers' operating decisions by making technical defaults more likely to occur; Bradley and Roberts (2004) add all financial and non-financial covenants to measure "covenant intensity." A second measure of loan restrictiveness is simply the likelihood that any given loan includes a financial covenant. A third measure of loan restrictiveness is the number of capital expenditure covenants attached to a loan; these typically limit total capital spending. Given the moral hazard introduced by favorable tax treatment of certain classes of capital spending, this type of financial covenant directly addresses an important conflict of interest. And the fourth measure of loan restrictiveness is the number of EBITDA (earnings before interest, taxes, depreciation, and amortization) covenants attached to a loan. Since the moral hazard implied by bonus deprecation has the effect of reducing EBITDA in return for an even greater reduction in taxes, EBITDA restrictions are potentially quite attractive to lenders.

Figure 3 depicts the aggregate use of bond covenants in the Dealscan data between 1999 and 2007, as measured by these four proxies. Across all the four measures, the aggregate restrictiveness of new loans appears countercyclical. This is not surprising, because lenders benefit most from greater control over borrower operations when moral hazard carries the greatest consequences for lenders - and that is when default probabilities are highest, commonly during recessions.

Firms starting at least one new loan between 1999 and 2004 can be classified in three types. Type I firms start at least one new loan in each of two periods: (i) 1999-2001 and (ii) 2002-2004. Type II firms start at least one loan during 1999-2001, but do not start new loans during 2002-2004. Type III firms have no reported loans from 1999-2001, but start at least one new loan during 2002-2004. Table 2 illustrates these classifications.

Due to the somewhat arbitrary nature of the period division, many infrequent borrowers, defined by borrowers whose typical borrowing intervals are longer than 3 years, may be thought of as randomly assigned into all three groups, which are denoted as I-2, II-2, and III-2. What makes one type different from another is, however, the existence of firms with a typical borrowing interval less than 3 years, and their self-selection into three types. That is, some of these firms, denoted as I-1 in Table 2, do stay in the private debt market even during the recession period and start a new loan, while there are other firms, denoted as II-1, which otherwise would have wanted to borrow, but did not do so, during the same period. Therefore, one can expect that only Type I includes frequent borrowers that successfully finance through private debts during the recession period, and Type II includes firms that may have wanted to borrow in 2002-2004, but did not.

Table 3 offers cross-type comparisons for 1999-2001. Table 3 indicates that Type I firms are bigger and financially healthier than other two types; and that Type II firms, compared to Type III firms, are smaller, younger, and financially more constrained.

Table 4 presents aggregate evidence of the dynamics of loan restrictiveness, measured four ways, for each type of firm.

Across all types of firms, loans have more restrictive covenants during the bonus depreciation period. During 1999-2001, the average number of financial covenants attached to a loan for Type I firms is 1.35, but the average rises to 1.51 during the bonus depreciation period. The average subsequently decreases to 1.13 during 2005-2007. Similarly, the likelihood of a loan having at least one covenant to attached to it for Type I firms is 47.25% during 1999-2001, 55.61% during 2002-2004, and 50.92% during 2005-2007. Financial covenants restricting capital expenditures and levels of EBITDA exhibit similar trends.

It is noteworthy that loans taken by Type II and Type III firms include more covenants than those taken by Type I firms for all periods. This is perhaps not surprising, since only Type I includes frequent borrowers who may have higher credit ratings and better ongoing relationships with lenders. It is also significant that differences in numbers of financial covenants between Type I and Type II prior to the introduction of bonus depreciation are generally larger than the differences between Type I and Type III during the bonus depreciation period. Coupled with the observation from Table 3 that Type II is the financially weakest group, it suggests that, being financially constrained, firms that drop out of the private debt market during the bonus period (and thus are included in Type II by construction) would have been offered more restrictive loan terms than they could afford.

In estimating the impact of tax policy on borrowing restrictions, it is helpful to distinguish firms by the extent to which they are financially constrained and the extent to which their assets are likely to be affected by tax changes. Firms subject to greater financial constraints are at greater risk of bankruptcy than are other firms, and are therefore trigger the most concern for lenders. A recent study by Hadlock and Pierce (2010) proposes a financial constraint index consisting solely of information on a firm's size and age; Hadlock and Pierce argue that, among the available alternatives, this index is the least likely to suffer from problems associated with endogenous financial decisions. The Hadlock and Pierce ("S-A") measure is: (-0.737* size) + (0.043* size^2) - (0.040*age): so that the higher is the S-A index of a firm, the more financially constrained it is. Presumably, lenders have more serious concerns over firms with higher measured values of the S-A index.

Firms whose balance sheets contain larger fractions of longer-lived capital assets benefit the most from bonus depreciation and have production technologies that can accommodate greater shifting of assets to tax-preferred categories in response to tax changes. In the Compustat data, capital intensity is measured as the ratio of after-depreciation plant and equipment to total assets in 2000 (the same ratio constructed using 1998 data serves as a robustness check), so higher measured capital intensity implies an emphasis on longer-lived assets. As a result of the introduction of bonus depreciation, lenders are apt to be most concerned with financially constrained firms of high capital intensity, and attempt to place new restrictions on their borrowing.

Figure 4 compares the trends in the aggregate use of debt covenants by firms prone to asset-substitution with the aggregate use of debt covenants by other firms. For the purpose of Figure 4, firms are classified as prone to asset-substitution if their average SA indexes and capital intensities both lie in the top 1/3 of the sample firms. The aggregate use of debt covenants by firms prone to asset-substitution (596 firms) peaked during the 2002-2004 bonus depreciation period, whereas this bunching of debt covenant use is much less pronounced among unconstrained firms (4468 firms).

To examine the impact of bonus depreciation on private debt market participation, the baseline empirical equation is:

$$\begin{aligned}\text{Restrictiveness}_{it} = b_0 + b_1 \cdot \text{Bonus}_t + b_2 \cdot \text{SA}_{it} + b_3 \cdot \text{CI}_i + b_4 \cdot \text{Bonus}_t * \text{SA}_{it} \\ + b_5 \cdot \text{Bonus}_t * \text{CI}_i + b_6 \cdot \text{SA}_{it} * CI_i + b7 \cdot \text{Bonus}_t * \text{SA}_{it} * \text{CI}_i \\ + b_8 \cdot q_{it} + b_9 \cdot \text{LoanAmount}_{it} + \text{firm-fixed}_i + \text{time-fixed}_t + \epsilon_{it}\end{aligned} \quad (27)$$

where $\text{Restrictiveness}_{it}$ is the dependent variable for loan restrictiveness measured in the four different ways described above, Bonus_t is a time dummy equal to one when the year-quarter lies in the period 2001.Q4 to 2004.Q4, and SA_{it} and CI_i are Size-Age index and Capital intensity, respectively.[18] In order to control for a potential relationship between the number of debt covenants and the size of a loan, the equation also includes LoanAmount_{it}, measured as the total size of private loans firm i starts at time t, divided by total assets.[19]

Note that, in order to measure the restrictiveness of loans, the sample for this regression includes only firms starting at least one new loan from 1999-2007. This restriction may introduce some bias due to the omission of observations of characteristics of loans that were discouraged by the introduction of bonus depreciation, though this generally works against the findings that appear in the regression tables.

The first panel of Table 5, consisting of Columns (1) to (2), presents estimated coefficients from regressions that examine average numbers of financial debt covenants attached to a loan. Column (1) reports estimated coefficients from a panel regression, with all types of firms, using firm and year fixed effects. The coefficient on the variable of primary interest, $\text{Bonus}_t*\text{SA}_{it}*\text{CI}_i$, is estimated to be 0.3081 and statistically significant. To interpret this result it is necessary also to consider the coefficient on $\text{Bonus}_t*\text{CI}_i$, which is estimated to be 1.0957, also significantly different from zero. An increase in capital intensity index by 1 is correlated with an increase in the number of covenants attached to a loan by 1.0957 during the bonus period. Since the standard deviation of capital intensity is around 0.25 (see Table 1), a one standard deviation increase in capital intensity is correlated with a 0.275 (=1.0957 * 0.25) increase in the number of covenants. The sign and significance of the 0.3081 coefficient suggests that the increase correlated with capital intensity is even more pronounced among financially constrained firms. That is, compared to a firm in the 25th percentile of SA index (-3.7640), a firm in the 75th percentile of SA index (-2.6978) would have on average 0.357 (= 0.275 + 0.3081*0.25*1.0664) more covenants, rather than 0.275, when its capital intensity increases by 0.25 (one standard deviation increase).

The second panel of Table 5 presents estimated coefficients from regressions in which the dependent variable is the likelihood of a firm having a loan which has at least one covenant attached to it. The signs of the estimated coefficients are consistent with the hypothesis that the introduction of bonus depreciation increased the likelihood that firms for which the accompanying moral hazard is more costly to lenders are the most likely to borrow with covenants, though the relevant coefficients (0.0504 and 0.0660) are statistically indistinguishable from zero. The larger estimated magnitude and greater statistical strength of the results reported in the first panel of the table suggests that the effects of bonus depreciation on the use of loan covenants materializes largely among firms that are in sufficiently precarious financial positions that their loans have covenants prior to the introduction of bonus depreciation.

The third and fourth panels of Table 5 present coefficients from regressions using the same

[18]Note that capital intensity, being time-invariant (it is measured in year 2000), is omitted due to the inclusion of firm fixed effects. The Size-Age index is included in the empirical equation, but has very little effect on the regression results, reflecting that the Size-Age index is quite stable over time.

[19]The other coefficient estimates reported in Table 5 change very little when the equations are rerun omitting the LoanAmount_{it} variable.

independent variables as those presented in the first panel, but with the number of Capital Expenditure covenants as the dependent variable in the third panel and EBITDA covenants as the dependent variable in the fourth panel. The tax policy-related coefficients remain significant but decline in magnitude, reflecting the lower mean values of these dependent variables. Thus, the coefficient on the interaction of bonus depreciation, the S-A index, and capital intensity in the Capital Expenditure covenants regressions is 0.1021, which suggests that a firm in the 75th percentile of SA index, compared to a firm in the 25th percentile of SA index, is expected to have 0.116 (=0.3582*0.25 + 0.1021*0.25*1.0664) more Capital Expenditure covenants during the bonus depreciation period. This compares to an implied effect of 0.089 (=0.3582*0.25) when its capital intensity increases by 0.25 (one standard deviation increase). In the same situation, the firm is expected to have 0.132 (=0.3971*0.25 + 0.1277*0.25* 1.0664) more EBITDA covenants, rather than 0.098 (=0.3971*0.25).

These estimates imply that the combined impact on the number of Capital Expenditure covenants as well as on the number of EBITDA covenants explains two-thirds on the impact on the total number of covenants attached to a loan: that is, 0.3081 ≈ 2/3*(0.1021 + 0.1277). Given that Capital Expenditure and EBITDA covenants are not the most frequently used covenants, this pattern is consistent with an interpretation that these two types of covenants may have been used particularly to control for moral hazard problems aggravated by bonus depreciation.

4.3 Bonus Depreciation and Borrowing

The greater moral hazard introduced by bonus depreciation raises the cost of borrowing and thereby discourages the likelihood and level of borrowing. It is possible to use the Dealscan and Compustat data to measure the extent to which corporate borrowing declined during 2002-2004, particularly among firms most apt to be affected by the tax change.

One important measure of borrowing is whether a firm takes a new loan in a given quarter. Tax effects can be measured by the following empirical equation:

$$\begin{aligned}\text{BorrowingDummy}_{it} = b_0 + b_1 \cdot \text{Bonus}_t + b_2 \cdot \text{SA}_{it} + b_3 \cdot \text{CI}_i + b_4 \cdot \text{Bonus}_t * \text{SA}_{it} \\ +b_5 \cdot \text{Bonus}_t * \text{CI}_i + b_6 \cdot \text{SA}_{it} * CI_i + b7 \cdot \text{Bonus}_t * \text{SA}_{it} * \text{CI}_i \\ +b_8 \cdot q_{it} + \text{firm-fixed}_i + \text{time-fixed}_t + \epsilon_{it} \qquad (28)\end{aligned}$$

in which $\text{BorrowingDummy}_{it}$ is dummy for whether firm i starts a new loan at time t, and the independent variables are the same as in prior equations. The intuition behind the specification of equation (28) resembles that underlying equation (27). The more financially constrained and capital-intense a firm is, the more likely it faces restrictive loan contracts with borrowing terms that contain high default premiums. Consequently, these firms are more likely than others either not to invest or to finance their investments with equity or retained earnings.

The first three columns of Table 6 report estimated coefficients from linear probability regressions in which the dependent variable takes the value one if a firm has a Dealscan-reported loan in a quarter, and zero otherwise. In the regression reported in Column (1), the -0.0287 coefficient on the interaction of bonus depreciation, the S-A index, and capital intensity suggests that, during the bonus depreciation period, a firm at the 75th percentile of SA index is 0.76% point (0.0287*0.25*1.0664) less likely to borrow from the private debt market than a firm at the 25th percentile of SA index when its capital intensity increases by 0.25 (one standard deviation increase of capital intensity). Controlling for industry-specific shocks, column (2) reports a similar set of coefficients as column (1).

The fixed-effects logit regressions reported in columns (3) and (4) report similar patterns. In the specification reported in Column (3), the coefficient on Bonus_t*CI_i is estimated to be -2.0369. Thus, one standard deviation increase, or 0.25, in capital intensity reduces the odds of financing through private debt by 40% (=1-exp(-2.0369*0.25)). In addition, the coefficient on the interaction of bonus depreciation, the S-A index, and capital intensity, Bonus_t*SA_{it}*CI_i, is estimated to be -0.5527. Thus, compared to a firm with an average SA index, a firm with an SA index one standard deviation higher has a 14% = (1- exp (-0.5527*0.25*1.0664)) reduced chance of borrowing during the bonus depreciation period.[20]

Although the empirical work focuses on behavior in private debt markets, borrowers have the option of turning to the public debt market instead. There are two reasons, however, why this type of substitution is unlikely to offer a satisfactory substitute for expensive and constrained private borrowing. First, as noted by "pecking order" theory of finance, there is a significant entry barrier for lower-credit borrowers to enter the public debt markets, so firms that are most affected by potential moral hazard considerations are the least likely to be able to access public debt markets. Second, public debt participants have the same moral hazard concerns as private lenders, and are just as likely to require covenants and high default premiums in response to the introduction of bonus depreciation.

It is instructive to consider the determinants of total borrowing reported by Compustat, and to compare the results with those obtained using the Dealscan private debt data. Net debt issuance is measured two ways, using the Compustat data and following Kahle and Stulz (2010). The first debt issuance measure is long-term debt issuance minus retirement, both of which come from firms' cash flow statements. Specifically, the first measure is calculated as long term debt issuance minus long term debt retirement divided by lagged assets. Significantly, this includes information only on long term debt. The second measure comes from firms' balance sheets. With current liabilities information, the second measure includes short-term debt issuance as well, calculated as changes in long-term debt and debt in current liabilities divided by lagged assets.[21]

[20] One might argue that the relation between private debt market *participation* and tax policy does not necessarily imply that the *size* of private debt is also sensitive to tax policy. Table 7 reports the results of estimating regressions similar to equation (28), using Loan Amount_{it} as a dependent variable. Column (1) presents coefficients estimated from a linear regression. The sign and significance of the coefficient on Bonus_t*SA_{it}*CI_i are as expected. Since the dependent variable is zero for many of the observations, it is also useful to estimate a Tobit regression, the coefficients of which are presented in column (2), and are qualitatively similar to those appearing in column (1).

[21] See Appendix for variable descriptions in detail.

The regressions reported in Table 8 estimate the following equation:

$$\begin{aligned}\text{DebtIssuance}_{it} = b_0 + b_1 \cdot \text{Bonus}_t + b_2 \cdot \text{SA}_{it} + b_3 \cdot \text{CI}_i + b_4 \cdot \text{Bonus}_t * \text{SA}_{it} \\ + b_5 \cdot \text{Bonus}_t * \text{CI}_i + b_6 \cdot \text{SA}_{it} * CI_i + b7 \cdot \text{Bonus}_t * \text{SA}_{it} * \text{CI}_i \\ + b_8 \cdot q_{it} + \text{firm-fixed}_i + \text{time-fixed}_t + \epsilon_{it}\end{aligned} \tag{29}$$

Net total debt issuance is the dependent variable in the regressions reported in the first two columns of Table 8, while net long-term debt issuance is the dependent variable in the regressions reported in Columns (3) and (4). Column (1) presents the results of estimating the equation with data from 1999 to 2005 (that is, before and during the bonus depreciation period), and offers evidence that capital-intensive financially constrained firms are less likely than others to issue debt during the bonus depreciation period. Column (2) reports estimated coefficients from estimating the equation over the full sample period from 1999 to 2007, in which the estimated coefficient on the interaction variable of interest is statistically indistinguishable from zero, suggesting that the apparent impact of bonus depreciation on total debt issuance as measured by Compustat variables is highly sensitive to the time period of the estimation. The regressions reported in Columns (3) and (4) offer qualitatively similar findings for long term debt issuance. It is not clear whether the difference between the findings using the Dealscan and Compustat variables for the 1999-2007 sample period reflects differences in firm coverage, noisiness in construction of the dependent variables, or possibly behavioral effects in which average borrowing by all Compustat firms is less affected by tax-induced moral hazard than is private borrowing by Dealscan firms. The bond covenant evidence is clearly consistent with higher borrowing costs in the bonus depreciation period, though how large an impact these higher costs have on amounts borrowed is more difficult to identify clearly.

5 Conclusion

The availability of tax subsidies for investments in some assets and not others gives firms incentives to change the composition of their investments. Such substitution is inefficient, and, if anticipated, will raise borrowing costs, reduce the payoff to new investments, and thereby reduce the stimulatory effect of investment credits on aggregate investment. This effect is so strong that there are plausible circumstances in which greater investment credits are associated with reduced aggregate investment.

Aggregate investment studies typically find only limited evidence of stimulatory effects of tax subsidies on investment. Studies of disaggregated investment behavior report significant tax effects that reflect, at least in part, the ability of investors to substitute some asset types for others. The aggregate findings are consistent with firm-level evidence if asset substitutability reduces the aggregate effect of tax credits targeted at specific categories of investments. Evidence from borrowing behavior around the introduction of bonus depreciation for U.S. equipment investment conforms to predictions of the model. Corporate bonds contained greater numbers of restrictive covenants during the period in which U.S. tax policy distorted the composition of U.S. investment in favor of equipment; furthermore, it appears that corporate borrowing declined during this period. These effects were most pronounced for firms in precarious financial positions and those whose investments where most apt to be affected by the tax incentives.

The unequal taxation of differing assets is understood to distort the allocation of resources in society, and there are numerous studies of the magnitudes of these distortions in various settings.[22] Summers (1987) challenges their implications, arguing that, since economies generally underinvest due to tax and other distortions, policies that affect the rate of investment have far greater influence on economic welfare than do policies that affect the composition of investment. What is not generally appreciated is the connection between these two considerations, that the distortionary nature of many tax subsidies influences the level as well as the composition of investment. Bond covenants impose costly restrictions, so are used only when lenders are sufficiently concerned about moral hazard that they feel the costs are worth paying. The greater use of bond covenants when firms were entitled to bonus depreciation, and accompanying drop in borrowing, are consistent with a model in which concerns about asset substitution increased the cost of debt-financed investment, thereby reducing the aggregate stimulatory effect of investment incentives.

[22]See, for example, Harberger (1966), Shoven (1976), Boadway (1978), Gravelle (1981), Auerbach (1983), Auerbach (1989), Jorgenson and Yun (1986), Jorgenson and Yun (1990), Feldstein (1999) and Chetty (2009).

References

Altshuler, Rosanne and Alan J. Auerbach, "The significance of tax law asymmetries: An empirical investigation," *Quarterly Journal of Economics*, 1990, *105* (1), 61–86.

_ **and Jason G. Cummins**, "Tax policy and the dynamic demand for domestic and foreign capital by multinational corporations," *Technical Committee on Business Taxation, Ottawa, Canada*, 1997, *working paper 97-4.*

Ang, James, Jess Chua, and John McConnell, "The administrative costs of corporate bankruptcy: A note," *Journal of Finance*, 1982, *37* (1), 219–226.

Auerbach, Alan J., "Corporate taxation in the United States," *Brookings Papers on Economic Activity*, 1983, (2), 451–513.

_ , "The dynamic effects of tax law asymmetries," *Review of Economic Studies*, 1986, *53* (2), 205–225.

_ , "The deadweight loss from 'non-neutral' capital income taxation," *Journal of Public Economics*, 1989, *40* (1), 1–36.

_ **and David Reishus**, "The effects of taxation on the merger decision," in Alan J. Auerbach, ed., *Corporate Takeovers: Causes and Consequences*, Chicago: University Of Chicago Press, 1991.

_ **and James M. Poterba**, "Tax loss carryforwards and corporate tax incentives," in Martin Feldstein, ed., *The Effects of Taxation on Capital Accumulation*, Chicago: University of Chicago Press, 1987.

_ **and Kevin A. Hassett**, "Tax policy and business fixed investment in the United States," *Journal of Public Economics*, 1992, *47* (2), 141–170.

Barclay, Michael J. and Clifford W. Smith, "The maturity structure of corporate debt," *Journal of Finance*, 1995, *50* (2), 609–631.

Beneish, Massod D. and Eric Press, "Costs of technical violation of accounting-based debt covenants," *Accounting Review*, 1993, *68* (2), 233–257.

Berlin, Mitchell and Jan Loeys, "Bond covenants and delegated monitoring," *Journal of Finance*, 1988, *43* (2), 397–412.

Black, Fischer and Myron Scholes, "The pricing of options and corporate liabilities," *Journal of Political Economy*, 1973, *81* (3), 637–654.

Boadway, Robin, "Investment incentives, corporate taxation, and efficiency in the allocation of capital," *Economic Journal*, 1978, *88* (351), 470–481.

Bradley, Michael and Michael R. Roberts, "The structure and pricing of corporate debt covenants," *Duke University Working Paper*, 2004.

Carey, Mark and Mark Hrycray, "Credit flow, risk, and the role of private debt in capital structure," *Federal Reserve Board Working Paper*, 1999.

— , Mitch Post, and Steven A. Sharpe, "Does corporate lending by banks and finance companies differ? Evidence on specialization in private debt contracting," *Journal of Finance*, 1998, *53* (3), 845–878.

Chava, Sudheer and Michael R. Roberts, "How does financing impact investment? The role of debt covenants," *Journal of Finance*, 2008, *63* (5), 2085–2121.

Chen, Kevin and John Wei, "Creditors' decisions to waive violations of accounting-based debt covenants," *Accounting review*, 1993, *68* (2), 218–232.

Chetty, Raj, "Is the taxable income elasticity sufficient to calculate deadweight loss? The implications of evasion and avoidance," *American Economic Journal: Economic Policy*, 2009, *1* (2), 31–52.

Chirinko, Robert S., "Business fixed investment spending: Modeling strategies, empirical results, and policy implications," *Journal of Economic literature*, 1993, *31* (4), 1875–1911.

Cummins, Jason G., Kevin A. Hassett, and Glenn R. Hubbard, "A reconsideration of investment behavior using tax reforms as natural experiments," *Brookings Papers on Economic Activity*, 1994, (2), 1–74.

Cutler, David M., "Tax reform and the stock market: An asset price approach," *American Economic Review*, 1988, *78* (5), 1107–1117.

DeAngelo, Harry and Ronald W. Masulis, "Optimal capital structure under corporate and personal taxation," *Journal of Financial Economics*, 1980, *8* (1), 3–29.

Dewatripont, Mathias and Jean Tirole, "A theory of debt and equity: Diversity of securities and manager-shareholder congruence," *Quarterly Journal of Economics*, 1994, *109* (4), 1027–1054.

Dichev, Ilia D. and Douglas J. Skinner, "Large-sample evidence on the debt covenant hypothesis," *Journal of Accounting Research*, 2002, *40* (4), 1091–1123.

Djankov, Simeon, Tim Ganser, Caralee McLiesh, Rita Ramalho, and Andrei Schleifer, "The Effect of Corporate Taxes on Investment and Entrepreneurship," *American Economic Journal: Macroeconomics*, 2010, *2* (3), 31–64.

Eberhardt, Allan C., William T. Moore, and Rodney L. Roenfeldt, "Security pricing and deviations from the absolute priority rule in bankruptcy proceedings," *Journal of Finance*, 1990, *45* (5), 1457–1469.

Edgerton, Jesse, "Investment incentives and corporate tax asymmetries," *Journal of Public Economics*, 2010, *94* (11-12), 936–952.

Feldstein, Martin S., "Tax avoidance and the deadweight loss of the income tax," *Review of Economics and Statistics*, 1999, *81* (4), 674–680.

Franks, Julian R. and Walter N. Torous, "An empirical investigation of U.S. firms in reorganization," *Journal of Finance*, 1989, *44* (3), 747–769.

— and — , "A comparison of financial recontracting in distressed exchanges and Chapter 11 reorganizations," *Journal of Financial Economics*, 1994, *35* (3), 349–370.

Gertner, Robert and David Scharfstein, "A theory of workouts and the effects of reorganization law," *Journal of Finance*, 1991, *46* (4), 1189–1222.

Gilson, Stuart C., "Bankruptcy, boards, banks, and blockholders:: Evidence on changes in corporate ownership and control when firms default," *Journal of Financial Economics*, 1990, *27* (2), 355–387.

Goolsbee, Austan, "Investment tax incentives, prices, and the supply of capital goods," *Quarterly Journal of Economics*, 1998, *113* (1), 121–148.

Graham, John R., "Debt and the marginal tax rate," *Journal of Financial Economics*, 1996, *41* (1), 41–73.

_ , "How big are the tax benefits of debt?," *Journal of Finance*, 2000, *55* (5), 1901–1941.

Gravelle, Jane G., "The social cost of nonneutral taxation: Estimates for nonresidential capital," in Charles R. Hulten, ed., *Depreciation, inflation, and the taxation of income from capital*, Washington, DC: Urban Institute, 1981.

Green, Richard C., "Investment incentives, debt, and warrants," *Journal of Financial Economics*, 1984, *13* (1), 115–136.

Grossman, Sanford J. and Oliver D. Hart, "Corporate financial structure and managerial incentives," in John J. McCall, ed., *The economics of information and uncertainty*, Chicago: University of Chicago Press, 1982.

Hadlock, Charles J. and Joshua R. Pierce, "New evidence on measuring financial constraints: moving beyond the KZ index," *Review of Financial Studies*, 2010, *23* (5), 1909–1940.

Hall, Robert E. and Dale W. Jorgenson, "Tax policy and investment behavior," *American Economic Review*, 1967, *57* (3), 391–414.

_ **and** _ , "Application of the theory of optimum capital accumulation," in Gary Fromm, ed., *Tax Incentives and Capital Spending*, Washington, DC: Brookings, 1971.

Harberger, Arnold C., "Efficiency effects of taxes on income from capital," in Marian Krzyzaniak, ed., *Effects of corporation income tax*, Detroit: Wayne State University Press, 1966.

Hart, Oliver and John Moore, "A theory of debt based on the inalienability of human capital," *Quarterly Journal of Economics*, 1994, *109* (4), 841–879.

_ **and** _ , "Debt and seniority: An analysis of the role of hard claims in constraining management," *American Economic Review*, 1995, *85* (3), 567–585.

Hassett, Kevin A. and Glenn R. Hubbard, "Tax policy and business investment," in Alan J. Auerbach and Martin Feldstein, eds., *Handbook of Public Economics*, Vol. 3, Elsevier, 2002, pp. 1293–1343.

Hines, James R., Jr., "Credit and deferral as international investment incentives," *Journal of Public Economics*, 1994, *55* (2), 323–347.

_ , "Altered states: Taxes and the location of foreign direct investment in America," *American Economic Review*, 1996, *86* (5), 1076–1094.

_ **and Eric M. Rice**, "Fiscal paradise: Foreign tax havens and American business," *Quarterly Journal of Economics*, 1994, *109* (1), 149–182.

Honoré, Bo E., "Trimmed LAD and least squares estimation of truncated and censored regression models with fixed effects," *Econometrica*, 1992, *60* (3), 533–565.

Hotchkiss, Edith Shwalb, "Postbankruptcy performance and management turnover," *Journal of Finance*, 1995, *50* (1), 3–21.

House, Christopher L. and Matthew D. Shapiro, "Temporary investment tax incentives: Theory with evidence from bonus depreciation," *American Economic Review*, 2008, *98* (3), 737–768.

Jensen, Michael C. and William H. Meckling, "Theory of the firm: Managerial behavior, agency costs and ownership structure," *Journal of Financial Economics*, 1976, *3* (4), 305–360.

Jorgenson, Dale W. and Kun-Young Yun, "Tax policy and capital allocation," *Scandinavian Journal of Economics*, 1986, *88* (2), 355–377.

_ **and** _ , "Tax reform and U.S. economic growth," *Journal of Political Economy*, 1990, *98* (5), S151–S193.

Kahle, Kathleen M. and Rene M. Stulz, "Financial policies and the financial crisis: How important was the systemic credit contraction for industrial corporations?," *NBER Working Papers W16310*, 2010.

Kalay, Avner, "Stockholder-bondholder conflict and dividend constraints," *Journal of Financial Economics*, 1982, *10* (2), 211–233.

Kwan, Simon H., "Firm-specific information and the correlation between individual stocks and bonds," *Journal of Financial Economics*, 1996, *40* (1), 63–80.

Lehn, Kenneth and Annette Poulsen, "Contractual resolution of bondholder-stockholder conflicts in leveraged buyouts," *Journal of Law and Economics*, 1991, *34* (2), 645–673.

Majd, Saman and Stewart C. Myers, "Tax asymmetries and corporate tax reform," in Martin Feldstein, ed., *The effects of taxation on capital accumulation*, Chicago: University of Chicago Press, 1987.

McDaniel, Morey W., "Bondholders and corporate governance," *Business Lawyer*, 1986, *41*, 413–460.

Miller, Merton H., "Debt and taxes," *Journal of Finance*, 1977, *32* (2), 261–275.

Mintz, Jack, "An empirical estimate of corporate tax refundability and effective tax rates," *Quarterly Journal of Economics*, 1988, *103* (1), 225–231.

Modigliani, Franco and Merton H. Miller, "Corporate income taxes and the cost of capital: a correction," *American Economic Review*, 1963, *53* (3), 433–443.

Myers, Stewart C., "The determinants of corporate borrowing," *Journal of Financial Economics*, 1977, *5* (2), 147–175.

Shoven, John B., "The incidence and efficiency effects of taxes on income from capital," *Journal of Political Economy*, 1976, *84* (6), 1261–1283.

Smith, Clifford W. and Jerold B. Warner, "On financial contracting: An analysis of bond covenants," *Journal of Financial Economics*, 1979, *7* (2), 117–161.

Standard and Poor's, *Standard and Poor's security price index record*, New York: Standard and Poor's, 1988.

Stiglitz, Joseph E., "Taxation, corporate financial policy, and the cost of capital," *Journal of Public Economics*, 1973, *2* (1), 1–34.

Summers, Lawrence H., "Should tax reform level the playing field?," in "Proceedings of the seventy-ninth annual conference" National Tax Association 1987.

Weiss, Lawrence A., "Bankruptcy resolution:: Direct costs and violation of priority of claims," *Journal of Financial Economics*, 1990, *27* (2), 285–314.

Table 1: Summary statistics

	Panel A: Dealscan-Compustat (6149 firms)			Panel B: Compustat (10044 firms)		
	mean	std. dev.	median	mean	std. dev.	median
Investment	.0772	.1043	.0452	.0852	.1248	.0439
q	2.3258	12.6889	1.3224	5.8444	150.1638	1.4385
Size	5.6809	1.9025	5.7274	4.9336	2.3448	5.0031
Age	14.4514	12.8791	9.0000	12.3693	12.3214	7.0000
Size-Age Index	-3.2235	.8499	-3.1612	-2.8477	1.1360	-2.9270
Capital Intensity	.3165	.2443	.2460	.3019	.2541	.2191
Total-Debt-to Asset (Stock)	.6402	3.3129	.5692	1.1069	21.0548	.5226
Net Total-Debt Issuance (Flow)	.0105	.2126	.0000	.0101	.2217	.0000
Net Long-Term-Debt Issuance (Flow)	.0071	.1235	.0000	.0182	1.5050	.0000
Likelihood of Having a Dealscan Loan in a Given Quarter	.0949	.2930	.0000			
Average Number of Any Covenants Attached to a Loan	1.4287	1.6754	1.0000			
Likelihood of Having Any Covenants Attached to a Loan	.4991	.4921	.5000		N/A	
Average Number of CapEx Covenants Attached to a Loan	.1706	.3716	.0000			
Average Number of EBITDA Covenants Attached to a Loan	.3714	.6255	.0000			

Note: The table presents summary statistics for firms in the Dealscan-Compustat merged sample (panel A) and for firms in the Compustat sample (panel B) from 1999 to 2001. Financial firms are excluded. Variable descriptions appear in Appendix.

Table 2: Illustration of firm-types

Type	Sub-type	Frequent Borrower	Actual Borrowing: Before Bonus 1999-2001	Actual Borrowing: After Bonus 2002-2004	"Drop-outs"
I	I-1	Yes (actual)	O	O	No
	I-2	No	O	O	
II	II-1	Yes (would-have-been)	O	X	Yes
	II-2	No	O	X	No
III	III-2	No	X	O	No

Note: The table illustrates firm types assigned based on whether a firm starts a new loan before the bonus period, during the bonus period, or both. Frequent borrowers are defined as those firms having a typical borrowing interval less than 3 years. Drop-outs are defined as those firms who would have borrowed during the 2002-2004 period, but did not.

Table 3: Firm characteristics comparison across firm types

Panel A presents summary statistics for firms in the Dealscan-Compustat merged sample from 1999 to 2001. Type I includes firms that have started at least one new loan during each period, before and during the bonus period. Type II includes firms that have started at least one new loan before the bonus depreciation period (1999.Q1 to 2001.Q3) the bonus depreciation period (2001.Q4 to 2004.Q4), but have not started a loan during the bonus period. Type III includes firms that have started at least one new loan only during the bonus depreciation period. Panel B compares Type II firms and Type III firms. *, **, *** indicate significance at the 10%, 5%, 1% level, respectively. Variable descriptions appear in Appendix.

Variables	Panel A			Panel B
	Type I	Type II	Type III	Type II vs. Type III Comparison
Number of Firms	2151	1430	1146	
Size	6.6065	5.3648	5.4759	0.1110***
Age	16.8028	12.0449	14.8076	2.7632**
Size-Age Index	-3.5588	-3.0617	-3.1957	-.1340***
Capital Intensity	.3508	.3036	.3161	.0124***
log(Total Assets)	6.6638	5.2522	5.3352	.0829***
log(Property, plant and equipment)	5.2974	3.6538	3.8183	.1644***
Debt to Asset Ratio	.6200	.5874	.6225	.0351***
Likelihood of Starting a New Loan	.1763	.1383	n/a	n/a
Net Long Term Debt Issuance to Asset	.0104	.0113	.0035	-.0078***
Net Total Debt Issuance to Asset	.0153	.0155	.0096	-.0059*

Table 4: Debt restrictiveness comparison across firm types

This table presents comparisons of debt covenant intensity among the three types of firms. Panel A uses the average number of total financial covenants attached to a loan as the proxy for debt covenant intensity. Panel B uses the likelihood of a loan having at least one debt covenant as the proxy for debt covenant intensity. Panel C uses the average number of Capital Expenditure covenants attached to a loan as the proxy for debt covenant intensity. Panel D uses the average number of EBITDA financial covenants attached to a loan as the proxy for debt covenant intensity. Type I includes firms that have started at least one new loan during each period, before and during the bonus period. Type II includes firms that have started at least one new loan before the bonus depreciation period (1999.Q1 to 2001.Q3) the bonus depreciation period (2001.Q4 to 2004.Q4), but have not started a loan during the bonus period. Type III includes firms that have started at least one new loan only during the bonus depreciation period. The first column compares the average number of total financial covenants between Type I and Type II before the bonus depreciation period. The second column compares the average number of total financial covenants between Type I and Type III during the bonus depreciation period. The third column calculates the differences in the average of each column. The fourth compares the average number of total financial covenants among the three types. *, **, *** indicate significance at the 10%, 5%, 1% level, respectively. Variable descriptions appear in Appendix.

Panel A. Average Number of Total Financial Covenants Attached to a Loan

Firm Types	Before Bonus	During Bonus	Differences	After Bonus
Type I	1.3536	1.5071	.1534 (.0367)***	1.1301
Type II (before) Type III (during)	1.5651 (Type II)	1.6681 (Type III)	.1030 (.0612)*	1.4234 (Type II); 1.2966 (Type III)

Panel B. Likelihood of Having Any Covenant Attached to a Loan

Firm Types	Before Bonus	During Bonus	Differences	After Bonus
Type I	.4725	.5561	.0836 (.0111)***	.5092
Type II (before) Type III (during)	.5423 (Type II)	.6170 (Type III)	.0747 (.0176)***	.5793 (Type II); .5515 (Type III)

This table presents comparisons of debt covenant intensity among the three types of firms. Panel A uses the average number of total financial covenants attached to a loan as the proxy for debt covenant intensity. Panel B uses the likelihood of a loan having at least one debt covenant as the proxy for debt covenant intensity. Panel C uses the average number of Capital Expenditure covenants attached to a loan as the proxy for debt covenant intensity. Panel D uses the average number of EBITDA financial covenants attached to a loan as the proxy for debt covenant intensity. Type I includes firms that have started at least one new loan during each period, before and during the bonus period. Type II includes firms that have started at least one new loan before the bonus depreciation period (1999.Q1 to 2001.Q3) the bonus depreciation period (2001.Q4 to 2004.Q4), but have not started a loan during the bonus period. Type III includes firms that have started at least one new loan only during the bonus depreciation period. The first column compares the average number of total financial covenants between Type I and Type II before the bonus depreciation period. The second column compares the average number of total financial covenants between Type I and Type III during the bonus depreciation period. The third column calculates the differences in the average of each column. The fourth compares the average number of total financial covenants among the three types. *, **, *** indicate significance at the 10%, 5%, 1% level, respectively. Variable descriptions appear in Appendix.

Panel C. Average Number of Capex Covenants Attached to a Loan

Firm Types	Before Bonus	During Bonus	Differences	After Bonus
Type I	.1433	.1812	.0379 (.0082)***	.1092
Type II (before) Type III (during)	.2196 (Type II)	.2401 (Type III)	.0205 (.0152)*	.1549 (Type II); .1462 (Type III)

Panel D. Average Number of EBITDA Covenants Attached to a Loan

Firm Types	Before Bonus	During Bonus	Differences	After Bonus
Type I	.3681	.4598	.0917 (.0147)***	.3995
Type II (before) Type III (during)	.3692 (Type II)	.4892 (Type III)	.1200 (.0240)*	.5424 (Type II); .4429 (Type III)

Table 5: Regressions of debt covenant intensity during the 1999-2007 period

The sample consists of firms in the Dealscan-Compustat merged sample that have borrowed at least once during the 1999-2007 period. The table presents regression results of debt covenant intensity. The dependent variable of column (1) - (2) is the average number of total financial covenants attached to a loan; the dependent variable of column (3) - (4) is the likelihood of a loan having at least one covenant; the dependent variable of column (5) - (6) is the average number of Capital Expenditure covenants attached to a loan; and the dependent variable of column (7) - (8) is the average number of EBITDA covenants attached to a loan. The specifications in the even-numbered columns also include industry-year fixed effects to absorb industry-wide shocks. *, **, *** indicate significance at the 10%, 5%, 1% level, respectively. All standard errors are clustered at the firm-level. Variable descriptions appear in Appendix.

Dependent Variable:	Total Number of Covenants		Likelihood to Have Covenants		CapEx Covenants		EBITDA Covenants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
S-A	.0771	-.3300	.0771	-.0350	.0135	-.0308	-.3491***	-.4447***
	(.2239)	(.2407)	(.0638)	(.0695)	(.0538)	(.0612)	(.0963)	(.1075)
S-A * C-I	-.0808	.1519	.1306	.2337	-.0277	-.0150	.0314	.1316
	(.3838)	(.4760)	(.1248)	(.1490)	(.0902)	(.1168)	(.1613)	(.1910)
Bonus * S-A	-.1322*	-.1340*	-.0276	-.0274	-.0346**	-.0258	-.0266	-.0233
	(.0679)	(.0722)	(.0220)	(.0231)	(.0175)	(.0186)	(.0275)	(.0296)
Bonus * C-I	1.0957*	.9569	.1602	.1663	.3582**	.3065*	.3971*	.2711
	(.5893)	(.6439)	(.2019)	(.2139)	(.1497)	(.1635)	(.2366)	(.2624)
Bonus * S-A * C-I	.3081**	.3273**	.0504	.0660	.1021***	.1003**	.1277**	.1064
	(.1519)	(.1644)	(.0536)	(.0566)	(.0376)	(.0408)	(.0597)	(.0674)
q	-.0051	-.0182	.0005	-.0026	-.0054	-.0074*	-.0048	-.0080
	(.0159)	(.0156)	(.0063)	(.0059)	(.0040)	(.0043)	(.0066)	(.0067)

Table 5 – *Continued from previous page*

Dependent Variable:	Total Number of Covenants		Likelihood to Have Covenants		CapEx Covenants		EBITDA Covenants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	.6032	.8373	.0001	.0001	-.2717	-.2069	-.0464	.1262
	(1.11226)	(1.0607)	(.0003)	(.0003)	(.2690)	(.2867)	(.4335)	(.4805)
Loan Amount	.0012	.0030	-.0012	-.0007	.0005	.0004	.0051	.0052
	(.0074)	(.0067)	(.0029)	(.0025)	(.0008)	(.0009)	(.0039)	(.0040)
Years	1999-2007							
Year-Quarter Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year Fixed	No	Yes	No	Yes	No	Yes	No	Yes
Observations	13001							
Firms	4052							

Table 6: Regressions of private debt market participation

The sample consists of firms in the Dealscan-Compustat merged sample. The table presents regression results of likelihood of a firm having a new private loan started in a quarter. The dependent variable is the dummy for whether firm i starts a new loan at time t. Columns (1) and (2) present the result of linear probability regressions. Column (1) includes cash flow and q as additional controls. Column (2) additionally controls for industry-level shocks. Column (3) and (4) present the result of fixed-effects logit regressions. *, **, *** indicate significance at the 10%, 5%, 1% level, respectively. All standard errors are clustered at the firm-level. Variable descriptions appear in Appendix.

Dependent Variable:	Dummy for whether firm i has a new loan at time t			
Specification	Linear Regression		Fixed-Effects Logit	
	(1)	(2)	(3)	(4)
S-A	-.0190***	-.0192***	-.7151***	-.7163***
	(.0047)	(.0048)	(.1238)	(.1329)
S-A * C-I	-.0613***	-.0420**	-.8792***	-.8816**
	(.0177)	(.0179)	(.2727)	(.3193)
Bonus * S-A	.0041	.0039	.1493***	.1463***
	(.0027)	(.0028)	(.0421)	(.0442)
Bonus * C-I	-.1081***	-.0900***	-2.0369***	-1.9180***
	(.0259)	(.0260)	(.4024)	(.4296)
Bonus * S-A * C-I	-.0287***	-.0227***	-.5227***	-.4544***
	(.0082)	(.0082)	(.1094)	(.1171)
q	.0001***	.0001***	.0024***	.0021***
	(.0000)	(.0000)	(.0004)	(.0006)
Cash Flow	.0041***	.0038**	1.4794	1.5747
	(.0016)	(.0014)	(1.1766)	(1.1756)
Years	1999-2007			
Year-Quarter Fixed	Yes	Yes	Yes	Yes
Firm Fixed	Yes	Yes	Yes	Yes
Industry-Period Fixed	No	Yes	No	Yes
Observations	136308	136308	111571	111571
Firms	5469	5469	4066	4066

Table 7: Regressions of private debt size

The sample consists of firms in the Dealscan-Compustat merged sample. The table presents regression results of the size of private loans reported in Dealscan. The dependent variable is LoanAmount_{it}, the total size of private loans which firm i starts at time t, divided by total assets. Observations with LoanAmount_{it} greater than 100% or less than 0% are excluded. Column (1) runs a linear fixed-effect panel regression with standard errors clustered at the firm-level. Column (2) runs a fixed-effects Tobit regression with standard errors calculated using bootstrap, as specified by the Stata code created by Bo E. Honoré (See Honoré (1992)). *, **, *** indicate significance at the 10%, 5%, 1% level, respectively. Variable descriptions appear in Appendix.

Dependent Variable:	Total amount of private loan that firm i makes at time t	
	Linear Regression (1)	Tobit Regression (2)
S-A	-.0042***	-.1201***
	(.0015)	(.0360)
S-A * C-I	-.0101*	-.0997
	(.0053)	(.0660)
Bonus * S-A	.0023***	.0443***
	(.0006)	(.0104)
Bonus * C-I	-.0159**	-.3420***
	(.0063)	(.1159)
Bonus * S-A * C-I	-.0038**	-.0863***
	(.0017)	(.0302)
q	.0000***	.0010
	(.0000)	(.0030)
Cash Flow	.0008	-1.2212
	(.0007)	(1.8436)
Years	1999-2007	
Year Fixed	Yes	Yes
Firm Fixed	Yes	Yes
Observations	136064	136064
Firms	5469	5469

Table 8: Regressions of total debt issuance (Compustat measures)

The sample consists of firms in the Dealscan-Compustat merged sample. The table presents regression results of net debt issuance measures defined in Appendix. Columns (1) and (2) regress net total debt issuance. Columns (3) and (4) regress net long-term debt issuance. Column (1) and (3) present the results with the sample period from 1999 to 2004. Column (2) and (4) present the results with the sample period from 1999 to 2007. *, **, *** indicate significance at the 10%, 5%, 1% level, respectively. All standard errors are clustered at the firm-level. Variable descriptions appear in Appendix.

Dependent Variable:	Net Total Debt Issuance		Net Long Term Debt Issuance	
	(1)	(2)	(3)	(4)
S-A	-.1946***	-.0753	-.0494***	.0106
	(.0707)	(.0468)	(.0127)	(.0321)
S-A * C-I	.1737	.0096	.0049	-.0648
	(.1222)	(.0412)	(.0224)	(.0509)
Bonus * S-A	.0261***	.0032	.0116***	-.0093
	(.0091)	(.0071)	(.0024)	(.0099)
Bonus * C-I	-.1514**	.0181	-.0792***	.0608
	(.0590)	(.0503)	(.0191)	(.0662)
Bonus * S-A * C-I	-.0482***	-.0044	-.0217***	.0183
	(.0178)	(.0146)	(.0052)	(.0195)
q	.0001	-.0004	-.0001*	-.0000
	(.0001)	(.0005)	(.0000)	(.0001)
Cash Flow	-.2435	-.0398	-.0748	.0101
	(.2253)	(.0328)	(.0693)	(.0097)
Years	1999-2004	1999-2007	1999-2004	1999-2007
Period	Before and During Bonus Period	All	Before and During Bonus Period	All
Year-Quarter Fixed	Yes	Yes	Yes	Yes
Firm Fixed	Yes	Yes	Yes	Yes
Observations	94148	131043	98107	136301
Firms	5333	5394	5441	5468

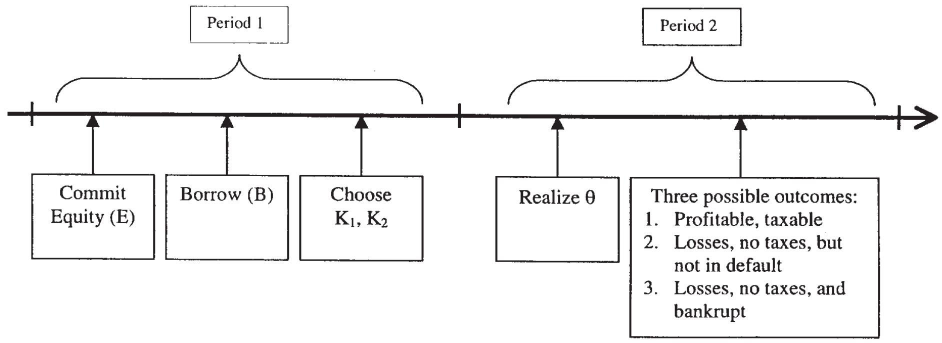

Figure 1: Timeline of events

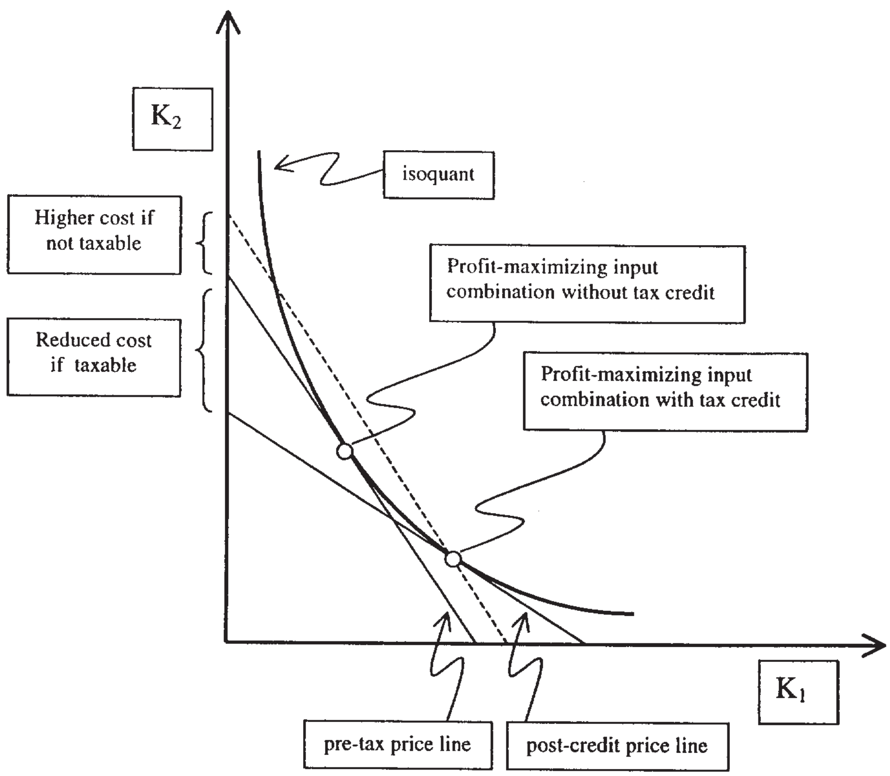

Figure 2: Credit-induced cost changes along an isoquant

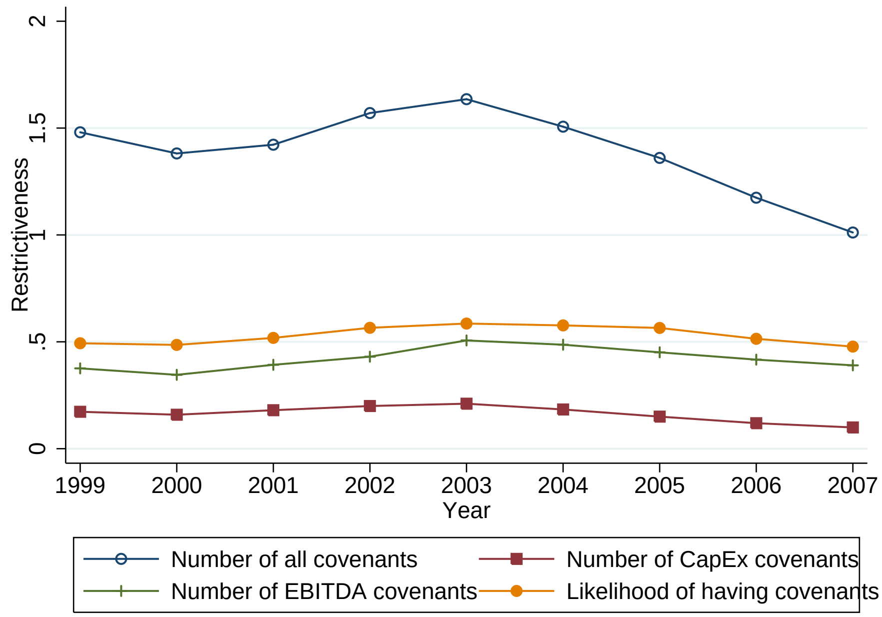

Figure 3: Aggregate use of bond covenants: Trends of four proxies

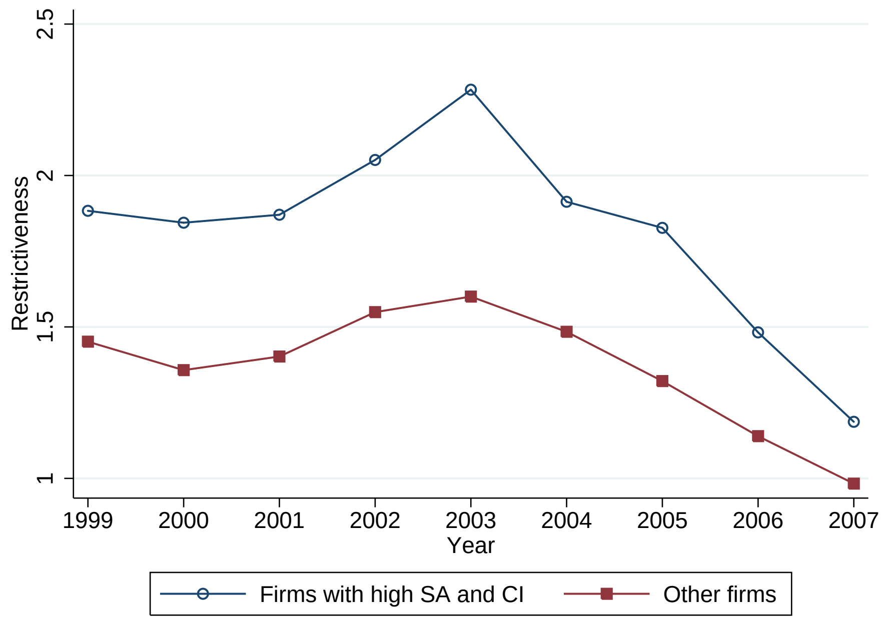

Figure 4: Aggregate trends of number of all financial covenants

Appendix. Variable descriptions

Compustat Measures

- Investment is the ratio of the current year's capital expenditures (iqitems 90) to the prior year's net property, plant, and equipment (iqitems 42). Observations with Investment greater than 100% or less than 0% are excluded.

- q is the sum of the market value of equity (iqitems 14 $\times$ 61) and book liabilities minus deferred taxes (iqitems 44 - iqitems 59 - iqitems 52), divided by book assets (iqitems 44).

- Cash Flow is the ratio of the current year's operating income plus depreciation (iqitems 8 + iqitems 5) to the prior year's net property, plant, and equipment (iqitems 42). For reporting convenience, it is divided by 1,000 whenever used in the regressions.

- S-A index is measured as -0.737 $\times$ Size plus 0.043 $\times$ Size^2 minus 0.040 $\times$ Age, where size is the log of inflation-adjusted book assets (iqitems 44) and age is the number of years the firm is listed on Compustat. Size is capped at log($4.5 billion) and age is at thirty-seven years.

- Capital Intensity is the ratio of the current year's net property, plant, and equipment (iqitems 42) to the current year's book assets (iqitems 44).

- Total Debt to Assets (Stock measure) is the sum of long-term debt (iqitems 51) and debt in current liabilities (iqitems 45) divided by lagged book assets (item 44).

- Net Total Debt to Assets (Flow measure) is the change in Total Debt to Assets (Stock measure).

- Net Long-term Debt to Assets (Flow measure) is long term debt issuance (iqitems 86) minus long term debt retirement (iqitems 92) divided by lagged book assets (iqitems 44).

Dealscan Measures

- Restrictiveness$_{it}$ is measured in four different ways as discussed in Section 4.
  - **Proxy 1: The number of all financial covenants attached to a loan.** The number of all financial covenants attached to a loan (package-level) is first counted. Restrictiveness$_{it}$ is then calculated as the expected number of all financial covenants attached to a loan for firm i at time t. For example, when firm i has two loan packages at time t, one with 5 financial covenants, the other with 0 financial covenant, Restrictiveness$_{it}$ is measured as 2.5.
  - **Proxy 2: The number of EBITDA covenants attached to a loan.** Restrictiveness$_{it}$ is calculated essentially the same as above, except that only EBITDA-related covenants

are counted. EBITDA-related covenants are "Max. Debt to EBITDA," "Max. Senior Debt to EBITDA," and "Min. EBITDA."

  - **Proxy 3: The number of Capital Expenditure covenants attached to a loan.** $\text{Restrictiveness}_{it}$ is calculated essentially the same as above, except that only Capital Expenditure-related covenants are counted. In Dealscan data, there is only one type of such covenant ("Max. Capex"), so it is similar to a dummy variable.
  - **Proxy 4: The likelihood that any given loan includes a financial covenant.** A dummy is coded as one when a loan package has any financial covenant, otherwise zero. $\text{Restrictiveness}_{it}$ is then calculated as the expected value of this dummy for firm i at time t. In the example above, the likelihood that firm i has a loan that has a financial covenant at time t is 50%.

- $\text{BorrowingDummy}_{it}$ is equal to one when firm i has a new loan at time t; zero otherwise.
- LoanAmount_{it} is the sum of all private loan amounts, reported in Dealscan, firm i starts at time t, divided by total assets. By construction, it is positive when $\text{BorrowingDummy}_{it}$ is one; zero otherwise.