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Investment Ramifications of Distortionary Tax Subsidies*

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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 debt contracts, which only imperfectly address asset substitution and distort investment. 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. Debt 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, firms at risk of default borrowed less, and were more apt to lease capital, than were other firms during the bonus depreciation period.

JEL Codes: H25, G31, G33.

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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, recent U.S. tax provisions include special incentives for equipment 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 paper 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 debt contracts; instead, debt 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 debt covenants that avoid the agency problems created by tax incentives, and the empirical work examines the use of debt 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 Miller (1963) and Stiglitz (1973), and foregoing access to an important market for funds.

The apparently small 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 paper considers an additional possibility: that standard empirical specifications incompletely 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 paper implies that if there is a chance that investors will default on their debts, then these

[1] Hasset and Hubbard (2002) and Chirinko (1993) survey this literature. Edgerton (2010) estimates 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; Zwick and Mahon (2017) offer evidence that firms of different sizes may have responded differently. Djankov et al (2010) and Bond and Xing (2015), in cross-country studies using different methodologies, conclude that tax burdens significantly affect investment levels.
[2] See, for example, Auerbach and Hassett (1992), Cummins, Hassett, and Hubbard (1994), Goolsbee (1998), and House and Shapiro (2008).

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 paper analyzes cases in which investors anticipate that tax credits have no value to firms with tax losses.

It is well established that debt costs 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 debt 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 debt 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 tangible investments that were the focus of the tax-induced distortion. Corporate borrowing fell and leasing increased during the bonus depreciation period, with these

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

reactions concentrated among financially precarious firms whose assets were concentrated in tangible investments.

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 debt contracts and other aspects of corporate investment 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 $y\left(K_1, K_2\right)\theta$ 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 strictly 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.

To simplify matters, firms and investors are assumed to be risk-neutral with respect to firm-specific shocks, in the sense that managers maximize expected profits without regard to the correlation between θ and the market return; and bondholders and shareholders similarly seek to maximize expected returns. This assumption, which corresponds to fully diversified investors and θ being a purely idiosyncratic shock to a firm's production function, is made to focus the analysis on payoff asymmetries and moral hazard introduced by tax incentives.

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 lies 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 assumed to be 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 $Q(K,c) = y\left[K\sigma_1(c), K\left(1-\sigma_1(c)\right)\right]$ and $\sigma_1 \equiv K_1/K$ is the firm's chosen 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 $\left[r(B,K,c) - B\right]$ plus repayment of debt principle (*B*). As the notation indicates, interest rates are functions of

[7] As a general matter, assets depreciate at differing rates, which is indeed important for the empirical work presented in section 4, since the amount of benefits from the bonus depreciation depends on the tax lives of assets purchased. 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.

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, or equivalently, σ_1.

Shareholders of a profitable, taxpaying firm receive:

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

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 depreciated capital stock and receive tax credits of $cK\sigma_1$.[8]

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.[9] Since the firm pays no taxes, shareholders receive:

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

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:

(3) $$\pi^e=\int_{\hat{\theta}_1}^{\infty}\left\{\left[Q(K,c)\theta-r(B,K,c)-\delta K\right](1-\tau)-B\tau+K+cK\sigma_1\right\}d\theta$$
$$+\int_{\hat{\theta}_2}^{\hat{\theta}_1}\left\{Q(K,c)\theta-r(B,K,c)+(1-\delta)K\right\}d\theta$$

[8] The value of the firm's depreciated capital stock is taken to be $K(1-\delta)$, which implicitly treats the investment tax credit as being available only for first period investments. In a multi-period investment model, an investment tax credit that is also available for second-period investments would reduce the market value of the depreciated capital stock to $K(1-\delta)(1-c\sigma_1)$, which would affect the specifics of the calculations that follow.

[9] 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.

in which $\hat{\theta}_1$ is the value of θ at which the firm is just on the verge of having a positive tax liability, so expression (1) equals expression (2); and $\hat{\theta}_2$ is the value of θ at which the firm is just on the verge of insolvency, so expression (2) equals zero.

Expected returns as defined in equation (3) are operating returns that make no allowance for the cost of invested equity (*E*). Denote the opportunity cost of equity (measured in second period units) by ρ. The firm chooses *E*, *B*, *K*, and σ_1 to maximize:

(4) $$\pi^e - \rho E$$

subject to:

(5) $$E + B \geq K.$$

The first-order condition corresponding to maximizing (4) over the choice of *K* is:

(6) $$\frac{\partial Q}{\partial K}\left[p_1\theta_1(1-\tau)+p_2\theta_2\right]+\left[(1-\delta)-\frac{\partial r}{\partial K}\right]\left[p_1(1-\tau)+p_2\right]+p_1\tau+p_1c\sigma_1=\lambda,$$

in which $\lambda \geq 0$ is the lagrange multiplier corresponding to the value of the constraint (6). In equation (6) the term p_1 corresponds to the likelihood that the firm has positive tax liability $\left(\theta \geq \hat{\theta}_1\right)$, and p_2 corresponds to the likelihood that the firm has no tax liability but is not bankrupt $\left(\hat{\theta}_1 > \theta \geq \hat{\theta}_2\right)$; furthermore, θ_1 is the expected value of θ in states of the world in which the firm owes taxes, and θ_2 is the expected value of θ in states of the world in which the firm has no tax liabilities but is not bankrupt.[10]

In addition, there are two first order conditions corresponding to alternative sources of finance:

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

which must be satisfied if the firm issues positive amounts of debt, and

(8) $$\rho = \lambda,$$

[10] In differentiating (4), the continuity of shareholder payoffs around $\hat{\theta}_1$ and $\hat{\theta}_2$ implies that even though $d\hat{\theta}_1/dK \neq 0$ and $d\hat{\theta}_2/dK \neq 0$, these terms have no profitability implications and therefore do not appear in the first order condition (6).

if the firm has 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 $r\left(B,K,c\right)$ if the firm is solvent in period two, and receive less if the firm is insolvent. Bondholders of bankrupt firms are entitled to seize firm assets, though the process of doing so can be costly. 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. Lenders are assumed to know *B* and *K*, but not to be able to contract over σ_1. Denoting the required certainty-equivalent rate of interest by $\overline{r}$, and the probability of bankruptcy by $p_3 = 1-\left(p_1+p_2\right)$ bond market equilibrium requires that

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

in which the first term on the right side of equation (9) is the payoff to bondholders in non-bankruptcy states, and the second term is the payoff in bankruptcy. Differentiating equation (9),

(10) $$\frac{\partial r}{\partial B} = \frac{1+\overline{r}}{1-p_3}$$

and

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

Equation (10) reflects that the possibility of default $\left(p_3>0\right)$ increases the borrowing rate on a new loan unaccompanied by additional capital investment, which would arise if the firm simply substituted debt for equity. The possibility of default also affects the cost of new borrowing that is invested in the firm, this cost being given by the sum of (10) and (11). Equation (11) illustrates that a new equity-financed investment would reduce interest rates, since with *B* held constant, any additional investment is implicitly financed with equity.

2.3 Investment Implications

Combining equations 6, 7, 8, 10 and 11,

$$(12)\quad \frac{\partial Q(K,c)}{\partial K}\left[p_1\theta_1(1-\tau)+p_2\theta_2+\frac{p_3\left[p_1(1-\tau)+p_2\right]}{p_1+p_2}\theta_3\right]=\frac{(\bar{r}+\delta)\left[p_1(1-\tau)+p_2\right]}{p_1+p_2}-c\sigma_1 p_1 .$$

This equation is a generalization of the Hall-Jorgenson analysis of investment, in which the required pretax return on marginal capital investment is a function of interest rates, depreciation, and tax parameters. If $p_1 = 1$ and $p_2 = p_3 = 0$, then (12) simply implies that $\frac{\partial Q(K,c)}{\partial K}\theta_1 - \delta = \bar{r} - c\sigma_1/(1-\tau)$, with the marginal product of capital net of depreciation equal to the pretax cost of funds (due to debt financing) minus the value of the tax credit. The bracket on the left side of (12) incorporates the possibility that $p_1 < 1$ with its weighted average of factors affecting the marginal product of capital across the three different outcome states. Notably, greater output is valuable even to the extent it arises in the bankruptcy state, when it will constitute a payoff to bondholders.

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 (12), the cost of capital appears as $\partial Q(K,c)/\partial K$, the tax-induced marginal product of capital. Differentiating equation (12) yields:

$$(13)\quad \frac{d\left[\frac{\partial Q(K,c)}{\partial K}\right]}{dc}=\frac{-p_1\left(\sigma_1+c\frac{d\sigma_1}{dc}\right)}{p_1\theta_1(1-\tau)+p_2\theta_2+\frac{p_3\left[p_1(1-\tau)+p_2\right]}{p_1+p_2}\theta_3},$$

which indicates that higher values of the tax credit are associated with redcued costs of capital, presuming $d\sigma_1/dc \geq 0$. In this context, however, a reducd cost of capital need not correspond to greater investment, since $\partial Q(K,c)/\partial K$ may decline simply because higher values of *c* will encourage a firm to substitute into low-productivity tax-favored investments. This is apparent from decomposing the effect of *c* on $\partial Q(K,c)/\partial K$:

$$\text{(14)} \qquad \frac{d\left[\frac{\partial Q(K,c)}{\partial K}\right]}{dc} = \frac{\partial^2 Q(K,c)}{\partial K^2}\frac{dK}{dc} + \frac{\partial^2 Q(K,c)}{\partial K \partial c},$$

in which the first term on the right side of equation (14) 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 higher values of σ_1.

It is useful to define two parameters, one describing a firm's price-induced asset substitution, the other describing the importance of bankruptcy states. The extent of price-induced asset substitution is captured by the elasticity of the share of capital of type one in the firm's capital stock with respect to the tax credit,

$$\text{(15)} \qquad \eta \equiv \frac{\partial \sigma_1}{\partial c}\frac{c}{\sigma_1}.$$

The extent to which the firm's output is expected to come in default states can be expressed as:

$$\text{(16)} \qquad f \equiv \frac{p_3\theta_3\left[p_1(1-\tau)+p_2\right]}{\left[p_1\theta_1(1-\tau)+p_2\theta_2\right]\left[p_1+p_2\right]}.$$

If default is impossible $(p_3 = 0)$ then $f = 0$. If $p_2 = 0$ then $f = p_3\theta_3 / p_1\theta_1$, and *f* may exceed unity at sufficiently high default probabilities. Equations (13) and (14) imply:

Proposition 1. *The effect of the tax credit on aggregate investment is:*

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

As a result, dK/dc can be negative with sufficiently large values of f and η.

Appendix A provides a proof of Proposition 1.

Since strict concavity of the production function implies that $\partial^2 Q(K,c)/\partial^2 K < 0$, it follows that $(1-f\eta)<0$ implies $dK/dc<0$. 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 $\eta=0$, then firms do not respond to tax credits by substituting assets in a way that is costly to bondholders.

Earlier studies in the tax-investment literature analyze the importance of $p_2>0$ in reducing the impact of c on investment. In the setting described by equation (17), however, $p_3>0$ has the potential not only to reduce the magnitude of the effect of c on investment, but even to reverse the sign of the effect. Starting with the case of $p_1=1$ and $p_2=p_3=0$, greater values of p_2 yield smaller, but nonetheless positive, values of dK/dc. By contrast, a higher value of p_3 may produce a negative value of dK/dc, with tax subsidies reducing investment levels.

It is noteworthy that, from its definition, $\eta=0$ if $d\sigma_1/dc=0$ or $c=0$, so either of these conditions is sufficient to guarantee that $dK/dc>0$. If $d\sigma_1/dc=0$ 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 equation (17) is the factor by which excessive asset substitution reduces the investment impact of specific tax subsidies.[11] In order to evaluate the magnitude of this factor, it is useful to replace η with the more commonly-estimated parameter ε, the elasticity of substitution between K_1 and K_2; as shown in Appendix A,

[11] Since p_1 premultiplies the right side of equation (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 $p_3>0$.

(18) $$\eta = \frac{-\varepsilon\left(1-\sigma_1\right)c}{1-c-\frac{\tau\delta}{\overline{r}+\delta}}.$$

High values of *f* and *c*, and large negative values of ε, conspire greatly to reduce dK/dc. For example, if $f=1$, $\sigma_1=0.2$, $c=0.3$, $\tau=0.35$, $\delta=.10$, $\overline{r}=0.05$, and $\varepsilon=-1$, then $\left(1-f\eta\right)\approx 0.49$. With otherwise the same parameters but $\varepsilon=-2$, $\left(1-f\eta\right)\approx -0.03$. 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 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 $\left(1-f\eta\right)$ 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.

Proposition 2. *The effect of tax credits on profitability can be expressed as*

(19) $$\frac{d\pi^e}{dc}\frac{1}{K} = p_1\sigma_1\left(1-f\eta\right).$$

Consequently, $d\pi^e/dc$ *can be negative for sufficiently high values of f and* η.

Appendix A provides a proof of Proposition 2.

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 debt, 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 firm 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.[12] 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 equipment assets benefit significantly more from bonus depreciation than do shorter-lived equipment 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 the asset-substitution problem.

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.[13] 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 three 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 Debt covenants

[12] Jenson 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.

[13] See, for example, Grossman and Hart (1982), Dewatripont and Tirole (1994), and Hart and Moore (1995).

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 debt 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.[14] 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 debt 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 debt covenants has to do with their enforcement. Covenant violations can lead to renegotiation or termination of debt 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 to waive at least some violations of covenant provisions.[15] 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 debt 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

[14] See, for example, Smith and Werner (1979), McDaniel (1986), and Berlin and Loeys (1988).
[15] See, for example, Chen and Wei (1993) and Beneish and Press (1993).

changing its character unless such contracts could be applied perfectly. In practice, debt 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.[16]

As noted by Smith and Werner (1979), and empirically verified by Bradley and Roberts (2015), borrowing rates tend to be lower when financial debt covenants are included in loan contracts, controlling for observable risks. This is consistent with the hypothesis that borrowers receive favorable borrowing rates in return for accepting debt covenants in settings in which there are potential conflicts of interest. In practice, 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 debt covenants. During this process, however, lenders may intervene in 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 relatively tightly set, so technical defaults occur quite frequently (in a typical quarter, about 15-20% of outstanding loans are in technical default), which provides lenders with partial control over borrower actions, thereby mitigating some aspects of moral hazard. Indeed, Garleanu and Zwiebel (2009) argue that asymmetric information between an entrepreneur and a lender should lead to debt covenants being very tightly set in debt contracts.

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.

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

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 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.[17]

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 can be reflected in reduced values of θ_3, though for the first order conditions to remain valid it is necessary that bankruptcy costs are small for firms just barely bankrupt, so that shareholder payoffs are continuous in θ. 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. Prior to 2018 U.S. law permitted net operating losses to be carried back two years for tax purposes. Hence if an unprofitable firm's losses did not begin in earnest until more than two years after its initial investment, the firm would have benefitted in the meantime from any first-year credits. In a setting with up-front tax subsidies and limited potential subsequent tax loss carrybacks, bankruptcy possibilities will continue to reduce the impact of specific tax subsidies

[17] Ang, Chua and McConnell (1982) document the administrative costs of corporate bankruptcies and subsequent liquidations. Franks and Torous (1989), Franks and Torous (1994), Eberhart, Moore, and Roenfeldt (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.

on investment and profitability, though limitations on loss carrybacks attenuate the effect of bankruptcy, as illustrated by a model described and analyzed in Appendix A.

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 could restrict the opportunity of borrowers to make tax-favored investments, but such restrictions introduce other inefficiencies and are often not included in debt contracts.

4 Debt Covenants and Borrowing around the 2002-2004 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.[18] 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

[18] Thus, whether the fourth quarter of 2001 is included in the bonus depreciation period depends on agents′ anticipations in that quarter about upcoming fiscal policies. For convenience, throughout the paper, the bonus depreciation period is referred to as 2002-2004. The United States reintroduced 50 percent bonus depreciation in 2008, which was subsequently extended for many years and at varying rates. This paper does not consider the behavioral effects of this second bonus depreciation era due to the difficulty of distinguishing tax effects from other economic consequences, many severe, of the financial crisis of 2008 leading to a sharp decline in bank loans (see, e.g., Ivashina and Scharfstein (2010)).

bonus depreciation period. The bonus depreciation policy is particularly interesting in studying the links between information costs and the effectiveness of tax policy, since longer-lived assets are believed to be used for riskier projects, as emphasized in Section 2.5.

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 new investments with loans from third parties, and will be inclined to lease rather than invest in new capital. The propositions that new loans are more likely to come with restrictions, that there will be fewer new loans, and that leasing will increase, are testable with the available data.

4.1 Data

Data on debt covenants are collected by Dealscan, which is maintained by Thompson Reuters LPC. Dealscan contains detailed information on private debt, including identities of lenders and borrowers, loan types, loan maturities, loan inception dates, and, since 1993, 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.

Dealscan data are matched with Compustat for borrower information through the company codes from Dealscan-Compustat Link Data created by Michael Roberts. Since the empirical work focuses on 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 6523 firms in the sample.

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. 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 (A) of table 1 presents summary statistics for Compustat firms that have at least one loan reported in Dealscan, while the right panel (B) presents statistics for all Compustat firms. The mean and medians across all variables are quite similar, except for values of q, a variable with 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 9.49% chance that at least one loan package is commenced 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 0.37.

4.2 Debt 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 (2015) add all financial and non-financial covenants to measure “covenant intensity.” A second measure of loan restrictiveness is the likelihood that any given loan includes at least one 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 debt covenants in the Dealscan data between 1999 and 2007, as measured by these four proxies. Across all four measures, the aggregate restrictiveness of new loans rises during the bonus depreciation period and falls subsequently. Some of this pattern may be attributable to the adverse macroeconomic conditions that prompted the U.S. government to introduce bonus depreciation for the fourth quarter of 2001, though despite the U.S. economic recovery of 2003-2004, lenders continued to make extensive use of debt covenants.

Firms starting at least one new loan between 1999 and 2004 can be classified into three types. Type I firms start at least one new loan in each of two periods: (i) 1999.Q1-2001.Q3 and (ii) 2001.Q4-2004.Q4. Type II firms start at least one loan during 1999.Q1-2001.Q3, but do not start new loans during 2001.Q4-2004.Q4. Type III firms have no reported loans from 1999.Q1-2001.Q3, but start at least one new loan during 2001.Q4-2004.Q4. 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. 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 do stay in the private debt market even during the bonus depreciation period and take new loans, while there are other firms of Type II that might otherwise have borrowed, but did not do so due to the high costs during the same period. Therefore, one can expect that only Type I includes frequent borrowers that successfully finance through private borrowing during the bonus depreciation period, and Type II includes firms that might otherwise have wanted to borrow in 2001.Q4-2004.Q4, but did not do so.[19]

[19] Appendix C presents comparisons of borrower characteristics for 1999-2001. The table 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 2 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.Q1-2001.Q3, 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.Q1-2007.Q4. Similarly, the likelihood of a loan having at least one covenant to attached to it for Type I firms is 47.25% during 1999.Q1-2001.Q3, 55.61% during 2001.Q4-2004.Q4, and 50.93% during 2005.Q1-2007.Q4. 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 firms prior to the introduction of bonus depreciation are generally larger than differences between Type I and Type III firms during the bonus depreciation period. Coupled with the observation 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 therefore trigger the most concern for lenders. Hadlock and Pierce (2010) propose 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: $(-0.737^* \text{ size}) + (0.043^* \text{ size}^2) - (0.040^*\text{age})$: 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.[20] One might be concerned that a firm with a high fraction of longer-lived capital prior to bonus depreciation may tend to invest in shorter-lived capital in subsequent years, so lenders would not necessarily view this firm as one that will benefit heavily from bonus depreciation. However, there is evidence that firms with high fractions of longer-lived capital in 1997 are also likely to have high fractions of longer-lived capital in 2000, a pattern more pronounced for longer-lived-capital-intensive firms, suggesting that average capital lifetimes are persistent characteristics of firms and their production technologies.[21]

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.[22] The aggregate use of debt covenants by firms prone to asset-substitution (588 firms) peaked during the 2002-2004 bonus depreciation period, whereas this bunching of debt covenant use is much less pronounced among unconstrained firms (4476 firms).

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

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[20] A more precise measure of the relevant capital intensity would distinguish long-lived equipment from other tangible assets, but Compustat does not report stocks of equipment assets for the relevant years.

[21] This evidence is presented in Table A1 in Appendix D.

[22] More strictly defining asset-substitution-prone firms as those in the top 1/4 of both indices shows even clearer differences between those firms and other firms, while a loose definition of asset-substitution-prone firms as those above median in both indices shows less clear differences. See Figures A1 and A2 in Appendix D. These results indicate that differences in the patterns are driven mainly by those firms with high SA and CI indices.

(20) $$Restrictiveness_{it} = b_0 + b_1 Bonus_t + b_2 SA_{it} + b_3 Bonus_t SA_{it} + b_4 Bonus_t CI_i + b_5 SA_{it} CI_i + b_6 Bonus_t SA_{it} CI_i + b_7 q_{it} + b_8 X_{it} + firm_i + year_t + \varepsilon_{it}$$

where $Restrictiveness_{it}$ 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.[23] $firm_i$ and $year_t$ are firm and year fixed effects. For the sake of interpretation, SA_{it} and CI_i are standardized to have zero mean and unit variance.

In order to control for potential impacts of the size of a loan, the duration of a loan, or the use of the syndication on the number of debt covenants, the equation also includes a set of additional controls, X_{it}, including the average loan amount, average loan duration, and average number of lenders for firm *i* at time *t*.[24]

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 3, consisting of columns (1) and (2), presents estimated coefficients from regressions explaining 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-quarter fixed effects. The coefficient on the variable of primary interest, $Bonus_t*SA_{it}*CI_i$, is estimated to be 0.0619 and statistically significant. To interpret this result it is necessary also to consider the coefficient on $Bonus_t*SA_{it}$, which is estimated to be -0.0123, although statistically insignificant, indicating that, for a firm with an average level of capital intensity (the standardized CI_i is zero), an increase in the standardized S-A index by one standard deviation is associated with a reduction in the number of covenants attached to a loan by 0.0123 during the bonus period. However, a significantly positive coefficient on $Bonus_t*SA_{it}*CI_i$, together with the fact that the absolute value of its coefficient (0.0619) is estimated to be higher

[23] Note that the capital intensity variable, being time-invariant (it is measured in year 2000), is not included as a separate variable since it is reflected in firm fixed effects. The Size-Age index is included in the estimating equation, but has very little effect on the regression results, reflecting that the Size-Age index is quite stable over time.
[24] The other coefficient estimates reported in table 3 change very little when the equations are rerun omitting these additional controls.

than the coefficient on $Bonus_t*SA_{it}$ (-0.0123), suggests that for a firm with a CI index one standard deviation higher than average, a one standard deviation increase in SA index increases the number of covenants during the bonus period significantly. That is, the sign and significance of the 0.0619 coefficient suggests that the effect attributable to financial constraints is more pronounced among firms with high capital intensity. Column (2) additionally includes industry-year fixed effects to control for unobserved industry-specific shocks that may be related to use of debt covenants, yielding results similar to those presented in Column (1). The second panel of table 3, consisting of columns (3) and (4), 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 (0.0112 and 0.0126) 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 debt 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 (columns 5 and 6) and fourth (columns 7 and 8) panels of table 3 present coefficients from regressions using the same independent variables as those presented in the first panel, but with the average 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 0.0205 in Column (5), implying that a firm with a one standard deviation above-average SA index, and investing so intensively in longer-lived capital that its CI index is also one standard deviation higher than average, is expected to have 0.0205 more Capital Expenditure covenants during the bonus depreciation period than is an otherwise-similar firm that is of only average capital intensity. In the same situation, the firm is expected to have 0.0253 more EBITDA covenants.

These estimates imply that the combined impact on the number of CapEx and EBITDA covenants explain about three-fourths of the impact on the total number of covenants attached to a loan: the sum of the estimated coefficients on the main variable in Column (5) and (7), 0.0205 and 0.0253, respectively, is approximately three-fourths of the estimate in Column (1), 0.0619. When lenders impose more restrictions on borrowers with high SA and CI indices during the bonus depreciation period, they do so especially in the form of CapEx and EBITDA covenants. Given that CapEx 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.

One of the key identifying assumptions in these specifications is that non-tax factors possibly affecting lenders' lending behaviors played little roles in imposing more severe covenants restrictions on firms with high SA and CI indices than on other firms during the bonus depreciation period. A concern in this regard is that the 2002 bonus depreciation was enacted to counteract economic downturn when firms facing reduced credit supply might have had to accept more covenants attached to loans, even without the tax policy. Although the empirical results suggest that financially constrained firms experienced significant increases in loan covenants, particularly among capital intense firms, a pattern that would not be fully explained by business-cycle considerations, it is useful to consider additional evidence with explicit controls for the state of the business cycle. Re-running the Table 3 regressions adding interactions of quarterly real GDP growth rates and the SA and CI indices changes the coefficients on the other variables little, as reported in Table A2 of Appendix D. And given that the 2002 bonus depreciation period does not coincide exactly with the economic downturn around the policy, it is possible to use different time windows for similar regressions as in Table 3 to disentangle the recession period from the bonus depreciation period. That is, the 2002 bonus depreciation was enacted retrospectively in 2002, while the recession started in March 2001 and ended in November 2001, according to NBER Business Cycles. The regressions reported in Table A3 of Appendix D use the time window of years 1999, 2000 and 2001. If unobserved business cycle effects play important roles in explaining increased use of debt covenants, the interaction term of year 2001 with SA and CI index would have been significantly positive – but there is no strong evidence supporting this view. By contrast, using the time windows of years

1999, 2000 and 2002 in the regressions reported in Table A4 of Appendix D (and years 1999, 2000 and 2003 in Table A5), the estimated coefficients on the tax variables are similar to those reported in Table 3. And additional specifications using an alternative to the S-A index produces results that are similar to those appearing in Tables 3 and 4.[25]

4.3 Bonus Depreciation, Borrowing and Leasing

The greater moral hazard introduced by bonus depreciation raises the cost of borrowing and thereby reduces the likelihood and level of borrowing. It is possible to measure the extent to which corporate borrowing declined during 2001.Q4-2004.Q4, particularly among firms most apt to be affected by the tax change.[26]

It is useful to consider two measures of borrowing: (1) whether a firm takes a new loan in a given quarter, and (2) the total size of new private loans divided by total assets. Tax effects can be measured by the following empirical equation:

$$\begin{aligned} (21) \qquad & Borrowing_{it} = b_0 + b_1 Bonus_t + b_2 SA_{it} + b_3 Bonus_t SA_{it} + b_4 Bonus_t CI_i \\ & + b_5 SA_{it} CI_t + b_6 Bonus_t SA_{it} CI_i + b_7 q_{it} + b_8 X_{it} + firm_i + year_t + \varepsilon_{it} \end{aligned}$$

in which $Borrowing_{it}$ is either a dummy for whether firm *i* starts a new loan at time *t*, or the size of new private loans taken by firm *i* at time *t*. The independent variables are the same as in prior equations, and thus the intuition behind the specification of equation (21) resembles that of equation (20). 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.

Column (1) of table 4 presents the results of fixed-effects logit regressions where the dependent variable is a dummy for whether firm *i* starts a new private loan at time *t*. The

[25] Re-running the regressions presented in Tables 3 and 4, using the growth of long-term debt as an alternative measure of financial fragility, albeit one that has endogenous features, produces results (available from the authors) that look very similar to those in Tables 3 and 4.

[26] 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 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.

coefficient on $Bonus_t*CI_i$ is estimated to be -0.0726. Thus, for a firm with an average level of financial constraints, a one standard deviation increase in capital intensity reduces the odds of financing through private debt by 7.0% (=1-exp(-0.0726)). 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 -0.1074. Thus, compared to a firm with an average SA index, for a firm with an SA index one standard deviation higher than average, one standard deviation increase in capital intensity reduces by 10.2% (=1- exp (-0.1074)) its odds of borrowing during the bonus depreciation period.[27]

Columns (2) and (3) report the results of estimating regressions similar to equation (35), using as the dependent variable $LoanAmount_{it}$, measured as the total size of private loans firm *i* starts at time *t*, divided by total assets. Column (2) 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 (3), and are qualitatively similar to those appearing in column (2). With roughly 10% of firm-quarter observations starting private loans, the coefficient of the main variable (-0.0177) in column (3) indicates that, for a firm with a one standard deviation higher than average SA index, a one standard deviation higher capital intensity is associated with 0.18% (= 0.0177*10%) smaller private loan amounts.

Firms facing borrowing costs that are elevated due to concerns about asset substitution are likely to reduce their investments and instead lease assets from lessors with lower borrowing costs. Column (4) of table 4 reports the results of a regression explaining the ratio of newly started operating lease expenditures to total assets.[28] Because operating leases are measured annually, the coefficient magnitudes in column (4) must be divided by 4 to make them comparable to those in other columns. For example, a firm with a unit higher capital intensity as well as a unit higher SA index is expected to increase annual leasing by 0.31 percent of assets, corresponding to a quarterly increase of 0.08 percent of assets. The estimates in column (3)

[27] Specifying the logit regression in column 1 of Table 4 instead as a linear probability model changes the results very little.

[28] The dependent variable excludes capital leases, which would appear as capital expenditure, and therefore may trigger debt covenants. Operating leases are typically used for short-term borrowing, which helps to mitigate asset-substitution concerns; and operating leases are used to transfer tax shields (see Graham, Lemmon, and Schallheim (1998) and Park (2012)).

imply that a firm in the same situation is expected to reduce private borrowing by 0.18 percent of assets. If all borrowing is used for capital investment, it follows that approximately 44% of the reduction in investment is replaced by operating leases, which helps firms meet their capital needs, albeit in a distortionary manner.[29]

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.

Many aggregate investment studies report 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 debt contained greater numbers of restrictive covenants during an earlier period in which U.S. tax policy distorted the composition of U.S. investment in favor of long-lived equipment; furthermore, it appears that corporate borrowing declined during this period, and leasing increased. 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, and there are numerous studies of the magnitudes of these distortions in various

[29] Park (2012) analyzes financing distortions attributable to tax-induced leasing arrangements.

settings.[30] 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. Debt 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 debt covenants in an earlier era when firms were entitled to bonus depreciation, and accompanying drop in borrowing and use of leases in place of capital acquisition, are all 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.

[30] 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).

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Table 1: Summary statistics

	Panel A: Dealscan-Compustat (6523 firms)			Panel B: Compustat (10885 firms)		
	mean	std. dev.	median	mean	std. dev.	median
Investment	.0773	.1045	.0452	.0854	.1255	.0440
q	2.3264	12.6891	1.3225	5.8508	150.1528	1.4389
Size	5.6888	1.9028	5.7273	4.9326	2.3460	5.0021
Age	14.4510	12.8789	9.0000	12.3681	12.3210	7.0000
Size-Age index	-3.2234	.8501	-3.1612	-2.8472	1.1372	-2.9268
Capital intensity	.3198	.2471	.2501	.3079	.2591	.2238
Operating lease (annual measure)	.0569	.0971	.0231	.0598	.1032	.0236
Likelihood of having a private loan in a given quarter	.0949	.2931	.0000			
Average number of covenants attached to a loan	1.4288	1.6755	1.0000			
Likelihood of having any covenants attached to a loan	.4991	.4922	.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	.6256	.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. All variables, except for operating lease, are measured quarterly. Variable definitions appear in Appendix B.

Table 2: 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 its measure of debt covenant intensity. Panel B uses the likelihood of a loan having at least one debt covenant as its measure of debt covenant intensity. Panel C uses the average number of Capital Expenditure covenants attached to a loan as its measure of debt covenant intensity. Panel D uses the average number of EBITDA financial covenants attached to a loan as its measure of debt covenant intensity. Type I includes firms that started at least one new loan both before and during the bonus period. Type II includes firms that started at least one new loan before the bonus depreciation period, but did not start a new loan during the bonus depreciation period. Type III includes firms that started at least one new loan during the bonus depreciation period, but not before. The first column compares the debt covenant intensity between Type I and Type II firms before the bonus depreciation period. The second column compares the debt covenant intensity between Type I and Type III firms during the bonus depreciation period. The third column calculates the differences in the average of each column. The fourth compares the debt covenant intensity among the three types. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively. Variable definitions appear in Appendix B.

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	.1535 (.0368)***	1.1301
Type II (before) Type III (during)	1.5651 (Type II)	1.7089 (Type III)	.1438 (.0577)**	1.4234 (Type II); 1.2967 (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)***	.5093
Type II (before) Type III (during)	.5423 (Type II)	.6171 (Type III)	.0748 (.0167)***	.5793 (Type II); .5516 (Type III)

Panel C. Average number of CapEx covenants attached to a loan

Firm Types	Before Bonus	During Bonus	Differences	After Bonus
Type I	.1433	.1813	.0379 (.0083)***	.1092
Type II (before) Type III (during)	.2197 (Type II)	.2402 (Type III)	.0205 (.0144)	.1550 (Type II); .1463 (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)***	.3996
Type II (before) Type III (during)	.3693 (Type II)	.4892 (Type III)	.1200 (.0225)***	.5424 (Type II); .4429 (Type III)

Table 3: Determinants of debt covenant intensity during the 1999-2007 period

The sample consists of firms in the Dealscan-Compustat merged sample that borrowed at least once during the 1999-2007 period. The dependent variable in columns (1) and (2) is the average number of total financial covenants attached to a loan; the dependent variable in columns (3) and (4) is the fraction of loans with any covenants; the dependent variable in columns (5) and (6) is the average number of Capital Expenditure covenants attached to a loan; and the dependent variable in columns (7) and (8) is the average number of EBITDA covenants attached to a loan. The specifications in the even-numbered columns include industry-year fixed effects. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively. All standard errors are clustered at the firm and year-quarter level. Variable definitions appear in Appendix B. For this table, S-A index and capital intensity index are standardized to have zero mean and unit variance.

Dependent Variable:	Average number of all covenants		Fraction of loans with any covenants		Average number of CapEx covenants		Average number of EBITDA covenants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
S-A	.2836**	.0342	.1740***	.1131***	.0269	-.0022	-.1777***	-.2269***
	(.1191)	(.1225)	(.0363)	(.0379)	(.0294)	(.0320)	(.0493)	(.0530)
S-A * C-I	.0049	.0495	.0337	.0495*	-.0076	-.0061	.0057	.0346
	(.0756)	(.0936)	(.0238)	(.0282)	(.0183)	(.0238)	(.0310)	(.0374)
Bonus * S-A	-.0123	-.0102	-.0052	-.0006	.0005	.0060	.0169	.0143
	(.0286)	(.0316)	(.0096)	(.0103)	(.0076)	(.0082)	(.0117)	(.0133)
Bonus * C-I	-.0137	-.0610	-.0087	-.0191	-.0027	-.0139	-.0188	-.0337**
	(.0273)	(.0415)	(.0089)	(.0128)	(.0067)	(.0101)	(.0117)	(.0170)
Bonus * S-A * C-I	.0619**	.0615**	.0112	.0126	.0205***	.0200***	.0253**	.0189
	(.0283)	(.0312)	(.0097)	(.0104)	(.0071)	(.0077)	(.0112)	(.0130)
q	-.0182	-.0327**	-.0028	-.0060	-.0086*	-.0108**	-.0082	-.0115*
	(.0161)	(.0159)	(.0062)	(.0057)	(.0044)	(.0050)	(.0067)	(.0067)

Table 3 – *Continued from previous page*

Dependent Variable:	Average number of all covenants		Fraction of loans with any covenants		Average number of CapEx covenants		Average number of EBITDA covenants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	.0395	.0539	-.0055	-.0008	-.0287	-.0229	.0010	.0055
	(.1042)	(.1027)	(.0263)	(.0302)	(.0279)	(.0297)	(.0446)	(.0505)
Loan Amount	-.0068	-.0042	-.0035	-.0028	-.0003	-.0005	.0020	.0024
	(.0080)	(.0063)	(.0033)	(.0027)	(.0008)	(.0008)	(.0024)	(.0027)
Loan Duration	.0784***	.0717***	.0172	.0181	.0012	.0004	.0241*	.0213
	(.0134)	(.0140)	(.0120)	(.0123)	(.0016)	(.0025)	(.0138)	(.0152)
Number of Lenders	.0192***	.0191***	.0065***	.0065***	.0021***	.0021***	.0068***	.0068***
	(.0015)	(.0015)	(.0005)	(.0005)	(.0003)	(.0003)	(.0006)	(.0006)
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	12270							
Firms	3929							

Table 4: Determinants of new loans and operating leases

The sample consists of firms in the Dealscan-Compustat merged sample. The table presents regression results of likelihood of a firm starting a new private loan, and the sizes of new private loans and operating leases. The dependent variable in column (1) is a dummy for whether firm i starts a new private loan at time t; the dependent variable in columns (2) and (3) is the total size of private loans that firm i starts at time t divided by total assets; and the dependent variable in column (4) is the size of newly-started operating leases divided by total assets. Column (1) reports a fixed-effects logit regression. Columns (2) and (4) run linear fixed-effects panel regressions with standard errors clustered at the firm and year-quarter level (year level for column (4)). Column (3) reports a fixed-effects Tobit regression using the method proposed by Honoré (1992). *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively. In column (4), observations with operating leases greater than 100% or less than 0% are dropped. Variable definitions appear in Appendix B. For this table, S-A index and capital intensity index are standardized to have zero mean and unit variance.

Dependent Variable:	Dummy for whether firm i starts a new private loan	Size of new private loan firm i starts at time t		Size of new operating lease firm i starts at time t
	Logit (1)	OLS (2)	Tobit (3)	OLS (4)
S-A	-.8476***	-.0064***	-.1278***	.0108**
	(.0791)	(.0011)	(.0195)	(.0053)
S-A * C-I	-.1813***	-.0021*	-.0205	-.0040
	(.0560)	(.0011)	(.0146)	(.0044)
Bonus * S-A	-.0156	.0009**	.0139**	-.0031***
	(.0212)	(.0004)	(.0056)	(.0012)
Bonus * C-I	-.0726***	-.0007*	-.0133**	.0016*
	(.0205)	(.0004)	(.0058)	(.0010)
Bonus * S-A * C-I	-.1074***	-.0008**	-.0177***	.0031**
	(.0225)	(.0004)	(.0059)	(.0013)
q	.0025***	.0001***	-.0011	.0056***
	(.0004)	(.0000)	(.0036)	(.0009)
Cash Flow	-.1569	-.0001	-.1221*	.0001*
	(.1175)	(.0001)	(.0632)	(.0001)
Years	1999-2007			
Time Fixed	Year-Quarter	Year-Quarter	Year-Quarter	Year
Firm Fixed	Yes	Yes	Yes	Yes
Observations	111571	136064	136064	24375
Data Frequency	Quarter	Quarter	Quarter	Year
Firms	4066	5469	5469	4550

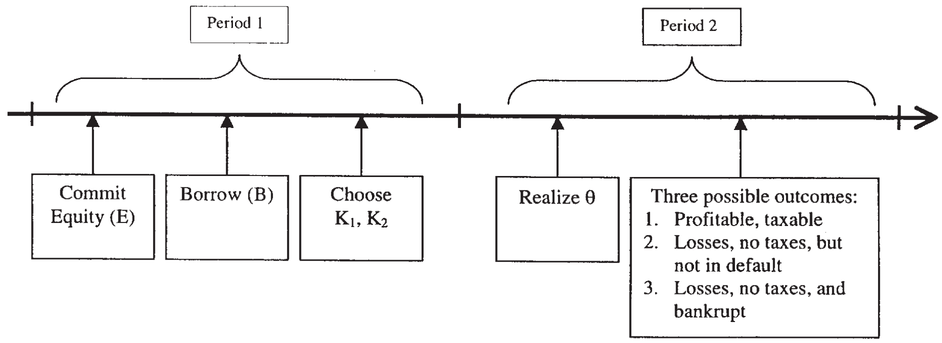


Figure 1: Timeline of events

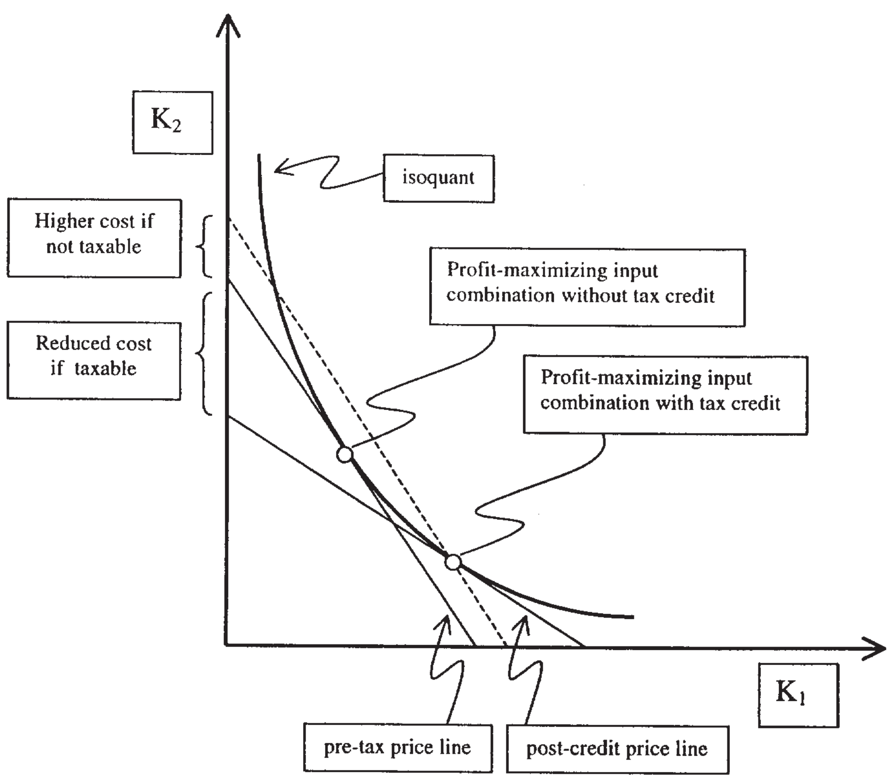


Figure 2: Credit-induced cost changes along an isoquant

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

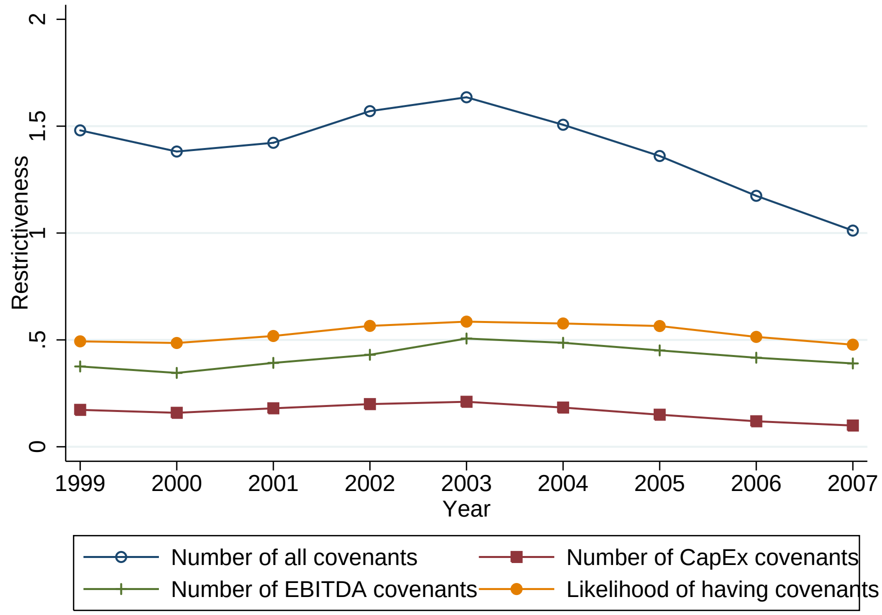
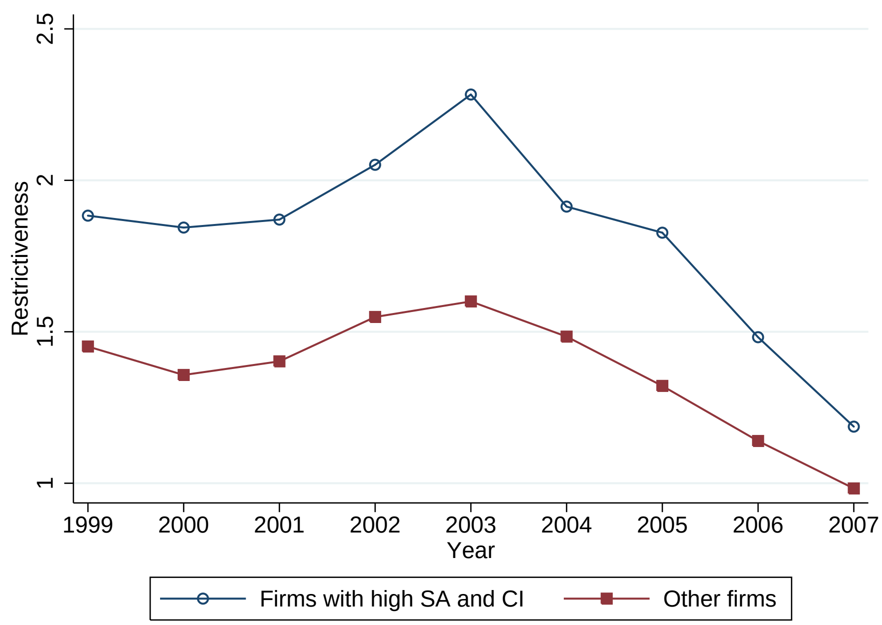


Figure 4: Aggregate trends of numbers of financial covenants attached to a loan



Note: Firms with high SA and CI are those with average SA indexes and capital intensities both in the top 1/3 of the sample firms.

Appendix A

Proof of Proposition 1.

In order to prove Proposition 1 it is necessary to evaluate $\frac{\partial^2 Q(K,c)}{\partial K \partial c}$, which depends on a firm's maximizing choice of K_1 and K_2 for a given total capital stock *K*. Rewriting equation (3) as:

$$\text{(A1)} \quad \begin{aligned} \pi^e &= \int_{\hat{\theta}_1}^{\infty} \left\{ \left[y(K_1, K_2)\theta - r(B,K,c) - \delta K \right](1-\tau) - B\tau + K + cK_1 \right\} d\theta \\ &+ \int_{\hat{\theta}_2}^{\hat{\theta}_1} \left\{ Q(K_1, K_2)\theta - r(B,K,c) + (1-\delta)K \right\} d\theta \end{aligned}$$

It follows that maximizing (A1) over the choices of K_1 and K_2, subject to $K_1 + K_2 \le K$, yields the first-order conditions

$$\text{(A2a)} \quad \frac{\partial y(K_1, K_2)}{\partial K_1} \left[p_1 \theta_1 (1-\tau) + p_2 \theta_2 \right] + p_1 c = \mu$$

$$\text{(A2b)} \quad \frac{\partial y(K_1, K_2)}{\partial K_2} \left[p_1 \theta_1 (1-\tau) + p_2 \theta_2 \right] = \mu \; ,$$

in which μ is the shadow value of the constraint $K_1 + K_2 \le K$. Together, (A2a) and (A2b) imply

$$\text{(A3)} \quad \frac{\partial y(K_1, K_2)}{\partial K_1} - \frac{\partial y(K_1, K_2)}{\partial K_2} = -\frac{p_1 c}{\left[p_1 \theta_1 (1-\tau) + p_2 \theta_2 \right]} \; .$$

Since $\frac{\partial Q(K,c)}{\partial c} = \left[\frac{\partial y(K_1, K_2)}{\partial K_1} - \frac{\partial y(K_1, K_2)}{\partial K_2} \right] K \frac{d\sigma_1}{dc}$, it follows from (A3) that

$$\text{(A4)} \quad \frac{\partial Q(K,c)}{\partial c} = -\frac{p_1 c}{\left[p_1 \theta_1 (1-\tau) + p_2 \theta_2 \right]} K \frac{d\sigma_1}{dc} \; .$$

Differentiating (A4) with respect to *K*, and applying $\frac{\partial^2 Q(K,c)}{\partial c \partial K} = \frac{\partial^2 Q(K,c)}{\partial K \partial c}$, yields

$$\text{(A5)} \quad \frac{\partial^2 Q(K,c)}{\partial K \partial c} = -\frac{p_1 c}{\left[p_1 \theta_1 (1-\tau) + p_2 \theta_2 \right]} \frac{d\sigma_1}{dc} \; .$$

Together, (13), (14), and (A5) imply:

(A6) $$\frac{\partial^2 Q(K,c)}{\partial K^2}\frac{dK}{dc}=\frac{p_1 c}{\left[p_1\theta_1(1-\tau)+p_2\theta_2\right]}\frac{d\sigma_1}{dc}-\frac{p_1\left(\sigma_1+c\dfrac{d\sigma_1}{dc}\right)}{p_1\theta_1(1-\tau)+p_2\theta_2+\dfrac{p_3\left[p_1(1-\tau)+p_2\right]}{p_1+p_2}\theta_3}.$$

Then applying the definitions (15) and (16) to (A6) produces (17). □

Demonstration of (18).

The elasticity of substitution between K_1 and K_2 is:

(A7) $$\varepsilon\equiv\frac{d(K_1/K_2)}{d(c_1/c_2)}\frac{c_1/c_2}{K_1/K_2},$$

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, $\sigma_1=K_1/(K_1+K_2)=(K_1/K_2)/\left[1+(K_1/K_2)\right]$. 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,

(A8) $$\frac{d\sigma_1}{dc}=\frac{\dfrac{d(K_1/K_2)}{d(c_1/c_2)}\dfrac{d(c_1/c_2)}{dc}}{\left[1+(K_1/K_2)\right]^2}=\frac{\varepsilon\sigma_1(1-\sigma_1)\dfrac{d(c_1/c_2)}{dc}}{c_1/c_2}$$

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 $d(c_1/c_2)/dc=-1/(1-\tau z)$. Finally, the present value of economic depreciation allowances is given by $z=\delta/(\overline{r}+\delta)$ (Hall and Jorgenson, 1971). These substitutions yield:

(A9) $$\eta=\frac{-\varepsilon(1-\sigma_1)c}{1-c-\dfrac{\tau\delta}{\overline{r}+\delta}}.$$

Proof of Proposition 2.

Differentiating the bond market equation (9) produces:

$$\text{(A10)} \qquad \left(p_1 + p_2\right)\frac{\partial r\left(B,K,c\right)}{\partial c} + p_3\theta_3 \frac{\partial Q\left(K,c\right)}{\partial c} = 0 \,,$$

which, together with equation (A4), implies:

$$\text{(A11)} \qquad \frac{\partial r\left(B,K,c\right)}{\partial c} = K\frac{d\sigma_1}{dc} c p_1 \frac{p_3\theta_3}{\left[p_1\theta_1\left(1-\tau\right)+p_2\theta_2\right]\left(p_1+p_2\right)} .$$

From equation (3) and the envelope theorem, the effect of c on expected profits is:

$$\text{(A12)} \qquad \frac{d\pi^e}{dc} = -\frac{\partial r\left(B,K,c\right)}{\partial c}\left[p_1\left(1-\tau\right)+p_2\right] + K\sigma_1 p_1 .$$

Then combining (A11) and (A12) yields:

$$\text{(A13)} \qquad \frac{d\pi^e}{dc} = K\sigma_1 p_1 \left\{1 - \frac{\frac{d\sigma_1}{dc}}{\sigma_1}\frac{c p_1 p_3 \theta_3\left[p_1\left(1-\tau\right)+p_2\right]}{\left[p_1\theta_1\left(1-\tau\right)+p_2\theta_2\right]\left(p_1+p_2\right)}\right\} .$$

Then applying the definitions (15) and (16) to (A13) produces (19). □

The model of section 3.3.

The text of section 3.3 notes that in a setting with up-front tax subsidies and limited potential subsequent tax loss carrybacks, bankruptcy possibilities reduce the impact of specific tax subsidies on investment and profitability, though limitations on loss carrybacks attenuate the effect of bankruptcy. To formalize this claim, suppose that n years elapse between initial investment and the 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 β is the firm's discount factor, 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 $c\left(1-\beta^{-n}\right)\sigma_1 K$ 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 (3) to:

(A14)
$$\pi^e = \int_{\hat{\theta}_1}^{\infty}\left\{\left[Q(K,c)\theta - r(B,K,c) - \delta K\right](1-\tau) - B\tau + K + cK\sigma_1\right\}d\theta + \int_{\hat{\theta}_2}^{\hat{\theta}_1}\left\{Q(K,c)\theta - r(B,K,c) + (1-\delta)K + c\left(1-\beta^{-n}\right)\sigma_1 K\right\}d\theta + \gamma cK\sigma_1\int_0^{\hat{\theta}_2}d\theta$$

Equation (9) is likewise affected, since bond market equilibrium must satisfy:

(A15) $$(1+\overline{r})B = (p_1+p_2)r(B,K,c) + p_3\left[Q(K,c)\theta_3 + (1-\delta)K + c\left(1-\gamma-\beta^{-n}\right)\sigma_1 K\right].$$

Imposing equations (A14) and (A15) changes the expression that appears on the right sides of equations (17) and (19); for example, equation (19) becomes:

(A15) $$\frac{d\pi^e}{dc}\frac{1}{K} = \left[p_1 + \left(1-\beta^{-n}\right)p_2 + \gamma p_3\right]\sigma_1(1-f\eta) + \sigma_1\frac{p_1(1-\tau)+p_2}{p_1+p_2}\left(1-\gamma-\beta^{-n}\right).$$

The right side of equation (A15) exhibits features similar to those of the right sides of equations (17) and (19). If $\eta = 0$ and $\gamma = 0$ then of course they are identical. If $n = \infty$ and $\gamma = 0$ then the right side of equation (A15) becomes $(p_1+p_2)\sigma_1\left(1+\frac{p_1(1-\tau)+p_2}{(p_1+p_2)^2} - f\eta\right)$, so a somewhat larger value of $f\eta$ is required for higher levels of c to be associated with reduced investment and profitability. If $\gamma = \left(1-\beta^{-n}\right)$, then the right side of equation (A15) becomes $\left[p_1 + \left(1-\beta^{-n}\right)(p_2+p_3)\right]\sigma_1(1-f\eta)$, 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 equations (17) and (19) apply generally to settings in which tax credits are received prior to the resolution of investment uncertainty.

Appendix B. Variable descriptions

Compustat Measures

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

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

- Cash flow is the ratio of the current year's operating income plus depreciation (iqitem 8 + iqitem 5) to the prior year's net property, plant, and equipment (iqitem 42), divided by 1000.

- Size-Age 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 (iqitem 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 capped at thirty-seven years.

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

- Operating lease (flow measure) is rental expense (iaitem 47) plus changes in rental commitments for the next five years (iaitem 95) divided by lagged book assets (iaitem 6), following Park (2012). This is an annual, not quarterly, measure.

Dealscan Measures

- Restrictiveness is measured in four different ways as discussed in Section 4.
  - **Measure 1: Average number of all financial covenants attached to a loan.** This measure is the expected number of all financial covenants attached to a loan for firm i at time t. For example, if firm i has two loan packages at time t, one with 5 financial covenants, and the other with no financial covenants, then the measure is 2.5.
  - **Measure 2: Fraction of loans with any financial covenants.** This measure is the expected value of a dummy variable indicating the presence of at least one financial covenant for a loan by firm i at time t. In the example above, the fraction of loans including any financial covenants at time t is 0.5.

  - **Measure 3: Average number of Capital Expenditure covenants attached to a loan.** This measure is calculated in the same way as Measure 1, except that only Capital Expenditure covenants ("Max Capital Expenditure") are counted.
  - **Measure 4: Average number of EBITDA covenants attached to a loan.** This measure is calculated in the same way as Measure 1, except that only EBITDA-related covenants ("Max Debt to EBITDA," "Max Senior Debt to EBITDA," and "Min EBITDA") are counted.

- BorrowingDummy is equal to one when a firm has a new loan at time t; zero otherwise.
- LoanAmount is the sum of all private loan amounts, reported in Dealscan, that firm i starts at time t, divided by total assets. By construction, it is positive when BorrowingDummy is one; zero otherwise. Observations with LoanAmount greater than 100% are dropped.
- Number_of_Lenders is the average number of lenders associated with loans that firm i starts at time t.
- Loan_Duration is the average duration of loans that firm i starts at time t, divided by 1000.

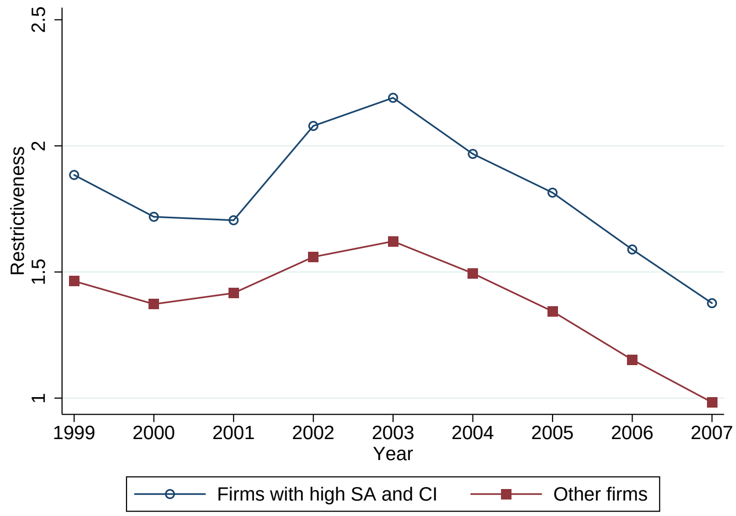
Appendix C. Firm characteristics comparison across firm types

Panel A presents summary statistics for firms in the Dealscan-Compustat merged sample from 1999 to 2001. Type I includes firms that started at least one new loan both before and during the bonus period. Type II includes firms that started at least one new loan before the bonus depreciation period, but did not start a new loan during the bonus depreciation period. Type III includes firms that started at least one new loan during the bonus depreciation period, but not before. Panel B presents differences between mean values of Type II firms and Type III firms; figures in parentheses are standard errors.

Variables	Panel A			Panel B
	Type I	Type II	Type III	Type II vs. Type III Comparison
Number of firms	2151	1430	1146	
Size	6.6063	5.3649	5.4753	.1114*** (.0241)
Age	16.8023	12.0445	14.8064	2.7619*** (.1683)
Size-Age index	-3.5587	-3.0617	-3.1954	-.1336*** (.0108)
Capital intensity	.3530	.3069	.3199	.0129*** (.0033)
log(Total assets)	6.6636	5.2523	5.3346	.0823*** (.0253)
log(Property, plant and equipment)	5.2971	3.6539	3.8174	.1635*** (.0315)
Likelihood of starting a new loan	.1763	.1383	n/a	n/a

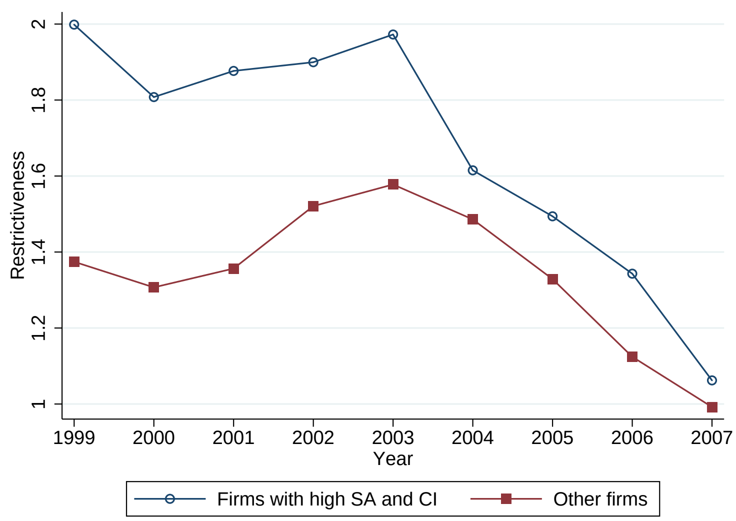
Appendix D. Supplementary tables and figures

Figure A1. Robustness checks for Figure 4



Note: Firms with high SA and CI are those with average SA indexes and capital intensities both in the top 1/4 of the sample firms.

Figure A2. Robustness checks for Figure 4



Note: Firms with high SA and CI are those with average SA indexes and capital intensities both in the top 1/2 of the sample firms.

Table A1: Number of firms by capital intensity measured in 1997 and 2000

		CI_{2000} deciles									
		1(low)	2	3	4	5	6	7	8	9	10(high)
CI_{1997} deciles	1(low)	1150	710	392	224	94	108	60	48	12	12
	2	373	895	734	401	218	79	62	46	11	15
	3	213	473	753	761	345	181	75	20	27	4
	4	181	244	419	774	778	321	92	63	16	14
	5	116	106	219	434	829	747	259	85	36	12
	6	64	78	71	136	444	993	729	259	40	11
	7	60	36	61	108	145	392	1154	734	139	68
	8	63	15	20	70	67	145	456	1211	645	133
	9	27	20	28	16	37	65	110	509	1496	593
	10(high)	57	20	30	12	14	23	39	111	556	1961

Table A2: Determinants of debt covenant intensity with quarterly GDP growth rates

The sample consists of firms in the Dealscan-Compustat merged sample that borrowed at least once during the 1999-2007 period. The dependent variable in columns (1) and (2) is the average number of total financial covenants attached to a loan; the dependent variable in columns (3) and (4) is the fraction of loans with any covenants; the dependent variable in columns (5) and (6) is the average number of Capital Expenditure covenants attached to a loan; and the dependent variable in columns (7) and (8) is the average number of EBITDA covenants attached to a loan. The specifications in the even-numbered columns include industry-year fixed effects. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively. All standard errors are clustered at the firm and year-quarter level. Variable definitions appear in Appendix B. Quarterly GDP growth rates are constructed quarter-over-quarter. For this table, S-A index and capital intensity index are standardized to have zero mean and unit variance.

Dependent Variable:	Average number of all covenants		Fraction of loans with any covenants		Average number of CapEx covenants		Average number of EBITDA covenants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
S-A	.2556**	-.0032	.1682***	.1046***	.0245	-.0066	-.1814***	-.2356***
	(.1206)	(.1240)	(.0368)	(.0384)	(.0301)	(.0326)	(.0501)	(.0533)
S-A * C-I	-.0018	.0410	.0315	.0469*	-.0088	-.0065	.0060	.0341
	(.0755)	(.0933)	(.0237)	(.0281)	(.0183)	(.0238)	(.0312)	(.0375)
Bonus * S-A	-.0159	-.0158	-.0058	-.0017	.0003	.0052	.0162	.0127
	(.0288)	(.0318)	(.0097)	(.0103)	(.0076)	(.0083)	(.0118)	(.0134)
Bonus * C-I	-.0156	-.0624	-.0096	-.0203	-.0032	-.0133	-.0183	-.0321**
	(.0276)	(.0419)	(.0090)	(.0128)	(.0066)	(.0101)	(.0118)	(.0172)
Bonus * S-A * C-I	.0631**	.0631**	.0115	.0129	.0207***	.0201***	.0253**	.0193
	(.0280)	(.0312)	(.0097)	(.0104)	(.0071)	(.0077)	(.0112)	(.0130)
S-A * GDP	.0081	.0114*	.0014	.0024	.0005	.0015	.0014	.0032
	(.0063)	(.0066)	(.0021)	(.0022)	(.0016)	(.0017)	(.0025)	(.0027)
C-I * GDP	.0049	.0040	.0022	.0023	.0013	-.0008	-.0010	-.0022
	(.0068)	(.0077)	(.0022)	(.0024)	(.0015)	(.0017)	(.0026)	(.0030)

Table A2– *Continued from previous page*

Dependent Variable:	Average number of all covenants		Fraction of loans with any covenants		Average number of CapEx covenants		Average number of EBITDA covenants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
q	-.0188	-.0336**	-.0028	-.0061	-.0086*	-.0109**	-.0084	-.0117*
	(.0161)	(.0159)	(.0062)	(.0057)	(.0044)	(.0050)	(.0067)	(.0067)
Cash Flow	.0410	.0514	-.0050	-.0022	-.0284	-.0224	.0008	.0069
	(.1050)	(.1038)	(.0264)	(.0303)	(.0279)	(.0296)	(.0449)	(.0510)
Loan Amount	-.0065	-.0038	-.0035	-.0027	-.0003	-.0005	.0021	.0025
	(.0079)	(.0062)	(.0033)	(.0027)	(.0008)	(.0008)	(.0024)	(.0028)
Loan Duration	.0785***	.0719***	.0172	.0181	.0012	.0005	.0242*	.0214
	(.0135)	(.0143)	(.0120)	(.0124)	(.0016)	(.0025)	(.0138)	(.0153)
Number of Lenders	.0192***	.0191***	.0065***	.0065***	.0021***	.0021***	.0068***	.0068***
	(.0015)	(.0015)	(.0005)	(.0005)	(.0003)	(.0003)	(.0006)	(.0006)
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	12270							
Firms	3929							

Table A3: Determinants of debt covenant intensity for years 1999, 2000 and 2001

The sample consists of firms in the Dealscan-Compustat merged sample that borrowed at least once in 1999, 2000 or 2001. The dependent variable in columns (1) and (2) is the average number of total financial covenants attached to a loan; the dependent variable in columns (3) and (4) is the fraction of loans with any covenants; the dependent variable in columns (5) and (6) is the average number of Capital Expenditure covenants attached to a loan; and the dependent variable in columns (7) and (8) is the average number of EBITDA covenants attached to a loan. The specifications in the even-numbered columns include industry-year fixed effects. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively. All standard errors are clustered at the firm and year-quarter level. Variable definitions appear in Appendix B. For this table, S-A index and capital intensity index are standardized to have zero mean and unit variance.

Dependent Variable:	Average number of all covenants		Fraction of loans with any covenants		Average number of CapEx covenants		Average number of EBITDA covenants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
S-A	-.9900**	-1.3746***	-.2333	-.3235**	.0568	-.0277	-.3403**	-.4986***
	(.4063)	(.4265)	(.1481)	(.1575)	(.1396)	(.1403)	(.1660)	(.1759)
S-A * C-I	-.1708	-.4004	-.1043	-.1687	.1849*	.1397	.0468	-.0359
	(.3702)	(.3990)	(.1322)	(.1442)	(.0998)	(.1058)	(.1495)	(.1595)
Year2001 * S-A	-.0996*	-.1326**	-.0391**	-.0458**	.0053	-.0062	-.0041	-.0265
	(.0579)	(.0642)	(.0190)	(.0203)	(.0158)	(.0170)	(.0233)	(.0261)
Year2001 * C-I	-.0803	-.0976	-.0410*	-.0457	.0219	.0342	.0002	.0022
	(.0701)	(.1028)	(.0225)	(.0299)	(.0178)	(.0225)	(.0286)	(.0427)
Year2001* S-A * C-I	.0490	.0390	.0102	.0050	.0354**	.0256	.0301	.0096
	(.0627)	(.0700)	(.0198)	(.0211)	(.0164)	(.0169)	(.0242)	(.0250)
q	-.0114	-.0234	.0030	-.0002	-.0068	-.0081	-.0061	-.0073
	(.0219)	(.0244)	(.0054)	(.0055)	(.0068)	(.0069)	(.0088)	(.0093)

Table A3 – *Continued from previous page*

Dependent Variable:	Average number of all covenants		Fraction of loans with any covenants		Average number of CapEx covenants		Average number of EBITDA covenants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	-.0629	-.0148	-.0258	-.0295	-.0103	.0051	.0037	.0092
	(.0555)	(.1019)	(.0185)	(.0314)	(.0178)	(.0246)	(.0459)	(.0595)
Loan Amount	.0022	.0044	.0000	.0006	.0011	.0013	.0005	.0006
	(.0055)	(.0062)	(.0014)	(.0015)	(.0012)	(.0012)	(.0020)	(.0022)
Loan Duration	-3.6439***	-3.0823**	-1.7687***	-1.5827***	-.0918	-.0813	-1.2669**	-1.1869**
	(1.3523)	(1.3480)	(.4190)	(.4224)	(.2862)	(.2752)	(.5640)	(.5553)
Number of Lenders	.0284***	.0282***	.0091***	.0090***	.0026***	.0027***	.0089***	.0090***
	(.0032)	(.0033)	(.0011)	(.0012)	(.0005)	(.0005)	(.0011)	(.0011)
Years	1999, 2000, 2001							
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	4371							
Firms	2697							

Table A4: Determinants of debt covenant intensity for years 1999, 2000 and 2002

The sample consists of firms in the Dealscan-Compustat merged sample that borrowed at least once in 1999, 2000 or 2002. The dependent variable in columns (1) and (2) is the average number of total financial covenants attached to a loan; the dependent variable in columns (3) and (4) is the fraction of loans with any covenants; the dependent variable in columns (5) and (6) is the average number of Capital Expenditure covenants attached to a loan; and the dependent variable in columns (7) and (8) is the average number of EBITDA covenants attached to a loan. The specifications in the even-numbered columns include industry-year fixed effects. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively. All standard errors are clustered at the firm and year-quarter level. Variable definitions appear in Appendix B. For this table, S-A index and capital intensity index are standardized to have zero mean and unit variance.

Dependent Variable:	Average number of all covenants		Fraction of loans with any covenants		Average number of CapEx covenants		Average number of EBITDA covenants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
S-A	-.7602**	-.8600**	-.0310	-.0345	.0726	.0240	-.3462**	-.3541**
	(.3843)	(.3889)	(.1122)	(.1160)	(.0912)	(.0941)	(.1549)	(.1547)
S-A * C-I	-.2995	-.2826	-.0562	-.0188	.0597	.0382	-.0288	.0216
	(.3310)	(.3442)	(.1142)	(.1184)	(.0747)	(.0795)	(.1280)	(.1310)
Year2002 * S-A	-.2083***	-.2126***	-.0550**	-.0445*	-.0092	.0004	-.0366	-.0535
	(.0715)	(.0813)	(.0216)	(.0230)	(.0178)	(.0193)	(.0298)	(.0342)
Year2002 * C-I	.0108	-.2162*	.0079	-.0290	-.0026	-.0161	-.0134	-.0615
	(.0819)	(.1113)	(.0254)	(.0316)	(.0196)	(.0239)	(.0137)	(.0444)
Year2002 * S-A * C-I	.0809	.1303*	.0200	.0400	.0291*	.0372**	.0568**	.0600*
	(.0708)	(.0770)	(.0233)	(.0245)	(.0168)	(.0173)	(.0286)	(.0319)
q	-.0038	-.0094	.0054	.0048	-.0082	-.0080	.0049	.0047
	(.0210)	(.0226)	(.0065)	(.0065)	(.0064)	(.0067)	(.0094)	(.0093)

Table A4 – *Continued from previous page*

Dependent Variable:	Average number of all covenants		Fraction of loans with any covenants		Average number of CapEx covenants		Average number of EBITDA covenants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	-.0094	-.1244	-.0011	-.0019	-.0027	-.0041	-.0125	-.0451
	(.0708)	(.1206)	(.0224)	(.0380)	(.0106)	(.0215)	(.0441)	(.0591)
Loan Amount	.2946	.2994	.0663	.0711	.0330	.0383	.1012	.0990*
	(.1956)	(.1894)	(.0532)	(.0523)	(.0301)	(.0287)	(.0628)	(.0600)
Loan Duration	-1.4509	-.9361	-.8552**	-.6899	.0276	.0279	-.5924	-.4015
	(1.4503)	(1.3839)	(.4333)	(.4362)	(.2771)	(.2712)	(.5381)	(.5131)
Number of Lenders	.0232***	.0226***	.0078***	.0075***	.0021***	.0021***	.0069***	.0066***
	(.0033)	(.0034)	(.0012)	(.0012)	(.0007)	(.0007)	(.0011)	(.0011)
Years	1999, 2000, 2002							
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	4331							
Firms	2738							

Table A5: Determinants of debt covenant intensity for years 1999, 2000 and 2003

The sample consists of firms in the Dealscan-Compustat merged sample that borrowed at least once in 1999, 2000 or 2003. The dependent variable in columns (1) and (2) is the average number of total financial covenants attached to a loan; the dependent variable in columns (3) and (4) is the fraction of loans with any covenants; the dependent variable in columns (5) and (6) is the average number of Capital Expenditure covenants attached to a loan; and the dependent variable in columns (7) and (8) is the average number of EBITDA covenants attached to a loan. The specifications in the even-numbered columns include industry-year fixed effects. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively. All standard errors are clustered at the firm and year-quarter level. Variable definitions appear in Appendix B. For this table, S-A index and capital intensity index are standardized to have zero mean and unit variance.

Dependent Variable:	Average number of all covenants		Fraction of loans with any covenants		Average number of CapEx covenants		Average number of EBITDA covenants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
S-A	.1368	.0969	.1240	.1255	.2063**	.2041*	-.1756	-.2106
	(.3886)	(.3881)	(.1150)	(.1183)	(.1040)	(.1067)	(.1496)	(.1497)
S-A * C-I	.4759	.5580	.1038	.1248	.2012**	.2512***	.1568	.2232
	(.3630)	(.3699)	(.1210)	(.1253)	(.0868)	(.0929)	(.1314)	(.1326)
Year2003 * S-A	-.1439*	-.0772	-.0517**	-.0288	.0036	.0164	.0289	.0375
	(.0776)	(.0813)	(.0235)	(.0243)	(.0214)	(.0228)	(.0323)	(.0351)
Year2003 * C-I	.1067	.1253	.0221	.0247	.0324	.0155	.0098	.0219
	(.0901)	(.1156)	(.0302)	(.0361)	(.0247)	(.0292)	(.0357)	(.0470)
Year2003 * S-A * C-I	.1856***	.2234***	.0337	.0555**	.0465**	.0398*	.0814***	.0646**
	(.0688)	(.0756)	(.0223)	(.0239)	(.0197)	(.0207)	(.0286)	(.0320)
q	-.0008	-.0124	.0054	.0029	-.0023	-.0037	.0027	.0023
	(.0199)	(.0222)	(.0063)	(.0061)	(.0057)	(.0065)	(.0078)	(.0081)

Table A5 – *Continued from previous page*

Dependent Variable:	Average number of all covenants		Fraction of loans with any covenants		Average number of CapEx covenants		Average number of EBITDA covenants	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash Flow	1.0069	1.2477	.3849	.5679	-.0668	-.0124	1.6452***	1.9809***
	(1.6406)	(1.8595)	(.5791)	(.6113)	(.6520)	(.6476)	(.5515)	(.4935)
Loan Amount	.0089	.0021	.0036	.0013	.0001	.0015	.0159	.0156
	(.0440)	(.0408)	(.0102)	(.0097)	(.0069)	(.0068)	(.0192)	(.0168)
Loan Duration	-1.7872	-.8364***	-1.3824	-1.0962	.0754	.1563	-.6458	-.4034
	(1.5206)	(1.5063)	(.4597)	(.4670)	(.3251)	(.3160)	(.5930)	(.5870)
Number of Lenders	.0225***	.0219***	.0067***	.0066***	.0022***	.0022***	.0075***	.0074***
	(.0026)	(.0027)	(.0008)	(.0009)	(.0005)	(.0005)	(.0010)	(.0010)
Years	1999, 2000, 2003							
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	4258							
Firms	2631							