

(How) Do Taxes Affect Capital Structure?*

Andrew MacKinlay[†]

January 2012

Abstract

I find the effect of taxes on firms' overall debt usage to be insignificant. Rather than influencing the total debt in firms' capital structure, taxes affect the relative composition of debt. Firms shift from private intermediated debt to public bond debt in response to increases in marginal tax rates. Firms' debt policy is most sensitive to tax rates in high interest rate environments. In policy experiments, I find that proposed tax law changes would likely have little effect on debt usage.

*I am indebted to my dissertation committee, Michael Roberts (Chair), Itay Goldstein, Mark Jenkins, and Krishna Ramaswamy for many helpful discussions and guidance. I also thank Andy Abel, Jennifer Blouin, Vincent Glode, Todd Gormley, David Musto, Greg Nini, Christian Opp, Nick Roussanov, Ivan Shaliastovich, Nicholas Souleles, and Luke Taylor for their comments. Financial support from the Robert R. Nathan Fellowship is gratefully acknowledged.

[†]The Wharton School, University of Pennsylvania, 2300 Steinberg-Dietrich Hall, 3620 Locust Walk, Philadelphia, PA 19104. Email: acmackin@wharton.upenn.edu. Phone: (610) 304-8756.

United States tax law provides firms with an incentive to issue debt. The extent to which firms react to this incentive is unclear. Fama and French (1998) are unable to find evidence of a positive relation between leverage and firm value. In contrast, Graham (2000) estimates that the tax benefits of debt are large and that the typical firm could add considerably to its value by increasing its leverage ratio. In survey evidence, Graham and Harvey (2001) find that CFOs consider interest tax savings to be moderately important for debt policy, ranking behind financial flexibility and cash flow volatility concerns, but ahead of transaction costs and distress costs. Reviewing the evidence, Myers concludes that although there are examples of specific tax-driven financing tactics such as financial leases, “finding clear evidence that taxes have a systematic effect on financing *strategy*, as reflected in actual or target debt ratios, is much more difficult.” (Myers, 2003, p. 225).

This paper contributes to the debate by evaluating the role of taxes in firms’ debt and equity issuance decisions. Specifically, I estimate firm-specific demand curves for debt capital. These curves capture the probability that a firm will issue debt as a function of its cost, its tax rate, and other relevant firm characteristics. Unconditionally, I find no relation between marginal tax rates and debt issuance.¹ This result holds not only for how likely a firm is to issue debt, but also when the quantity of debt issued is considered.

Although the overall demand for debt is insensitive to marginal tax rates, marginal tax rates do affect the composition of a firm’s debt. Recognizing that debt is heterogeneous and debt structure is an important element of capital structure (Rauh and Sufi, 2010), I separate debt into two major types: privately raised bank debt and publicly issued bond debt. As marginal tax rates increase, firms substitute away from private bank debt and into public bond debt. An increase in firms’ marginal tax rates alters the relative after-tax costs of the two debt types and makes the more expensive but less restrictive public debt more desirable.

Conditionally, the effect of taxes on capital structure is strongest in high interest rate environments. Differences in taxes matter when the value of interest tax shields is potentially large.

¹The marginal tax rate is defined as the present value of current and futures taxes paid on an additional dollar of current period income.

In these environments, the largest shifts between public and private debt occur and high-tax firms are more likely to issue debt. In periods with low costs of debt, there is little observed difference in the issuance behavior of firms attributable to taxes.

The incentive to operate with high leverage because of the tax deductibility of interest paid on debt is a popular policy issue. Some policymakers advocate lowering the corporate tax rate to induce firms to take on less debt. They argue that these lower debt levels would reduce firms' risk of bankruptcy and aggregate risk in the economy. Using my demand estimates, I investigate the impact of such a hypothetical corporate tax cut on firm financing choices. Consistent with the results discussed above, altering the corporate tax rate does not change firms' overall propensity to issue debt. Instead, firms move from public bond debt to private bank debt, and this move is most pronounced in market environments when the cost of debt is highest. Because firms raise similar quantities of debt in the public and private debt markets, the substitution would not translate into lower leverage ratios. Although there may be other reasons for corporate tax reform, the leverage channel does not appear to be important.

Several empirical studies have found a significant positive relation between firms' marginal tax rates and debt usage.² My paper recognizes that observed capital structures are the product of firms' demand for financial capital and capital markets' willingness to supply this capital. Recent research provides evidence that the condition of lenders affect the price and quantity of capital available to firms.³ To the extent that supply shocks occur in specific debt markets, such as bank loans or public bonds, the relative cost and availability of these different types of debt change as well.

In equilibrium, the cost of debt is simultaneously determined by firms' demand for capital and the supply conditions of banks and other capital providers. Because the cost is correlated with other relevant firm characteristics, not all of which are observable, a naïve estimation finds that firms are not sensitive to the cost of debt. To address this endogeneity and properly identify

²See MacKie-Mason (1990), Graham (1996a), and Graham, Lemmon, and Schallheim (1998).

³These papers include Faulkender and Petersen (2006), Sufi (2009), Leary (2009), Lemmon and Roberts (2010), and Chava and Purnanandam (2011).

the role of the cost of debt capital, I use exogenous variation in the capital supply of banks and insurance companies. This supply variation, provided by unrelated bank loan losses and insurance losses, allows me to isolate firms' demand curves for both private and public debt from the observed issuance decisions.

When properly identified, firms' demand for debt is strongly decreasing in its cost. Firms with higher marginal tax rates are more profitable, less risky, and therefore face a lower pre-tax cost of debt. In traditional regressions of financial policy measures on proxies for the marginal tax rate, these two sources of variation—tax incentives and cost differences driven by future profitability—are commingled. Separating the two sources of variation, the effect of taxes on overall debt usage is minimal. Although many theoretical studies use taxes as the key debt policy determinant, this result suggests alternative mechanisms may be of higher importance.

Although the focus of this paper is on the role of taxes in capital structure, the framework used here is not limited to that question. Isolating firms' demand curves for debt from observed capital structure is important for understanding the role of any potential friction to the debt decision. These demand curves show whether commonly cited frictions—such as distress costs, agency conflicts, and information asymmetries—are actively considered by firms, or if the observed data that is consistent with these frictions is an artifact of changes in the supply of capital. When frictions do affect firm demand, the shift in demand curves resulting from these frictions quantifies their relative importance.

The remainder of the paper is structured as follows. Section 1 describes the empirical hypotheses. Section 2 presents the empirical model. Section 3 discusses the data used for this study. Section 4 discusses the endogeneity and instrumentation of the cost of debt. Section 5 presents the results. Section 6 presents the policy implications, and Section 7 concludes.

1 Empirical Hypotheses

Because this paper explicitly incorporates both the pre-tax cost of debt and multiple types of debt, I first present a stylized model to illustrate the main effects at work for taxes and the pre-tax cost of debt. In the main empirical specification in Section 2, the model is generalized to allow for additional factors that affect debt policy. The stylized model is a simple linear demand equation:

$$D_D(\tau_C, r_D) = \alpha - \beta(1 - \tau_C)r_D, \quad (1)$$

where the firm's demand for debt is a function of its marginal tax rate, τ_C , and its pre-tax cost of debt, r_D . Demand factors unrelated to taxes and the cost of debt are represented by the coefficient α . The firm's demand is decreasing in the after-tax cost of debt, $\beta(1 - \tau_C)r_D$, where $\beta > 0$.

Equation (1) abstracts from many other factors that feed into the firm's debt decision. The purpose of this simpler demand function is to develop hypotheses for how tax rates and the pre-tax cost of debt affect the firm's demand for debt; these factors are included in the estimated generalized demand function. Considering the pre-tax cost of debt in equation (1), it follows that holding all else equal, a firm's demand for debt capital is decreasing in its cost.

Hypothesis 1: Firms with a higher pre-tax cost of debt capital are less likely to issue debt,

$$\frac{\partial D_D(\tau_C, r_D)}{\partial r_D} = -\beta(1 - \tau_C) < 0. \quad (2)$$

For example, if the pre-tax cost of private debt increases, firms should move to other types of capital or refrain from raising external capital altogether.

Because interest payments are tax-deductible, a firm with a higher taxable income benefits from debt financing. For a firm with no taxable income or already fully shielded income, the tax shields associated with new debt are not usable and therefore not valuable. In equation (1), this benefit is captured by $(1 - \tau_C)$, where τ_C varies from the top statutory rate for a firm with

substantial taxable income to near zero for a firm with little or no taxable income.

Hypothesis 2: Firms facing a higher tax rate demand debt more than firms facing a lower tax rate,

$$\frac{\partial D_D(\tau_C, r_D)}{\partial \tau_C} = \beta r_D > 0. \quad (3)$$

Another implication of equation (1) is that differences in τ_C among firms lead to heterogeneity in the reaction to changes in the pre-tax cost of debt capital, r_D . Specifically, for firms with higher tax rates, a given change in the pre-tax cost of debt has a more muted effect on the demand for debt.

Hypothesis 3: Firms with a higher tax rate are less sensitive to changes in the pre-tax cost of debt capital than firms with a lower tax rate,

$$\frac{\partial^2 D_D(\tau_C, r_D)}{\partial r_D \partial \tau_C} = \beta > 0. \quad (4)$$

Because $\partial D_D(\tau_C, r_D)/\partial r_D < 0$, the positive derivative in equation (4) means that $\partial D_D(\tau_C, r_D)/\partial r_D$ is negative but with smaller magnitude the higher τ_C . Hypothesis 3 concerns a tax effect on the elasticity, as opposed to the level, of demand for debt. When the pre-tax cost of debt is omitted from the estimation, this effect is ignored.

These implications apply to a firm focusing on a single debt option. A firm's demand for debt is different when there are multiple debt types. With different debt types, the linear demand equation can be expanded:

$$D_{D1}(\tau_C, r_{D1}, r_{D2}) = \alpha - \beta(1 - \tau_C)r_{D1} + \gamma(1 - \tau_C)r_{D2}. \quad (5)$$

In this equation, debt is one of two types ($D1$, $D2$), and the cost of the other type of debt is directly incorporated into the demand equation. If $\gamma > 0$, an increase in the cost of the other debt type makes the current option more desirable. Assuming r_{D1} represents the pre-tax cost of private debt, the firm's demand for private debt is now a function of its own cost and the

pre-tax cost of public debt, r_{D2} . A change in tax rate now has two effects:

$$\frac{\partial D_{D1}(\tau_C, r_{D1}, r_{D2})}{\partial \tau_C} = \beta r_{D1} - \gamma r_{D2}. \quad (6)$$

The first term in the derivative is the same effect as stipulated in Hypothesis 2. With multiple debt types, there is a countervailing effect, $-\gamma r_{D2}$. This second term captures the extent to which the firm substitutes to the other debt type as tax rates change. Because tax rates affect demand for debt through the cost of debt, the levels of r_{D1} and r_{D2} determine how a firm reacts to a tax-rate change. The relative magnitudes of the two terms in equation (6) could lead the firm to demand *less* of a type of debt as its marginal tax rate increases.

2 Empirical Model

The hypotheses in Section 1 are empirically testable. The firm's demand for debt, D_D , is typically specified in one of three ways. The most common approach is to use the firm's leverage ratio (Rajan and Zingales, 1995; Graham et al., 1998; Rauh and Sufi, 2010). Alternatively, one can consider changes in the quantity of debt issued (Graham, 1996a). The third alternative is to focus on discrete debt issuances and consider the probability of a firm issuing debt (MacKie-Mason, 1990; Gomes and Phillips, 2005).

Because each debt decision has two components—the quantity of debt chosen and the type of debt chosen—none of these alternatives fully captures the firm's demand for debt. Using leverage ratios or changes in total debt ignores the type of debt issued. Even if one considers the quantity of debt or leverage ratio for a specific type of debt, as in Rauh and Sufi (2010), the explicit choice of the type of debt is not modeled. Considering the discrete issuance decisions of firms, the quantity choice is necessarily de-emphasized.

To consider the role of taxes when the firm chooses between types of debt with different characteristics, this paper focuses on the discrete issuance decision. As equation (5) suggests, debt types with different costs and characteristics imply additional tax effects. These additional

effects are ignored when debt is treated as a single entity. Looking at discrete issuance decisions allows measurement of these additional effects. If these additional effects are significant, how a firm substitutes across different types of debt is an important consideration for understanding observed capital structure and the impact of potential tax policy changes.

The importance of the type of debt does not make the quantity of debt an irrelevant concern. Although not the central focus, Section 5.5 considers the empirical hypotheses in terms of the quantity of debt chosen. Section 5.5 also discusses how firms' quantity decisions may affect inferences about firms' debt-type decisions.

Because I test how a firm's issuance decision depends on both characteristics of the firm (particularly its marginal tax rate) and the pre-tax cost of different types of debt, I use a conditional logit framework. This model is well-developed in the economics literature, going back to McFadden (1974). Each firm has three security choices—public debt, private debt, and equity—and can opt not to raise external capital.⁴

The key assumption of the model is that for the set of possible security issuance choices, including foregoing issuance, the firm chooses the option in its best interest. The value to firm i of issuing security j in calendar year-quarter t is captured by the latent variable v_{ijt} . Because v_{ijt} is not directly observable, it is inferred from the observed decisions of firms over time. Given that only relative preferences are revealed by observed firm decisions, the absolute level of v_{ijt} is not identified. To address this issue, I normalize by assuming $v_{ijt} = 0$ for the option of not issuing any security. A choice with a value of $v_{ijt} > 0$ denotes the security issuance is more favorable than the option of not issuing, and a value of $v_{ijt} < 0$ denotes the security issuance is less favorable than not issuing.

⁴Allowing firms the outside option of choosing not to issue a security is important for a few reasons. First, although the firms I consider have all raised external capital, they do not do so regularly. Specifying the model as being conditional on a firm issuing a security would ignore the dynamics that compel a firm to raise capital in the first place. Without including this option, for any changes in firm or security characteristics, the model assumes the firm would still raise capital. It is plausible, however, that a firm may delay or decide not to raise capital if the cost of the security or the firm itself undergoes a material change. Using a model which includes the outside option does not impose this restriction.

For purposes of estimation, v_{ijt} is characterized as follows:

$$v_{ijt} = \underbrace{\beta_{0,j} + \beta_1 r_{ijt} + \beta_{2,j} \tau_{it} + \beta_{3,j} \tau_{it} \cdot r_{ijt} + \beta'_{4,j} f_t + \beta'_{5,j} m_t}_{v_{ijt}^o} + \varepsilon_{ijt}. \quad (7)$$

The variable v_{ijt} is a function of observables, v_{ijt}^o , and an unobserved error term, ε_{ijt} . The observable part v_{ijt}^o is composed of a security-specific constant $\beta_{0,j}$, the pre-tax cost of debt or equity capital, r_{ijt} , the firm's marginal tax rate, τ_{it} , other firm characteristics f_t , and macroeconomic variables m_t . The error term, ε_{ijt} , captures any unobserved or unspecified drivers of demand. Because certain variables, such as firm characteristics and macroeconomic variables, do not vary over security choices for a specific firm in a specific quarter, their impact is captured by permitting the coefficients to vary by security type j . As such, a positive coefficient denotes that an increase in the related variable increases the demand for that security, relative to the outside option. The cost of the outside option is set to zero.

Equation (7) is a generalization of the simple linear demand given by equation (1). The firm characteristics, macroeconomic variables, and the security-specific constant in equation (7) are included to control for the non-tax and non-cost determinants of the firm's demand for a specific type of capital. In equation (1), these elements are included in α . One additional generalization is the inclusion of τ_{it} separate from r_{ijt} . This term allows for the possibility that the firm's marginal tax rate affects the firm's decision beyond its effect on the cost of debt. If taxes play a role only through adjusting the cost of debt, as equation (1) assumes, the coefficient $\beta_{2,j}$ should be zero.

Although equation (7) has been the focus of discussion until this point, the conditional logit estimation gives the firm's demand as the probability of issuing that security. The probability of issuance, P_{ijt} , is defined as:

$$P_{ijt} = Prob(v_{ijt}^o + \varepsilon_{ijt} > v_{ikt}^o + \varepsilon_{ikt}, \forall k \neq j). \quad (8)$$

The value of P_{ijt} depends not only on the latent value of security j , v_{ijt} , but also on the latent value of all the other security choices for firm i in quarter t . In other words, the probability of a firm issuing public debt depends not only on the cost of public debt and whether the firm's characteristics make public debt desirable, but also on the cost of private debt and whether the firm's characteristics make private debt desirable. Because the model is structured in this manner, it captures not only how changes in the pre-tax cost of public debt affect the demand for public debt, but also how changes in the pre-tax cost of private debt affect the demand for public debt. Therefore the model captures the cross-elasticities that are modeled in equation (5).

The model can be estimated using standard conditional logit estimation techniques but for two complications. First, there is a missing data issue. The pre-tax costs of public and private debt for firms are only observed when one of these types is chosen. Imputing the missing pre-tax cost of debt data is discussed in Section 3.3. Second, the pre-tax cost of debt is endogenous to the firm's demand for debt. This endogeneity issue and the instrumental variables approach used to resolve it are discussed in detail in Section 4.

3 Data and Summary Statistics

The sample of firms chosen is restricted to nonfinancial firms that are in the Compustat universe and have a Standard and Poor's credit rating between A+ and B-. The sample of firms are constructed this way for two reasons. First, focusing on firms with a public debt rating assures that the different securities choices—private debt, public debt, and equity—are all feasible for the firms considered. Second, a firm's credit rating aids in estimating the cost of the different securities. This results in 1,644 unique nonfinancial firms from the first quarter of 1988 through the first quarter of 2010.

3.1 Issuance Data

Data on firms' issuance decisions comes from three sources. For the private debt market, I use the DealScan database, which covers both single-lender and syndicated multiple-lender loans. For the public debt market, I use the Mergent FISD database for origination information. For equity issuance, I track issuances using quarterly split-adjusted share growth data from CRSP: in order to restrict equity issuances to those that are related to raising capital and not for executive compensation, I require the amount raised to be at least 3% of the previous quarter's book assets.

For modeling purposes, I assume a firm can only raise one type of capital in a given calendar year-quarter. When a firm issues multiple securities in the same calendar year-quarter, I use the following procedure. The issues are aggregated to provide the total amount of capital raised in that quarter, and then classified under the type that the majority of the capital is raised under. If the majority is a debt issuance, the maturity and yield are determined from a value-weighting of the individual issues. In practice, most firms do not issue across the security types used here. In the final sample, only 451 firm-quarters issued both equity and debt simultaneously, and only 646 issued both private and public debt. Given the 29,487 total firm-quarters in the final sample, multiple issuances that cross security types account for only 3.5% of the sample.

Table 1 details how firms raise capital in the sample period: on average, 79.3% of firms do not raise capital, 9% of firms issue private debt, 8.1% of firms issue public debt, and 3.6% of firms issue equity in a given quarter. The average yield to maturity that a firm pays to raise debt is 5.87% for private debt and 7.24% for public debt. Private debt tends to be shorter term in maturity, with an average maturity of 4.2 years compared to 12.5 years for public debt.

The amount of capital raised varies across types. Public debt issuances raise \$388 million on average, whereas private debt raises \$859 million. Private debt amounts are the total capital that *can be* drawn from the issuance, and not necessarily the actual amount drawn. This distinction may partly explain why private debt has higher capital amounts.⁵ The average equity

⁵About 25% of private debt issuances included a revolving credit line. The average capital raised for private

issuance is substantial at \$729 million, and that average is the result of substantial skew; the median equity issuance being much smaller at \$135 million. This amount compares to median values of \$250 million for public debt and \$394 million for private debt. Although there are a few enormous equity issuances in the sample, the majority are smaller than for other types of external capital.

3.2 Firm Characteristics and Macroeconomic Variables

Table 1 also includes the firm characteristics that are used in the demand estimation. All firm characteristics are from the quarter prior to the issuance decision. The exceptions are the simulated marginal tax rate and statutory tax rate variables, which are from the most recent fiscal year prior to the current calendar quarter. Because the focus is on the tax incentives of security issuance, proxied for by the marginal or statutory tax rate variable, the other variables are included as controls for the elements of security demand that are unrelated to tax considerations.

The *Marginal Tax Rate (MTR)* variable is from John Graham's website. A firm's future income is simulated using a constrained random walk process; the expected present value of additional current and future taxes from one extra dollar of current-period income is determined by averaging over these simulations.⁶ The *Statutory Tax Rate* variable is defined as the current U.S. federal statutory tax rate given the firm's taxable income minus any tax loss carry forwards.

The *Market-to-Book* ratio is included to capture differences in investment opportunities of firms. Asset tangibility (*Tangibility*), defined as the ratio of fixed assets (property, plants, and equipment) to total book assets, is included to capture differences in collateral among firms. Because firms with higher marginal tax rates may have higher current and future profitability, I include three additional variables. *Profitability* is simply last quarter's operating income scaled

⁶Graham (1996b) argues the simulated tax rates are the best available proxy for marginal tax rates. More details as to the variable's construction can also be found in Graham and Mills (2008). See Blouin, Core, and Guay (2010) for an alternative method of simulating future income for the purposes of calculating marginal tax rates.

by book assets. *Profitability Drift* is the average quarterly change in the firm's operating income scaled by last quarter's book assets.⁷ *Profitability Volatility* is calculated similarly, but is the volatility of quarterly operating income scaled by last quarter's book assets. These drift and volatility variables are used to control for differences in the future profitability of the firm.

Earnings Yield, the cost-of-equity variable, is calculated with firm-specific earnings forecasts from the IBES database.⁸ The quarterly stock return (*Stock Return*) is included as an additional control for changes in equity valuation, and the *Earnings Surprise* variable is a proxy for information asymmetry. *Altman's Z-Score* captures differences in the financial condition of firms.⁹

In considering incremental debt and equity issuances by firms, the model should account for the existing capital structure. I include the existing total leverage ratio (*Leverage*) of firms, the ratio of short-term debt to assets (*Short-Term Debt to Assets*), and the ratio of cash to assets (*Cash to Assets*). These variables capture the extent of pre-existing leverage, how much debt is due in the coming year, and how much cash is on hand to absorb any financing needs.

When firms do use the external markets, they raise substantial amounts of capital. The average capital raised as a percent of the previous quarter's book assets ranges from 13% for equity and public debt to 19% for private debt. In order to capture differences in the need for funds among firms, I include a *Financing Need* variable. This variable is the sum of the internal funding deficit of a firm over the past four quarters prior to the current calendar quarter, scaled by the previous quarter's book assets.

Beyond issuance and firm accounting variables, some additional macroeconomic and supply-side variables are used as controls in the analysis. United States government debt yield data and other U.S. macroeconomic data comes from the St. Louis Federal Reserve (FRED) database. Quarterly year-over-year GDP growth (*GDP Growth*) is included to capture the effect of larger

⁷This average operating income change is computed on a rolling basis, requiring a minimum window of five years. Results are unchanged if the estimation window is restricted to five years.

⁸Specifically, earnings yield is the median forecast of earnings for the next four quarters divided by the share price as of the end of the last calendar quarter.

⁹See Appendix A for additional details about variable construction.

business-cycle variation on security-issuance decisions; the CRSP value-weighted stock return index (*CRSP VW Market Return*) captures aggregate stock market movements. The three-month treasury bill rate (*3-Month T-Bill*) is also included to capture changes in interest rates driven by U.S. monetary policy. Like the firm variables, these macroeconomic variables are from the prior quarter in the estimation.

3.3 Cost of Debt and Equity

In the framework used here, the cost of public debt, private debt, and equity are needed for every firm-quarter to estimate equation (7). When the firm issues public or private debt, the yield to maturity is a clear measure of the pre-tax cost. Establishing the pre-tax cost if the firm did not issue debt, however, poses a problem. To address this missing data, the pre-tax cost of debt for public and private debt are imputed from the observed issuances of firms that did raise debt. Specifically, I assume that the pre-tax cost of debt for a firm in a given quarter is the same as what other firms of similar credit risk pay, adjusting for observable firm characteristics that affect the pre-tax cost of debt. This assumption provides a means to estimate the pre-tax cost of debt for securities not chosen:

$$r_{ijt} = \gamma_0 + \gamma_1' f_{it} + \gamma_2' \mathbf{1}_{cr} + \gamma_3' \mathbf{1}_t + \epsilon_{ijt}, \quad (9)$$

where the pre-tax cost of debt for security j for firm i in year-quarter t is a function of firm characteristics, f_{it} , as well as credit rating (cr) and year-quarter fixed effects. I estimate equation (9) separately for private and public debt and use the estimated coefficients to generate the yields on each security for each firm-quarter. The coefficients for this estimation are presented in Table 2.¹⁰

One issue is that if debt is risky, the yield is not the same as the cost of debt (Berk and

¹⁰An alternate specification, in which credit rating by year-quarter fixed effects are used instead of separate credit rating and year-quarter fixed effects, generates very similar results. The main specification has the advantage that for quarters in which very few securities are issued in a specific credit rating, the average yield captured by the fixed effects is far less noisy.

DeMarzo, 2009). As a final step, these imputed yields, denoted \hat{r}_{ijt} , are adjusted by the firm's probability of default and the security type's expected loss, given default. The probability of default is specific to the credit rating of the firm, and the loss rate is dependent on whether the security is a bank loan (the assumption for private debt) or an unsecured senior bond (the assumption for public debt).¹¹ This adjustment makes the imputed yields a better approximation of the pre-tax cost of debt capital for the firm.

The pre-tax cost of debt for a firm also depends on the specifics of the particular debt contract, such as the quantity of capital raised, the maturity of the contract, and any additional contract provisions that make the debt more or less risky. The nuances of specific contracts cannot be captured in the imputation done in equation (9). The imputed cost of debt should be considered as the yield associated with the average public or private debt issuance for firms with similar characteristics at that time. Differences in debt contracts that arise from differences in the credit quality and other characteristics of firms are captured in equation (9); the associated differences in yield are reflected in the imputation. To avoid comparing the actual yield for a chosen debt type, which reflects very specific contract terms, against the imputed yield for the other debt type, which is the average or typical yield for that type of firm, only the imputed yields are used in the estimation model.

A forecast-based earnings yield is used as a proxy for the cost of equity. Because the earnings yield is available every quarter for firms in the sample, an imputation step is not necessary.

¹¹Default probabilities and loss rates are calculated using Moody's annual corporate default and recovery rate data. Specifically, the default rate is determined as an annualized rate for defaults in each credit rating over the past ten years, calculated on a rolling basis. The expected loss on the security is taken to be 19.9% for private debt and 55.4% for public debt.

4 Identification Strategy

4.1 The Identification Problem

Estimating the effect of the pre-tax cost of debt in equation (7) is susceptible to three potential sources of endogeneity: a simultaneity bias, correlation with omitted security characteristics, and measurement error. Because the pre-tax cost is determined simultaneously by firm demand and capital supply, changes in the firm's demand for debt directly affect the cost at which the debt is available. In this case, increases in aggregate firm demand for debt increase the cost of debt, and thus the estimate of the effect of the pre-tax cost of debt in equation (7) is biased upward.

The firm's demand for a particular security is affected by omitted security characteristics that are correlated with the security's cost. Because the costs are imputed using time-fixed effects and firm characteristics, idiosyncratic omitted characteristics are not an issue. While these omitted characteristics are in the error term, they are not correlated with the imputed cost. Insofar as specific securities may undergo trends in characteristics at an aggregate level, these omitted characteristics remain correlated with the imputed costs. This type of endogeneity also biases the coefficient on the cost of debt in equation (7) upward.

Although the imputation step breaks the correlation between cost of debt and idiosyncratic omitted characteristics, the difference between the imputed cost of debt and true cost of debt is measurement error. When this measurement error is uncorrelated with the imputed cost, it is not problematic. If, instead, the classical errors-in-variables assumption holds that the true cost of debt and measurement error are uncorrelated, then the estimate of the coefficient for the cost of debt in equation (7) is attenuated toward zero. The remaining coefficients are also potentially biased depending on their correlation with the cost of debt.¹²

All three of these sources of endogeneity bias the coefficient for the cost of debt towards zero. For the simultaneity and omitted variable biases, the bias can lead to a positive coefficient

¹²For a more detailed discussion of the endogeneity issues associated with measurement error, simultaneity issues, and omitted variables, see Roberts and Whited (2011).

for the cost of debt in equation (7). In these extreme cases, the estimation implies that a firm prefers to pay *more* for debt capital, all else held equal. To identify the true effect of the cost of debt on the firm's demand for debt, I use an instrumental variables approach described below.

4.2 Control Function Approach

Focusing on the firm's demand for debt, the impact of these sources of endogeneity is best explained as an omitted variables bias. The unobserved error in equation (7) can be separated into two independent parts: $\varepsilon_{ijt} = \varepsilon_{ijt}^{(1)} + \varepsilon_{ijt}^{(2)}$. Let $\varepsilon_{ijt}^{(1)}$ be the demand shocks correlated with the imputed cost of debt, \widehat{r}_{ijt} . The true idiosyncratic preference shocks are captured by $\varepsilon_{ijt}^{(2)}$. This component contains any shocks not correlated with the observable variables, including the pre-tax cost of debt; by assumption it follows a type I extreme value distribution. This error assumption produces the traditional logit framework used in discrete choice models. The remaining error, $\varepsilon_{ijt}^{(1)}$, captures the simultaneity, omitted variable, and measurement error problems that bias the estimation. The correlation between this error and the cost of debt is addressed using instruments.

In a linear framework, instruments are applied using a two-stage least squares approach. In the first stage, the imputed cost is regressed on the instruments and observed demand characteristics:

$$\widehat{r}_{ijt} = \alpha'_0 z_{ijt} + \alpha'_{1,j} f_{it} + \alpha'_{2,j} m_t + \mu_{ijt}, \quad (10)$$

in which z_{ijt} are the instruments. Any potential instrument needs to satisfy two requirements: (1) it must affect the cost of debt (relevance), and (2) it must not factor into the firm's demand for a security (exclusion). Specifically, the instruments provide variation in the imputed yields that are not correlated with the problematic error, $\varepsilon_{ijt}^{(1)}$. Therefore, in equation (10), only μ_{ijt} is correlated with $\varepsilon_{ijt}^{(1)}$. The fitted values from equation (10) are by construction uncorrelated with μ_{ijt} , and hence $\varepsilon_{ijt}^{(1)}$. Replacing the original imputed cost with the fitted values corrects for the omitted variables bias in equation (7).

In the non-linear framework used here, there is an analogous approach which requires slightly more structure. Under the assumption that μ_{ijt} and $\varepsilon_{ijt}^{(1)}$ are not only correlated but are jointly normally distributed, estimates of μ_{ijt} resolve the omitted variables bias. Intuitively, instead using fitted values of \widehat{r}_{ijt} from equation (10) and thus eliminating the correlation with $\varepsilon_{ijt}^{(1)}$, the correlation is maintained but $\varepsilon_{ijt}^{(1)}$ is made observable. Once the problematic error is observable, the correlation is no longer a source of bias.

This methodology is referred to as the control function approach (Heckman and Robb, 1985; Rivers and Vuong, 1988; Petrin and Train, 2010). Since μ_{ijt} and $\varepsilon_{ijt}^{(1)}$ are assumed jointly normally distributed, $\varepsilon_{ijt}^{(1)}$ is a function of the estimates of the residuals μ_{ijt} from equation (10):

$$CF(\varepsilon_{ijt}^{(1)}) = \beta \widehat{\mu}_{ijt} + \sigma \eta_{ijt}. \quad (11)$$

Here β is the coefficient from the linear projection of $\varepsilon_{ijt}^{(1)}$ on μ_{ijt} , and η_{ijt} is a standard normal variable.¹³ This control function replaces $\varepsilon_{ijt}^{(1)}$ in the main estimation equation:

$$v_{ijt} = \beta_{0,j} + \beta_1 \widehat{r}_{ijt} + \beta_{2,j} \tau_{it} + \beta_{3,j} \tau_{it} \cdot \widehat{r}_{ijt} + \beta'_{4,j} f_t + \beta'_{5,j} m_t + \beta_6 \widehat{\mu}_{ijt} + \sigma \eta_{ijt} + \varepsilon_{ijt}^{(2)}. \quad (12)$$

Because the part of $\varepsilon_{ijt}^{(1)}$ that was correlated with \widehat{r}_{ijt} is observable through $\beta_6 \widehat{\mu}_{ijt}$, equation (12) can be estimated without β_1 being biased.¹⁴

After including imputed costs and the control function, the final form of v_{ijt} is equation (12). The probability of issuance derived from equation (12) is a mixed conditional logit because the error distribution is a mixture of a type I extreme value variable, $\varepsilon_{ijt}^{(2)}$, and a normal

¹³Specifically, under the assumption of u_{ijt} and $\varepsilon_{ijt}^{(1)}$ being jointly normally distributed, the coefficient is given by: $\beta = \frac{\rho \sigma_{\varepsilon^{(1)}}}{\sigma_u}$.

¹⁴The control function corrects the bias on $\beta_{3,j}$ as well. This aspect contrasts with the two-stage least squares approach, in which each interaction term is separately instrumented and replaced with fitted values. See Imbens and Wooldridge (2007) for more details.

variable, η_{ijt} . The probability of issuance is defined as:

$$P_{ijt} = \frac{1}{N} \sum_{n=1}^N \frac{\exp(\beta_{0,j} + \beta_1 \widehat{r}_{ijt} + \beta_{2,j} \tau_{it} + \beta_{3,j} \tau_{it} \cdot \widehat{r}_{ijt} + \beta'_{4,j} f_{it} + \beta'_{5,j} m_t + \beta_6 \widehat{\mu}_{ijt} + \sigma \eta_{n,ijt})}{\sum_{k=0}^J \exp(\beta_{0,k} + \beta_1 \widehat{r}_{ikt} + \beta_{2,k} \tau_{it} + \beta_{3,k} \tau_{it} \cdot \widehat{r}_{ikt} + \beta'_{4,k} f_{it} + \beta'_{5,k} m_t + \beta_6 \widehat{\mu}_{ikt} + \sigma \eta_{n,ikt})}, \quad (13)$$

where $\varepsilon_{ijt}^{(2)}$ is analytically integrated out, and the integration of η_{ijt} is approximated by simulation. Inspecting equation (13), it becomes clear why the imputed costs are necessary. The probability of firm i choosing security j in year-quarter t depends not only on the cost of security j , but on the costs of all other security choices. The coefficients are estimated via simulated maximum likelihood. To account for the estimation error that stems from the imputation and control function steps, all standard errors are estimated using a bootstrap approach. The bootstrap is blocked by firm to account for dependence in the residuals of a given firm over time.

4.3 Instruments in Detail

The residual μ_{ijt} incorporates any determinants of the pre-tax cost of debt beyond the observed variables in the first-stage equation (equation (10)). These shocks can be generated from the supply-side (such as a contraction in investor demand or available bank capital) or from the demand-side (such as unobserved contract terms or period-specific changes in firm preferences). The more μ_{ijt} purely captures the shocks coming from demand sources, the more effectively the control function addresses the omitted variables bias.

Appropriate instruments, therefore, need to capture the supply variation. For this purpose, this paper uses a combination of time-series and indicator variables. The first variable is the combination of various bank loan charge-offs (*Loan Charge-Offs*), constructed from the Chicago Federal Reserve's Call Report data. The loan charge-offs for foreign government loans, foreign mortgage loans, and U.S. farm loans for each bank are combined and normalized by total bank assets. This charge-off ratio affects the cost of bank debt through a simple supply argument. The more losses on loans a bank sustains, the less capital that has to lend to

corporate borrowers. Because the bank has a smaller supply of capital for the same borrower demand, it charges a higher yield for that capital. These particular charge-offs are unrelated to the security issuance decision of U.S. nonfinancial firms. Some of these loans arguably affect firm demand, as they are indicative of larger macroeconomic conditions. Because macroeconomic variables are included to control for changes in aggregate business conditions, the loan losses must have a unique impact on firm demand. The loan losses affecting firm demand, while unlikely, reduces the effectiveness of the instrument. In this case, the coefficient for the cost of debt is biased upwards.

Because different banks lend to different firms, banks are grouped into portfolios depending on the credit rating of their borrowers. The portfolio weight for each bank is determined by the total dollar amount the bank lends to firms of that credit rating. The total loan amount is taken from the four calendar quarters prior to the current period. The assumption is that these banks are the most likely to continue lending to each group of firms; any losses sustained by these banks affect the cost of private debt for these particular firms. These portfolios provide cross-sectional variation in loan losses in addition to the time-series variation.

The second instrument addresses capital supply in the public debt markets. A large portion of investors in the corporate bond market are large institutions such as insurance companies and pension funds. For example, private pension plans, property-casualty insurance companies, and life insurance companies invested \$171.2 billion on net in corporate bond debt in 2009. U.S. nonfinancial companies issued \$377.2 billion on net in corporate bonds in the same year.¹⁵ Any shock to the capital supply of these institutions lessens the pool available for corporate debt, driving up the required yield. Property-casualty insurance companies are particularly at risk of exogenous shocks to their capital, given the possibility of earthquakes, hurricanes, and other natural disasters. Certain insurance lines—those covering earthquakes, medical malpractice suits, and weather-related crop loss—are particularly suitable as instruments. Changes in medical malpractice losses or weather-related crop losses are unlikely to affect the broader

¹⁵Data is taken from the Federal Reserve's *Flow of Funds Accounts of the United States*, Flows and Outstandings, Second Quarter 2011.

corporate demand for debt. Insofar as any of these shocks reduce firm demand for financing, the cost of debt coefficient is biased upward. I use the ratio of aggregate losses and adjusted expenses to net premiums earned (*LAE Ratio*) from *A.M. Best's Aggregates and Averages* for specific insurance lines clearly unrelated to corporate demand for capital securities. Because shocks to the LAE ratio directly capture unexpected changes in available insurance capital, these shocks should impact bond yields. The LAE ratio is available as an aggregate value on an annual basis and is therefore the same for all firms in a given quarter.

The variation in these two instruments is plotted in Figure 1. Focusing on the loan charge-offs, there is significant variation, particularly in the late 1980s and early 1990s. Because the cross-section of bank charge-offs is divided into four portfolios that each lend to a particular credit grade in the sample (A, BBB, BB, B), there are four distinct datapoints in each calendar year-quarter. Much of the early variation reflects foreign government loan losses, and in particular, those related to loans by U.S. banks to Latin American countries. Focusing on the variation in LAE ratios, there are a few distinct shocks. The largest shock is a direct result of the January 17, 1994, Northridge earthquake in California: an estimated \$20 billion in damages resulted from the event. In addition, the major increase in losses in the early 2000s is driven by increasing medical malpractice losses. The sharp drop in 2005 and afterwards, then, captures the effect of medical malpractice losses dropping to lower levels.

Period-specific indicators mark exogenous shocks to capital and serve as additional instruments. Discussed in detail in Lemmon and Roberts (2010), three separate events coincided to provide a large supply shock for speculative-grade corporate debt at the end of 1989 and beginning of 1990: the collapse of Drexel Burnham Lambert, Inc., the passage of the Financial Institutions Reform, Recovery, and Enforcement Act of 1989, and regulatory changes in the insurance industry. Chava and Purnanandam (2011) use the Russian default on August 17, 1998, an adverse shock to the supply of bank credit; as such, it is included here as a shock to capital supply.

Table 3 presents the estimates from the first-stage regression (equation (10)) for the two

principal instruments—bank loan charge-offs and insurance LAE ratios. In terms of marginal effects, a one standard deviation increase in charge-offs is associated with an 10 to 38 basis-point increase in yields on private debt, depending on credit rating. For public debt, the impact of an increase in loan charge-offs is between 34 and 60 basis points, depending on credit quality. Charge-offs have a marked effect on yields, especially for speculative-grade firms.

The LAE ratios related to insurance companies should impact public-debt yields more than private-debt yields. Indeed, a one standard deviation increase in the LAE ratio increases public-debt yields about 16 basis points for A-rated firms. For A-rated firms' private debt, an increase in the LAE ratio is associated with a decrease in the cost of private debt. For firms in other credit ratings, the LAE ratio has a similar positive effect on public-debt yields as compared to the corresponding private-debt yields. For these lower credit ratings, however, the overall impact of changes in LAE ratio on public debt costs are not positive.¹⁶ These results suggests that insurance capital matters mainly in investment-grade public debt markets.

5 Results

5.1 Importance of the Cost of Debt

The framework generates an estimate of P_{ijt} for each firm-security-quarter. As equation (13) shows, P_{ijt} is a function of the demand equation variables; therefore, the impact of changing any individual variable can be measured. Varying the cost of debt gives a demand curve for that specific firm-security-quarter combination. By comparing these demand curves, the importance of different variables on firm demand for issuance can be quantified. Figure 2 plots the average demand curves for private debt for firm-quarters in both the highest and lowest quintiles of marginal tax rates. On each curve, the center point marks the average cost of debt for that quintile. The other points on the curve mark a one standard deviation change in the

¹⁶For BBB-rated and BB-rated firms the effect of a change in the LAE ratio on the cost of public debt are not significantly different from zero. For B-rated firms, the effect is significantly negative.

cost of debt, which is 1.94 percentage points in the sample.

Examining Figure 2, two facts stand out. First, the curves are strongly downward-sloping. Across all firm-quarters, a one standard deviation change in cost of debt changes the probability of issuance by 73%, for the main specification. In absolute terms, a firm is 7.75 percentage points less likely to issue debt on average. Because, on average, firms issue private debt 9% of the time in a specific year-quarter, these changes are economically large. In accordance with Hypothesis 1, debt issuance is strongly influenced by the cost of debt capital.

Second, high-tax firms do indeed issue private debt more than low-tax firms. The average probability of issuance for high-tax firms is 71 basis points higher than the average probability of issuance for low-tax firms. Furthermore, the average demand curves show that low-tax firms have a higher pre-tax cost of debt capital. Specifically, the high-tax firm-quarters have an average pre-tax cost of debt of 5.24%, compared to 6.12% for low-tax firm-quarters. A low marginal tax rate is correlated with firms having less-certain future profitability and therefore being riskier for investors. This increased risk causes lower marginal tax rate firms to have a higher pre-tax cost of debt capital. Given the 90% confidence intervals around each average demand curve, this difference in yield translates to distinct demand curves for high-tax and low-tax firms.

Figure 3 plots demand curves for public rather than private debt. Here, the difference in the average demand for debt is even more pronounced than for private debt. The highest-tax firm-quarters have an average demand for public debt of 10%, compared to 8% for the lowest-tax firm-quarters. At average yields of 6.09% for high tax firms and 6.54% for low tax firms, the pre-tax cost of debt for public debt is higher than private debt for both types of firms. Across the entire sample, a one standard deviation increase in the pre-tax cost of public debt (1.60 percentage points) corresponds to a decrease of 3.88 percentage points in the likelihood of issuance for the main specification. This change represents a 43% decrease in relative terms.

Figures 2 and 3 evidence three distinct phenomena. First, changes in the cost of debt significantly affect the demand for debt, consistent with Hypothesis 1. Second, high-tax firms

are more likely to issue each type of debt than low-tax firms. Finally, the yields faced by low-tax firms are consistently higher than those faced by high-tax firms. Comparing the average demand for high-tax and low-tax subsamples, a distinct difference in demand becomes evident.

5.2 Taxes and the Propensity to Issue Debt

Although the figures incorporate the pre-tax cost of debt in addition to standard firm-specific variables, it is instructive to consider a specification from which the cost is omitted. Because previous papers—for instance, Graham (1996a) and Graham et al. (1998)—find a positive correlation between simulated marginal tax rate and changes in leverage without directly including the cost of debt capital, such a specification serves as a comparative baseline. This specification is also helpful because these other papers consider leverage whereas I am looking at a binary issuance decision. A specification that excludes the pre-tax cost of debt shows the extent to which differences in the empirical framework drive results. Table 4 presents the logit estimates for this specification.

In the nonlinear framework applied here, the marginal effect of marginal tax rates on the demand for debt is more informative than the coefficient alone. The first column of Panel A of Table 8 presents the average marginal effect of an increase in the marginal tax rate on demand for the two debt types. For public debt, a one standard deviation increase in the marginal tax rate (15.3%) corresponds to a 67 basis point increase in the probability of issuance. Panel B of Table 8 presents the effect on demand in relative rather than absolute terms for each debt type. For public debt, the 67 basis point increase corresponds to a 7.3% change in the likelihood of issuance.

Considering private debt, I find no effect of marginal tax rates on issuance. This result shows that, even before including the cost of debt, an important heterogeneity exists in how firms treat debt. When debt is treated as a single entity, this heterogeneity is missed. The two individual marginal effects, taken together, create the comparable marginal effect of taxes on debt as a single entity. Thus, the effect of a one standard deviation increase in marginal tax

rates on debt is 61 basis points. The economic magnitude of this result is similar to that calculated in Graham (1996a), where increasing the marginal tax rate of a firm by 22% increases the amount of debt issued by between 1.52% and 2.79%, as a percent of capital structure. Although considering different samples and dependent variables, we both find a positive but not economically large effect of taxes on debt issuance.

With the first column of Table 8 serving as a benchmark, the second specification adds the security-specific cost of capital as well as the control function which addresses the endogeneity of the cost of debt. Incorporating the cost of debt has a marked effect on the role of taxes in the issuance decision. The importance of marginal tax rates on private debt changes from essentially zero in the first specification to *reducing* demand by 51 basis points in the second specification. At the same time, marginal tax rates have the same effect on public debt as in the first specification. This change shows that the overall impact of taxes on debt drops from increasing demand by 61 basis points in the first specification to only increasing demand by 14 basis points in the second specification. In other words, the effect of marginal tax rates is biased upward when the cost of debt is excluded.

This bias makes sense when comparing the demand curves in Figure 2. Because firms facing higher expected marginal tax rates tend to be safer firms with higher and less volatile future profitability, they have a lower pre-tax cost of debt. As evidenced by the marginal effect of yield on the issuance decision, changes in the cost of debt will, in large part, drive the issuance decision. By omitting this cost-of-debt channel, some of the impact of changes in cost of capital is falsely attributed to tax motivations.

5.3 Taxes and Debt Structure

Including a cost-of-debt measure in the issuance decision offers another insight: tax changes cause a substitution across debt types. Although the net effect on debt issuance is a 14 basis point increase—an effect not significantly different from zero—public debt issuance increases by 65 basis points or 7.72% in relative terms. Most of this increase comes at the expense of

private debt. When facing an increased tax burden, firms appear to prefer to shield income with public-bond debt rather than private-bank debt. As shown in equation (6), the firm's demand for debt experiences two counteracting effects when the marginal tax rate increases. The first effect is the straightforward increase in the demand for debt because the after-tax cost of debt is decreased; this appears to be the dominant effect for public debt. The second effect is the substitution across debt types when the after-tax cost of other debt types are similarly reduced by the tax-rate increase. For private debt, this substitution effect dominates when the marginal tax rate increases. Because the pre-tax cost of public debt is higher than the pre-tax cost of private debt, the tax-rate increase gives a larger reduction to the cost of public debt. The larger reduction to the cost of public debt makes public debt more desirable relative to private debt, and as a result, firms substitute towards public debt and actually issue *less* private debt in response to the tax-rate increase.

Finally, the third specification in Table 8 includes credit-rating fixed effects. This specification determines the extent to which the effects of yield and taxes are the result of variation across the credit spectrum, rather than variation over time among firms of similar credit qualities. The effect of the pre-tax cost of debt on debt issuance is strengthened when including credit-rating fixed effects, and the impact of taxes on the likelihood of issuing public debt is weakened. Because the marginal tax rate increases with credit quality, the marginal tax-rate effect results from higher credit quality firms issuing public debt more often than lower credit quality firms.

Although substitution among debt choices may occur when tax rates change, another explanation is that marginal tax rates capture an additional non-tax difference between firms. Marginal tax rates, for instance, may indicate differences in future profitability. As the marginal tax rate increases, so too does the the future profitability of the firm; this change, then, could lead firms to substitute from more restrictive bank debt to issuing bonds on the public market. To mitigate this concern, I calculate and include two measures of future profitability. The first measure is a firm-specific average change or drift in quarterly operating income, scaled by the

previous calendar year-quarter's book assets. The larger this measure, the more positive the trend in profitability. A firm-specific average volatility in quarterly operating income is calculated as a proxy for the variability of future profitability.¹⁷ These two measures control for differences in future profitability so as to avoid bias in the measure of tax effects.

As an additional robustness check, I re-perform the analysis using the statutory tax rate variable instead of the marginal tax rate variable. Because the statutory tax rate variable is calculated only from current period income and tax loss carry-forwards, confounding variation from differences future profitability is not a concern. The average marginal effect of statutory tax rate on debt issuance is presented in Table 9. The results for this alternate tax variable are similar to those with the marginal tax rate variable. When the statutory tax rate increases, firms issue more public debt but do not increase the likelihood of issuing private debt. The similarity of the results under this alternate tax measure support that the observed substitution effects are attributable to tax incentives and not omitted differences in future profitability.

5.4 Taxes and Cost of Debt Sensitivity

Hypothesis 3 concerns changes in the price-sensitivity of firm demand to changes in the marginal tax rate. As the marginal tax rate of a firm increases, the firm becomes less sensitive to changes in the pre-tax cost of debt. The intuition for this hypothesis comes from the fact that the same change in the pre-tax cost of debt, r_D , has impacts the after-tax cost of debt, $r_D(1 - \tau_C)$, less as the expected tax rate, τ_C , increases. Given that P_{ijt} is a function of the marginal tax rate, the pre-tax cost of debt, and their interaction, this implication is directly testable.

Table 10 shows the effect of a change in marginal tax rate on the cost-of-debt sensitivity ($\partial P_{ijt}/\partial r_D$). As the first specification does not include the cost of debt, only the second and third specifications are relevant. The results across these specifications are similar: no significant difference exists in the sensitivity of private debt across changes in the marginal tax

¹⁷In my sample, the profitability drift measure has a correlation of .10 with marginal tax rate and the profitability volatility measure has a correlation of -.12 with marginal tax rate.

rate. For public debt, a one standard deviation increase in the marginal tax rate is associated with firms having a cost of debt sensitivity that is 35 or 45 basis points more positive. Because cost-of-debt sensitivity is negative, a positive quantity denotes that firms are less sensitive to changes in the cost of debt as their marginal tax rate increases. In relative terms, a firm is 18% less sensitive on average when the marginal tax rate increases. Tax concerns, therefore, not only change the likelihood of issuing debt, but alter how firms react to changes in the pre-tax cost of debt.

5.5 Taxes and the Quantity of Debt

Because much of the previous literature investigates tax effects in terms of leverage or changes in the quantity of debt outstanding for the firm, it is fair to ask if the results above are an artifact of looking at the discrete issuance decision. Table 11 presents the effect of the firm's marginal tax rate on the quantity of debt chosen. The first specification does not include the pre-tax cost of debt and can be considered a quarterly analogue to the specifications run in Graham (1996a). As in Graham (1996a), a firm's marginal tax rate has a clear positive effect on the firm's total debt chosen. The second specification introduces the imputed pre-tax cost of debt, although here the cost is for all debt and does not distinguish between public and private debt.¹⁸ The effect of the cost of debt on the firm's debt choice is positive, although not statistically significant. Not controlling for the endogeneity of the cost of debt discussed in Section 4, the cost of debt plays no role or a slightly perverse one.

The third specification instruments for the endogeneity present in the cost of debt. Because the regressions here are linear, a simpler two-stage least squares approach is taken. The bank loan charge-offs and insurance LAE ratios are used as instruments. With instruments, the effect of an increase in the cost of debt is strongly negative. Further, just as in the discrete choice estimation, the importance of the marginal tax rate to the issuance decision drops by half. In fact, it no longer remains a significant determinant of the firm's change in its total debt. Even

¹⁸The cost imputation regression results for the single-debt case are available upon request.

for the choice of the quantity of debt issued or retired in a given quarter, the pre-tax cost of debt is the important determinant. Omitting the cost, this effect is falsely attributed to the firm's marginal tax rate.

6 Policy Implications

Recently, corporate tax reform has been a popular political topic. In August 2010, the President's Economic Recovery Advisory Board (PERAB) published a report on tax reform options. One of the central mandates of the report requires consideration of potential corporate tax-reform options. A central rationale for corporate tax reform relates directly to firm-issuance behavior:

Distortions in the corporate tax system have deleterious economic consequences. Because certain assets and investments are tax favored, tax considerations drive overinvestment in those assets at the expense of more economically productive investments. Because interest is deductible, corporations are induced to use more debt, and thus become more highly leveraged and take on more risk than would otherwise be the case. (United States. President's Economic Recovery Advisory Board., 2010, p.65).

One proposal reduces the corporate tax rate to mitigate perceived economic distortions. The effect on debt is stated directly: “[A] lower corporate tax rate would reduce the incentive to use debt rather than equity to finance new investments. This could result in lower debt levels, reducing the likelihood of financial distress at over-levered firms, and resulting in lower aggregate risks from corporate bankruptcies.” (United States. President's Economic Recovery Advisory Board., 2010, p.70). Part of the rationale, then, for corporate tax reform aims to affect corporate financing behavior.

Given that the firms' demand for debt is estimated as a function of taxes, the extent to which changes in tax policy impact firm behavior is testable. Obviously, changes in tax codes would have additional effects on firm balance sheets and even the equilibrium pricing of debt and equity. As the demand estimates allow direct investigation of one of the channels the proposed

reforms means to address, such an exercise is illustrative if somewhat limited.

The magnitude of a plausible tax cut is difficult to state definitively. However, on April 5, 2011, the House Republicans released their budget resolution for fiscal year 2012. The resolution proposes a 10% tax cut, lowering the highest statutory rate from 35% to 25% (U.S. House. Committee on the Budget., 2010). This amount serves as a plausibly-sized cut to quantify changes in issuance demand. The effect of a larger or smaller tax cut would scale as expected.

In Figure 5, the change in probability of issuing debt is plotted for the proposed 10% tax cut. In other words, the probability of issuing public or private debt in each firm-quarter is recalculated given a 10 percentage point cut in the firm's marginal tax rate.¹⁹ Figure 5a shows the effect for debt as a single category: the average change in issuance behavior is small, less than 1% over most of the sample.

Part of the reason for the negligible aggregate effect is that firms will likely react to the tax cut by switching from public-bond debt to private-bank debt. Figure 5b plots the change in issuance for each debt type separately. As expected, the probability of issuing debt decreases—but only for public debt. In fact, rather than just refraining from issuing any security or equity, private debt issuance increases. As discussed in Section 5.2, the relative desirability of public and private debt change as tax rates change. When tax rates decrease, the more expensive public debt becomes less desirable.

When considering the direct effect of tax rates on security issuance, taxes mainly affect what type of debt a firm issues, not whether the firm issues debt, equity, or abstains from raising external capital. These results suggest that any reduction of corporate tax rates would principally alter the composition of debt issued and not its overall usage.

¹⁹The effect of the tax cut is bounded at zero, so it can have a smaller effect for firms with already low or zero marginal tax rates. Also, because the marginal tax rate is a combination of expected future profitability and dynamic features of the tax code, a cut in the statutory rate will not necessarily have a one-to-one effect on the firm's marginal tax rate. It is unlikely, however, for a cut in the statutory rate to have more than a one-to-one effect, so a more nuanced adjustment of the marginal tax rate would only weaken the importance of the tax cut.

7 Conclusion

This paper disentangles the supply and demand factors that go into the firms' capital structure decision. Instrumenting for the endogeneity of the cost of debt, I directly incorporate the yield firms pay on debt securities when estimating their demand for capital. This estimation produces demand estimates as a function of firm characteristics, but also captures firm sensitivity to changes in the cost of debt, determinants of this sensitivity, and broad substitution patterns among security choices.

Using these estimates, I focus on the role of taxes in the capital structure decision. Excluding the pre-tax cost of debt from the demand equation, I find a positive relation between a firm's marginal tax rate and its probability of issuing debt. Including the pre-tax cost of debt in the demand equation, I find the positive relation between the probability of issuing debt and taxes disappears. This result stems from marginal tax rates being negatively correlated with the pre-tax cost of debt. A high marginal tax-rate firm has better future profitability, less risk, and can borrow capital at a lower rate. By omitting the pre-tax cost of debt capital, estimates of the importance of marginal tax rates are biased upward.

Firm demand is strongly downward sloping in the pre-tax cost of debt. A tax effect exists in the firm sensitivity to the pre-tax cost of public debt: specifically, high marginal tax-rate firms are less sensitive to changes in the pre-tax cost of public debt than low marginal tax-rate firms. This difference in sensitivity implies that the extent to which tax effects manifest in observed issuances depends on the current interest rate environment. When the pre-tax cost of public debt is higher than usual for firms, high-tax and low-tax firms' issuance choices are most distinct. When the pre-tax cost of debt is lower than normal, high-tax and low-tax firms issue debt with similar frequency. Thus, although firms consistently respond to taxes across all market environments, these responses are clearly observed only in times of higher pre-tax costs of debt. Taken together, these results confirm that tax rates do affect firms' capital structure, but their role is far more subtle than previously thought.

A Variable Definitions

The quarterly stock return variable is calculated using monthly CRSP data and the analyst's earnings surprise variable is constructed from IBES summary history data. The average median quarterly earnings estimate variable is the average of all previous median forecasts for quarter t up until the end of quarter t . For example, if the quarter ends in December 1998, I average the median quarterly earnings estimate from December 1998, November 1998, October 1998, September 1998, and so forth as far back as such estimates are available (usually one year). All other variables are derived from the Compustat quarterly database. For market-to-book, the monthly close stock price ($PRCCM$) is from the final month of the fiscal quarter. The financing need variable is the quarterly analogue of that used in Gomes and Phillips (2005).

$$\text{Firm Size} = \log(ATQ)$$

$$\text{Market-to-Book} = \frac{PRCCM * CSHPRQ + DLCQ + DLTTQ + PSTKQ - TXDITCQ}{ATQ}$$

$$\text{Tangibility} = \frac{PPENTQ}{ATQ}$$

$$\text{Profitability} = \frac{OIBDPQ}{ATQ}$$

$$\text{Profitability Drift} = \frac{\Delta OIBDPQ_{t,t-1,\dots}}{ATQ_t}$$

$$\text{Profitability Volatility} = \frac{\sigma(\Delta OIBDPQ_{t,t-1,\dots})}{ATQ_t}$$

$$\text{Altman's Z-Score} = \frac{3.3 * PIQ + SALEQ + 1.4 * REQ + 1.2 * (ACTQ - LCTQ)}{ATQ}$$

$$\text{Leverage} = \frac{DLCQ + DLTTQ}{ATQ}$$

$$\text{Short-Term Debt to Assets} = \frac{DLCQ}{ATQ}$$

$$\text{Cash to Assets} = \frac{CHEQ}{ATQ}$$

$$\begin{aligned} \Delta WRKCAP_t = & \Delta CHECHY + (-\Delta RECCHY_t) + (-\Delta INVCHY_t) \\ & - (\Delta APALCHY_t + \Delta TXACHY_t + \Delta AOLOCHY_t + \Delta FIAOY) \end{aligned}$$

$$\text{Financing Need}_t = \frac{\sum_{j=-3}^0 (\Delta CAPXY_{t-j} + \Delta WRKCAP_{t-j} - OIBDPQ_{t-j})}{ATQ_t}$$

$$\text{Stock Return} = (1 + ret_{month1}) * (1 + ret_{month2}) * (1 + ret_{month3}) - 1$$

$$\text{Earnings Surprise to Price} = \frac{|\text{Avg. Median Qrtly Earnings Estimate} - \text{Actual Qrtly EPS}|}{\text{Stock Price at Fiscal Quarter End}}$$

$$\text{Earnings Yield} = \frac{\text{Median Earnings Forecast for Next Year}}{\text{Stock Price at Fiscal Quarter End}}$$

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Supply-Side Instruments

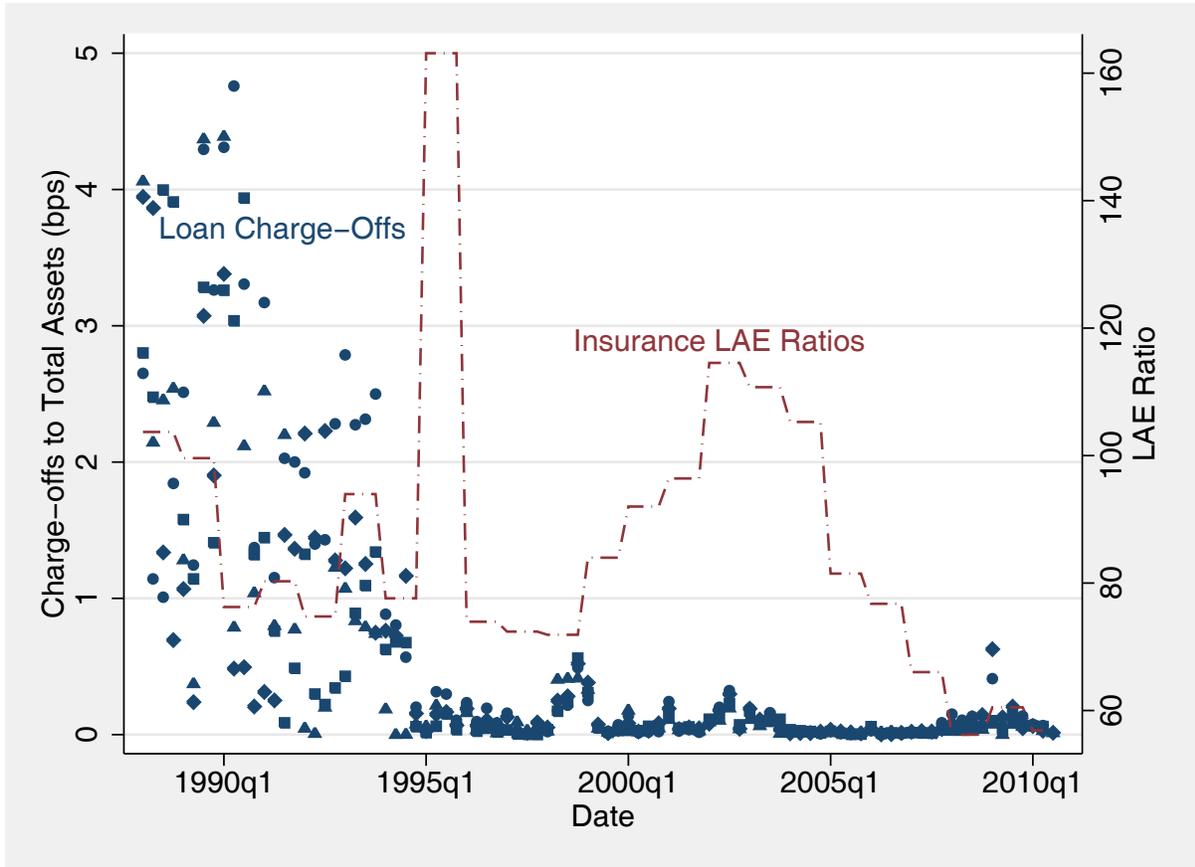


Figure 1: Average bank charge-offs for a portfolio of lenders to each credit rating divided by total bank assets, scaled to basis points. Insurance losses and adjusted expenses over net premiums earned (LAE Ratio). Bank charge-offs include foreign government loans, foreign mortgage loans, and farm loans. LAE Ratio includes medical malpractice, earthquake, and multiple crop peril lines.

Average Private Debt Demand Curves by Tax Quintile

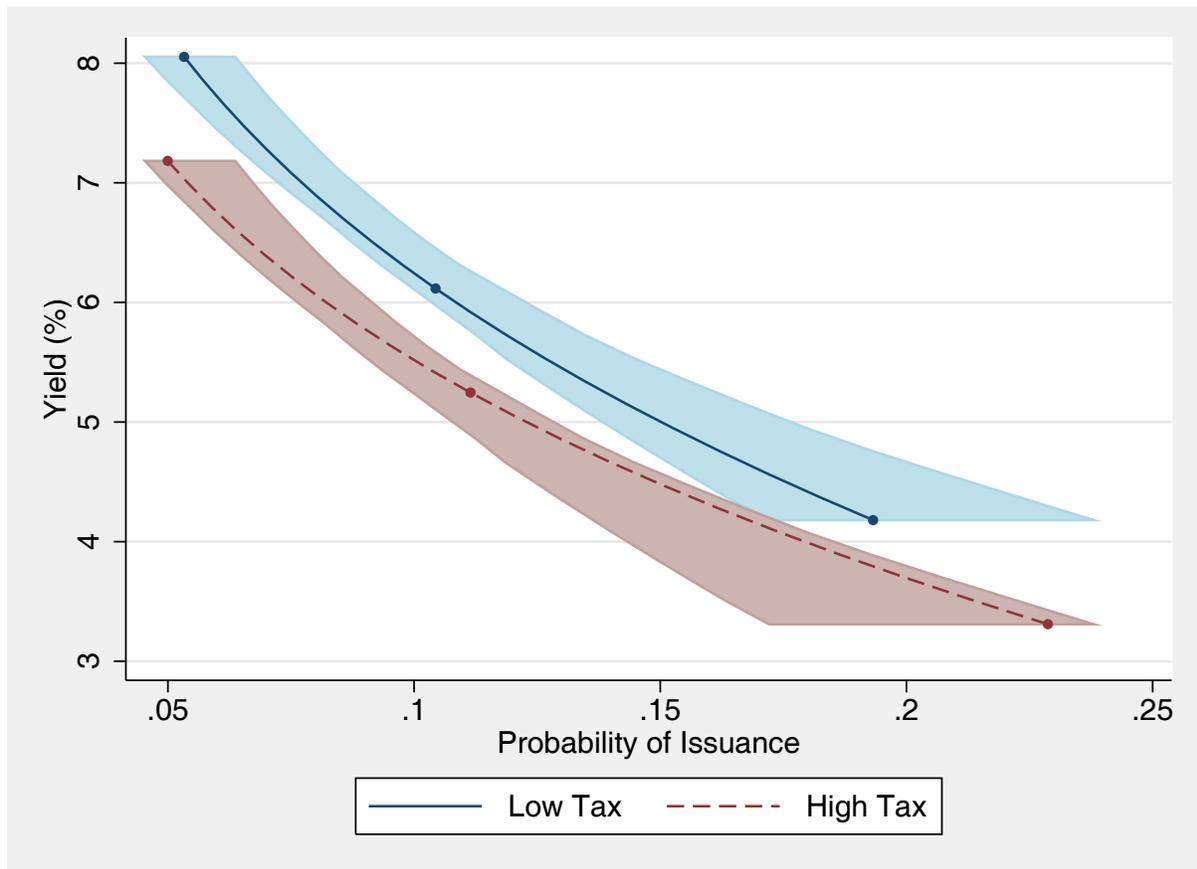


Figure 2: Average firm demand curves for privately-issued debt for firms in the highest and lowest quintiles of marginal tax rate. The center point on each curve is the average imputed yield paid on the security. The outer points are one standard deviation above and below the average imputed yield. One standard deviation in marginal tax rate is .153. One standard deviation in imputed yield is 1.94%. The 90% confidence intervals are given around the demand curves.

Average Public Debt Demand Curves by Tax Quintile

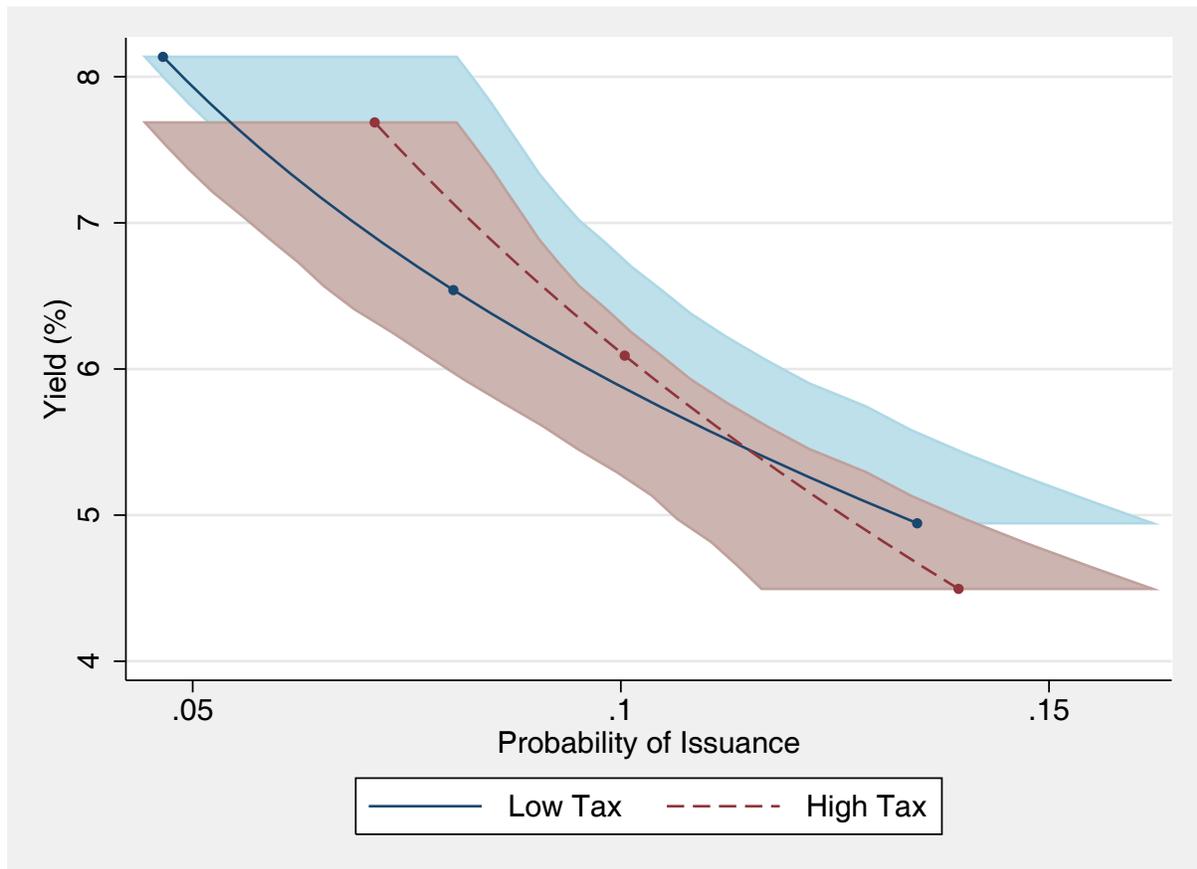
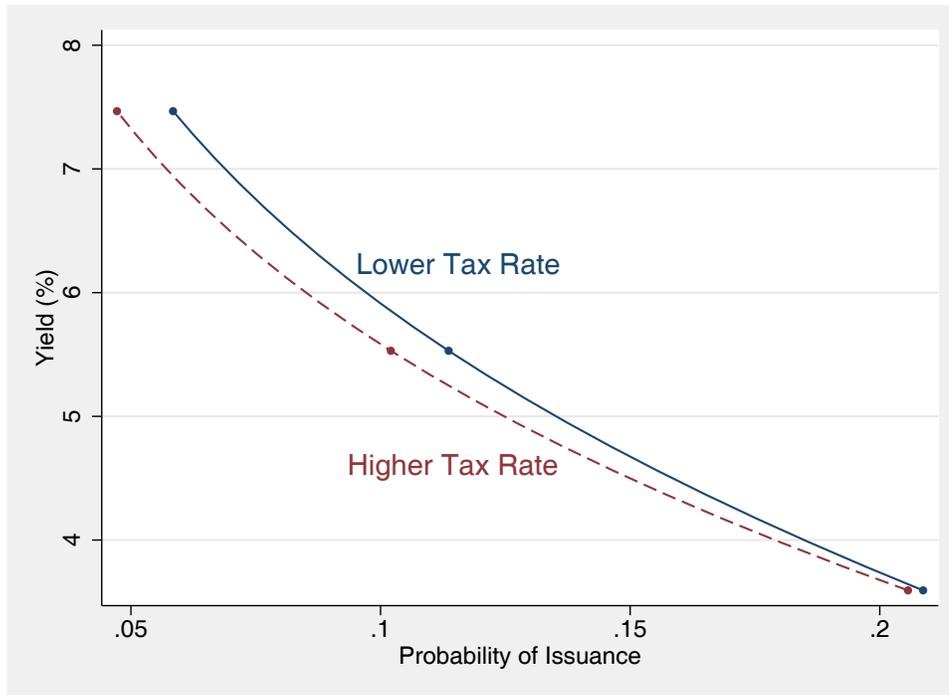
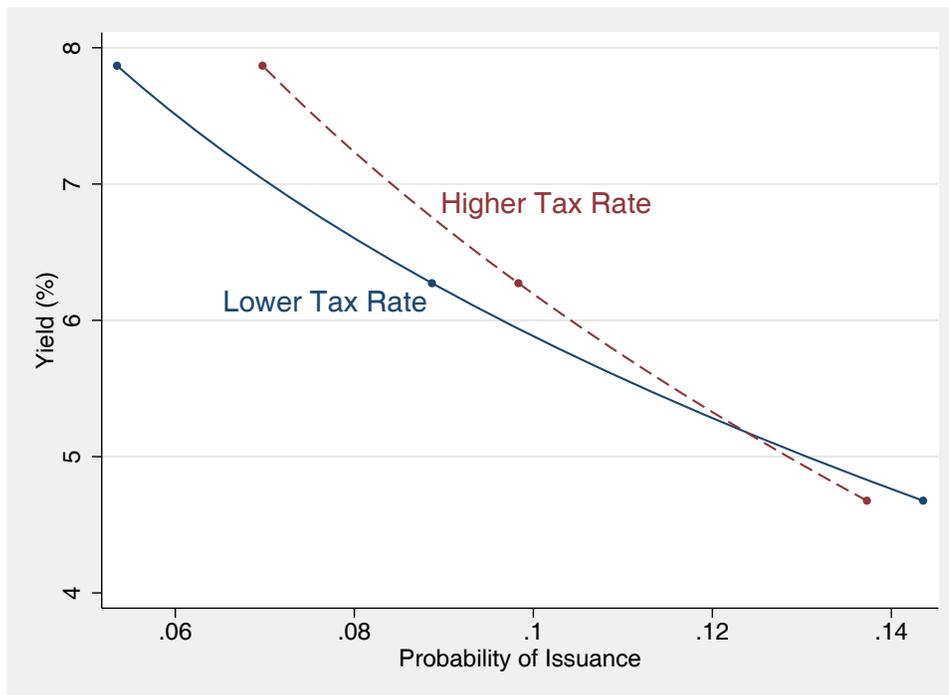


Figure 3: Average firm demand curves for publicly-issued debt for firms in the highest and lowest quintiles of marginal tax rate. The center point on each curve is the average imputed yield paid on the security. The outer points are one standard deviation above and below the average imputed yield. One standard deviation in marginal tax rate is .153. One standard deviation in imputed yield is 1.6%. The 90% confidence intervals are given around the demand curves.

AME of Marginal Tax Rate on Demand



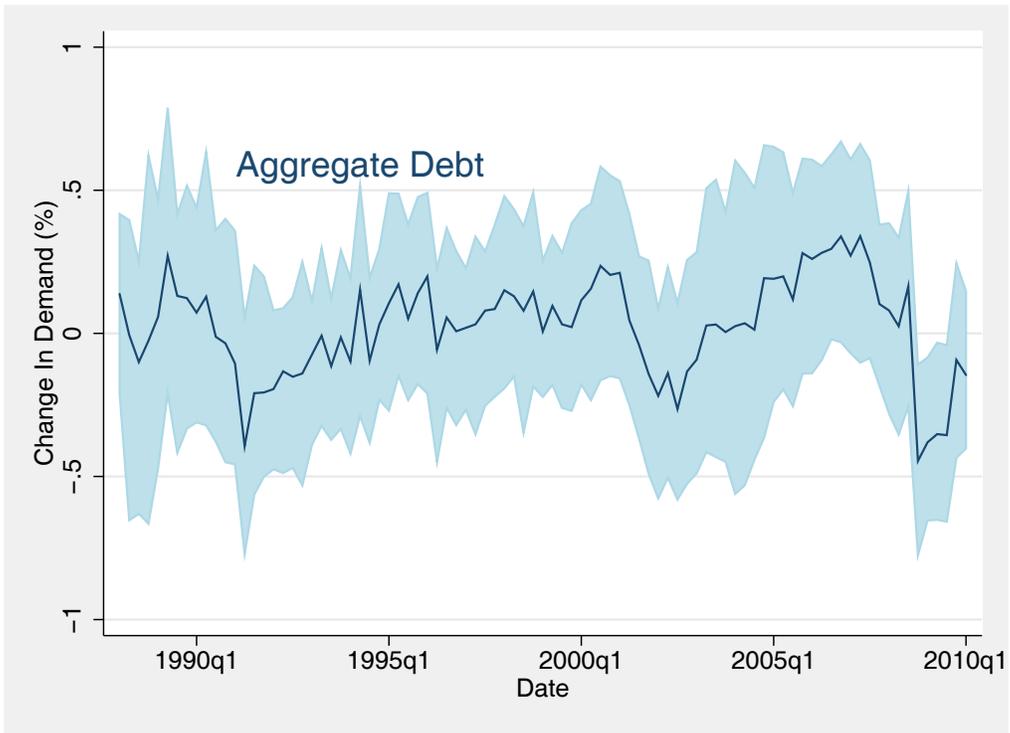
(a) Private Debt



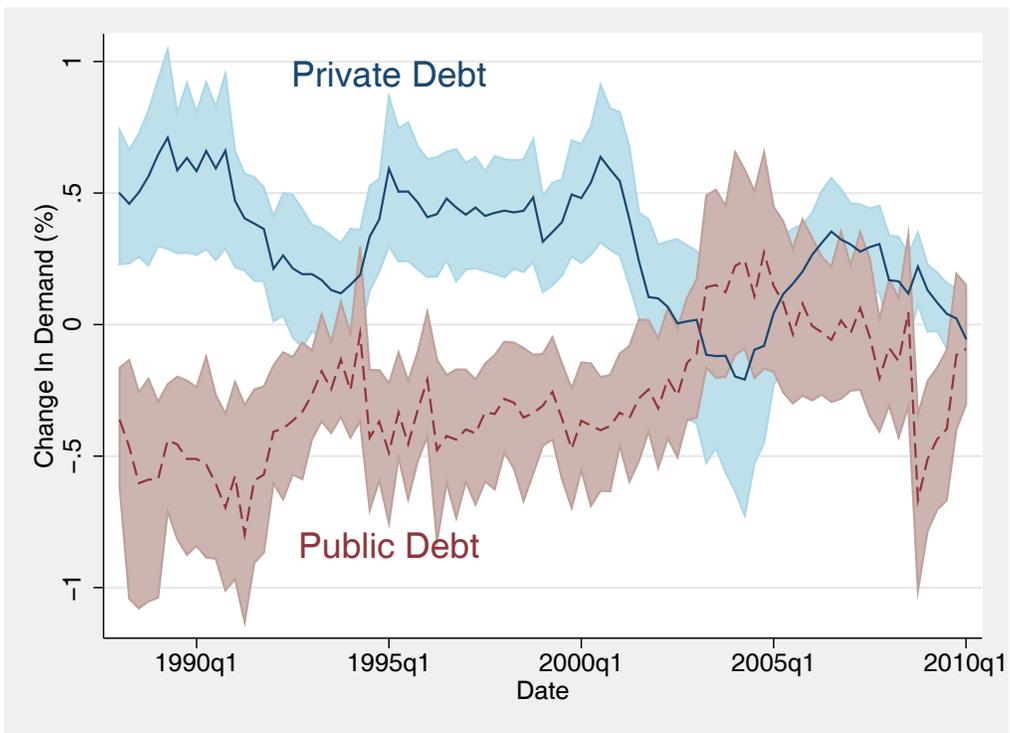
(b) Public Debt

Figure 4: Average marginal effect of a one standard deviation change in marginal tax rate. The center point on each curve is the average imputed yield paid on the security. The outer points are one standard deviation above and below the average imputed yield. One standard deviation in marginal tax rate is .153. One standard deviation in imputed yield is 1.94% for private debt and 1.6% for public debt.

Impact of a 10% Tax Cut



(a) All Debt



(b) By Type of Debt

Figure 5: Impact of a 10% tax cut on the probability of issuing debt over the sample. The 90% confidence intervals are provided around the estimated change. The demand estimates used are from Table 5.

Table 1: Summary Statistics

	Outside Option		Private Debt		Public Debt		Equity	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<i>Market-Level Variables</i>								
Market Share (%)	79.29	6.26	9.01	3.65	8.09	3.26	3.61	1.28
<i>Product-Specific Variables</i>								
Yield to Maturity (%)			5.87	2.37	7.24	2.50		
Maturity (Yrs.)			4.16	2.74	12.57	9.29		
Capital Raised (US\$ Mil.)			859	1,831	388	433	729	3,104
<i>Firm Characteristics</i>								
Firm Size (US\$ Mil.)	5,747	15,652	9,824	25,184	10,944	24,681	4,233	9,773
Marginal Tax Rate (%)	20.64	15.44	21.04	15.32	21.97	15.06	19.62	15.86
Statutory Tax Rate (%)	24.44	16.00	25.07	15.72	26.00	15.17	23.94	16.22
Market-to-Book	1.15	0.63	1.17	0.65	1.16	0.68	1.70	1.09
Profitability*	3.32	2.14	3.38	1.98	3.15	1.95	3.49	2.52
Profitability Drift*	0.01	0.13	0.01	0.12	0.02	0.10	0.04	0.12
Profitability Volatility*	1.16	1.05	1.02	0.91	0.94	0.84	1.05	1.09
Tangibility	0.42	0.25	0.41	0.24	0.47	0.26	0.38	0.26
Earnings Yield (%)	6.83	4.01	6.80	3.82	6.49	3.81	5.23	3.43
Stock Return (%)	2.15	24.70	3.09	22.41	4.89	24.17	13.15	31.10
Earnings Surprise to Price*	1.88	17.30	1.46	12.51	1.05	3.18	0.89	3.60
Altman's Z-Score	0.53	0.62	0.53	0.57	0.44	0.53	0.53	0.70
<i>Capital Structure Variables</i>								
Capital Raised to Assets*			18.60	19.83	13.06	17.36	13.29	15.62
Leverage*	39.26	20.75	38.47	19.33	39.88	17.88	35.90	19.78
Short-Term Debt to Assets*	4.26	6.61	4.68	6.62	4.73	6.06	3.16	4.97
Cash to Assets*	6.16	8.14	5.20	6.53	5.17	7.85	10.72	13.13
Financing Need*	-4.80	9.75	-4.55	9.33	-3.05	10.48	-2.45	13.09

Variables with an * are scaled by a factor of 100. All firm-specific variables are measured as of the previous fiscal quarter. All ratios are winsorized at the 2.5 and 97.5 percent levels by market. Specific variable definitions can be found in Appendix A.

Table 2: Imputed Yield

	Private Debt	Public Debt
Financing Need	-0.018 (0.030)	0.133** (0.053)
Leverage	0.177*** (0.036)	0.357*** (0.069)
Profitability	-0.114*** (0.035)	0.026 (0.054)
Profitability Drift	0.028 (0.036)	-0.120** (0.058)
Profitability Volatility	0.052 (0.031)	0.077 (0.058)
Tangibility	-0.004 (0.029)	0.104* (0.059)
Market-to-Book	-0.100*** (0.021)	-0.513*** (0.057)
Short Term Debt to Assets	0.058* (0.030)	0.005 (0.051)
Cash to Assets	0.022 (0.025)	-0.310*** (0.069)
Altman's Z-Score	0.014 (0.026)	0.209*** (0.078)
Earnings Surprise	-0.007 (0.059)	0.120 (0.064)
Marginal Tax Rate	-0.054*** (0.023)	-0.027 (0.044)
Stock Return	0.006 (0.024)	-0.077 (0.049)
Year-Quarter Fixed Effects	X	X
Credit Rating Fixed Effects	X	X
Observations	3,011	2,744
Root MSE	0.945	1.797
Adjusted R^2	0.819	0.424

Estimates from yield regression. Coefficients standardized by sample standard deviations. Firm block-bootstrapped standard errors in parentheses. An * denotes significance at the ten percent level; ** denotes significance at the five percent level; *** denotes significance at the one percent level.

Table 3: Control Function: First-Stage Regression Results

Loan Charge-Offs	0.108** (0.038)
Loan Charge-Offs, Private Debt, BBB Firms	0.015 (0.041)
Loan Charge-Offs, Private Debt, BB Firms	0.282*** (0.036)
Loan Charge-Offs, Private Debt, B Firms	0.244*** (0.037)
Loan Charge-Offs, Public Debt, A Firms	0.264*** (0.056)
Loan Charge-Offs, Public Debt, BBB Firms	0.391*** (0.070)
Loan Charge-Offs, Public Debt, BB Firms	0.504*** (0.080)
Loan Charge-Offs, Public Debt, B Firms	0.480*** (0.077)
LAE Ratio	-0.250*** (0.062)
LAE Ratio, Private Debt, BBB Firms	-0.150*** (0.044)
LAE Ratio, Private Debt, BB Firms	-0.074*** (0.034)
LAE Ratio, Private Debt, B Firms	-0.132*** (0.065)
LAE Ratio, Public Debt, A Firms	0.406** (0.087)
LAE Ratio, Public Debt, BBB Firms	0.198 (0.075)
LAE Ratio, Public Debt, BB Firms	0.171* (0.085)
LAE Ratio, Public Debt, B Firms	0.009 (0.079)
Observations	61,360
Adjusted R^2	0.700

Coefficients for yield regressed on select instruments, standardized by sample standard deviations. Charge-offs are scaled by a factor of 10000. Firm block-bootstrapped standard errors in parentheses. An * denotes significance at the ten percent level; ** denotes significance at the five percent level; *** denotes significance at the one percent level. Supply shock indicators include 1990 speculative-grade debt shock and 1998 Russian debt default. Firm characteristics include leverage, profitability, profitability drift, profitability volatility, tangibility, market-to-book ratio, earnings surprise, short-term debt to assets, cash to assets, marginal tax rate, Z-score, quarterly stock return, and financing need. Macroeconomic variables include quarterly GDP growth, CRSP Value-Weighted Stock Index return, and the three-month treasury bill rate. Security-type and credit-rating fixed effects included. Private debt for A-rated firms is the excluded category.

Table 4: Logit Estimates, Specification (1)

	Private Debt	Public Debt	Equity
Leverage	-0.339*	0.349	-0.521*
	(0.181)	(0.245)	(0.311)
Market-to-Book	0.087*	0.144**	0.632***
	(0.049)	(0.070)	(0.061)
Earnings Surprise	-0.031	-6.117***	-1.359
	(0.737)	(1.398)	(1.261)
Short Term Debt to Assets	1.297***	2.850***	-1.251
	(0.410)	(0.653)	(0.833)
Cash to Assets	-3.096***	-2.095***	1.864***
	(0.400)	(0.481)	(0.433)
Profitability	3.096**	2.845	4.203*
	(1.404)	(1.874)	(2.543)
Profitability Drift	-3.572	-63.125*	130.553***
	(22.530)	(38.199)	(35.223)
Profitability Volatility	-13.145***	-23.668***	-12.638***
	(2.661)	(4.868)	(4.103)
Marginal Tax Rate	0.023	0.535***	0.134
	(0.187)	(0.207)	(0.273)
Altman's Z-Score	-0.225***	-0.353***	-0.397***
	(0.051)	(0.067)	(0.078)
Stock Return	0.223**	0.333***	1.190***
	(0.091)	(0.083)	(0.135)
Financing Need	0.757***	2.333***	1.831***
	(0.232)	(0.284)	(0.369)
CRSP VW Market Return	-0.844***	0.046	0.067
	(0.226)	(0.277)	(0.430)
3-Month T-Bill	-0.079***	-0.081***	0.027
	(0.011)	(0.013)	(0.016)
GDP Growth	0.120***	-0.025**	0.029
	(0.010)	(0.013)	(0.020)
Debt Type Constant	-1.593***	-1.623***	-3.688***
	(0.123)	(0.150)	(0.169)
Observations	29,487		
Firms	1,644		
Pseudo R^2	0.437		

Estimates from conditional mixed logit regression. Coefficients under a specific security choice are specific to that choice. Standard errors calculated by bootstrapping data by firm. An * denotes significance at the ten percent level; ** denotes significance at the five percent level; *** denotes significance at the one percent level.

Table 5: Logit Estimates, Specification (2)

	Private Debt	Public Debt	Equity
Yield (%)	-0.305*** (0.048)		
Control Function	0.152** (0.059)		
Earnings Yield (%)	-0.042** (0.018)		
Leverage	0.341* (0.189)	0.949*** (0.251)	-0.511 (0.313)
Market-to-Book	-0.033 (0.055)	-0.050 (0.097)	0.558*** (0.066)
Earnings Surprise	0.025 (0.510)	-4.994*** (1.216)	-1.541 (1.570)
Short Term Debt to Assets	1.169*** (0.446)	2.821*** (0.665)	-0.991 (0.866)
Cash to Assets	-2.369*** (0.412)	-3.221*** (0.526)	1.904*** (0.432)
Profitability	1.555 (1.582)	3.314* (1.927)	6.066** (2.736)
Profitability Drift	22.535 (30.727)	-84.381** (42.164)	133.487*** (33.245)
Profitability Volatility	-8.619*** (3.048)	-19.012*** (5.103)	-11.169*** (4.046)
Marginal Tax Rate	0.750* (0.408)	-1.748** (0.686)	0.207 (0.279)
<i>Yield Interaction</i>	-0.195*** (0.073)	0.363*** (0.108)	
Altman's Z-Score	-0.223*** (0.052)	-0.222*** (0.066)	-0.371*** (0.081)
Stock Return	0.226** (0.097)	0.241*** (0.089)	1.138*** (0.135)
Financing Need	0.797*** (0.250)	2.783*** (0.320)	1.753*** (0.361)
CRSP VW Market Return	-0.915*** (0.263)	-0.281 (0.291)	0.005 (0.439)
3-Month T-Bill	0.210*** (0.038)	-0.003 (0.026)	0.035** (0.018)
GDP Growth	0.088*** (0.013)	-0.054*** (0.015)	0.024 (0.021)
Debt Type Constant	-0.973*** (0.199)	0.056 (0.326)	-3.478*** (0.202)
Observations	29,487		
Firms	1,644		
Pseudo R^2	0.439		

Estimates from conditional mixed logit regression. Coefficients under a specific security choice are specific to that choice. Standard errors calculated by bootstrapping data by firm. An * denotes significance at the ten percent level; ** denotes significance at the five percent level; *** denotes significance at the one percent level.

Table 6: Logit Estimates, Specification (3)

	Private Debt	Public Debt	Equity
Yield (%)	-0.378*** (0.042)		
Control Function	0.198*** (0.042)		
Earnings Yield (%)	-0.045*** (0.017)		
Leverage	0.411** (0.205)	1.787*** (0.255)	-0.807** (0.324)
Market-to-Book	-0.037 (0.052)	-0.179** (0.087)	0.624*** (0.069)
Earnings Surprise	0.042 (0.447)	-2.717*** (0.838)	-2.082 (1.708)
Short Term Debt to Assets	1.335*** (0.489)	1.976*** (0.627)	0.075 (0.760)
Cash to Assets	-2.311*** (0.412)	-2.506*** (0.540)	1.298*** (0.432)
Profitability	1.249 (1.624)	3.133 (1.996)	5.833** (2.770)
Profitability Drift	25.327 (32.498)	-66.125 (43.936)	112.360*** (30.335)
Profitability Volatility	-8.000*** (2.993)	-13.972*** (5.103)	-11.565*** (3.861)
Marginal Tax Rate	0.808 (0.442)	-2.262*** (0.654)	0.383 (0.266)
<i>Yield Interaction</i>	-0.213*** (0.078)	0.387*** (0.099)	
Altman's Z-Score	-0.218*** (0.052)	-0.267*** (0.066)	-0.289*** (0.079)
Stock Return	0.214** (0.098)	0.307*** (0.092)	1.049*** (0.125)
Financing Need	0.772*** (0.259)	3.130*** (0.352)	1.496*** (0.355)
CRSP VW Market Return	-0.912*** (0.271)	-0.469 (0.296)	0.093 (0.440)
3-Month T-Bill	0.274*** (0.036)	0.016 (0.022)	0.040** (0.018)
GDP Growth	0.082*** (0.015)	-0.059*** (0.016)	0.021 (0.021)
Debt Type Constant	-0.958*** (0.183)	0.853*** (0.300)	-4.095*** (0.227)
BBB Market FE	0.186*** (0.069)	-0.384*** (0.072)	0.472*** (0.125)
BB Market FE	0.219*** (0.084)	-0.719*** (0.095)	0.817*** (0.124)
B Market FE	0.140 (0.089)	-1.057*** (0.120)	0.823*** (0.175)
Observations	29,487		
Firms	1,644		
Pseudo R^2	0.442		

Estimates from conditional mixed logit regression. Coefficients under a specific security choice are specific to that choice. Standard errors calculated by bootstrapping data by firm. An * denotes significance at the ten percent level; ** denotes significance at the five percent level; *** denotes significance at the one percent level.

Table 7: Logit Estimates, No Instrumentation

	Private Debt	Public Debt	Equity
Yield (%)	-0.212*** (0.035)		
Earnings Yield (%)	-0.045*** (0.017)		
Leverage	0.216 (0.197)	1.357*** (0.258)	-0.806** (0.325)
Market-to-Book	0.012 (0.050)	-0.032 (0.072)	0.623*** (0.069)
Earnings Surprise	0.029 (0.452)	-2.753*** (0.847)	-2.079 (1.708)
Short Term Debt to Assets	1.228*** (0.449)	1.970*** (0.602)	0.080 (0.761)
Cash to Assets	-2.463*** (0.398)	-1.869*** (0.520)	1.296*** (0.432)
Profitability	1.753 (1.523)	2.936 (1.919)	5.866** (2.772)
Profitability Drift	19.541 (28.265)	-54.363 (40.249)	112.545*** (30.311)
Profitability Volatility	-9.402*** (2.648)	-17.409*** (4.847)	-11.590*** (3.858)
Marginal Tax Rate	0.920** (0.453)	-2.167*** (0.662)	0.383 (0.266)
<i>Yield Interaction</i>	-0.214*** (0.079)	0.379*** (0.099)	
Altman's Z-Score	-0.240*** (0.051)	-0.348*** (0.066)	-0.289*** (0.079)
Stock Return	0.221** (0.094)	0.365*** (0.085)	1.047*** (0.125)
Financing Need	0.801*** (0.243)	2.817*** (0.333)	1.495*** (0.356)
CRSP VW Market Return	-0.845*** (0.247)	-0.188 (0.283)	0.092 (0.439)
3-Month T-Bill	0.151*** (0.031)	-0.039** (0.016)	0.040** (0.018)
GDP Growth	0.089*** (0.011)	-0.042*** (0.013)	0.020 (0.021)
Debt Type Constant	-1.343*** (0.168)	-0.052 (0.250)	-4.095*** (0.226)
BBB Market FE	0.131* (0.070)	-0.385*** (0.074)	0.473*** (0.125)
BB Market FE	0.072 (0.084)	-0.731*** (0.096)	0.818*** (0.124)
B Market FE	-0.055 (0.085)	-1.046*** (0.113)	0.824*** (0.175)
Observations	29,487		
Firms	1,644		
Pseudo R^2	0.442		

Estimates from conditional mixed logit regression. Coefficients under a specific security choice are specific to that choice. Standard errors calculated by bootstrapping data by firm. An * denotes significance at the ten percent level; ** denotes significance at the five percent level; *** denotes significance at the one percent level.

Table 8: Probability of Issuing Debt

Panel A: Average Marginal Effect			
Specification	(1)	(2)	(3)
<i>Private Debt</i>			
Marginal Tax Rate	-0.06 (0.25)	-0.51** (0.24)	-0.52** (0.24)
Yield (%)		-6.34*** (0.85)	-7.75*** (0.75)
<i>Public Debt</i>			
Marginal Tax Rate	0.67*** (0.24)	0.65** (0.27)	0.18 (0.29)
Yield (%)		-3.01*** (0.74)	-3.88*** (0.57)
<i>Control Variables</i>			
Firm Characteristics	X	X	X
Macro Variables	X	X	X
Credit Rating FEs			X
Panel B: Relative Average Marginal Effect			
Specification	(1)	(2)	(3)
<i>Private Debt</i>			
Marginal Tax Rate	-0.54 (2.45)	-5.38** (2.30)	-5.56** (2.30)
Yield (%)		-59.65*** (8.15)	-72.91*** (7.29)
<i>Public Debt</i>			
Marginal Tax Rate	7.31*** (2.80)	7.72** (3.05)	2.62 (3.23)
Yield (%)		-33.32*** (8.01)	-43.18*** (6.29)
<i>Control Variables</i>			
Firm Characteristics	X	X	X
Macro Variables	X	X	X
Credit Rating FEs			X

Panel A presents the average marginal effect of a one standard deviation change in the marginal tax rate and imputed yield (in %). Panel B presents the relative average marginal effect of a one standard deviation change in the marginal tax rate and imputed yield (in %). The relative average marginal effect is the percent change in probability of issuance; the average marginal effect is the percentage-point change in probability of issuance. Specification 3 includes credit rating fixed effects. Standard errors in parentheses. An * denotes significance at the ten percent level; ** denotes significance at the five percent level; *** denotes significance at the one percent level.

Table 9: Probability of Issuing Debt, Alternate Tax Measure

Panel A: Average Marginal Effect			
Specification	(1)	(2)	(3)
<i>Private Debt</i>			
Statutory Tax Rate	0.34 (0.21)	-0.05 (0.21)	-0.00 (0.23)
Yield (%)		-7.06*** (0.88)	-8.74*** (0.86)
<i>Public Debt</i>			
Statutory Tax Rate	0.95*** (0.24)	0.90*** (0.27)	0.43 (0.30)
Yield (%)		-3.52*** (0.72)	-4.35*** (0.64)
<i>Control Variables</i>			
Firm Characteristics	X	X	X
Macro Variables	X	X	X
Credit Rating FEs			X
Panel B: Relative Average Marginal Effect			
Specification	(1)	(2)	(3)
<i>Private Debt</i>			
Statutory Tax Rate	3.27* (1.96)	-0.95 (2.03)	-0.60 (2.16)
Yield (%)		-65.95*** (8.26)	-81.68*** (8.07)
<i>Public Debt</i>			
Statutory Tax Rate	10.41*** (2.81)	10.19*** (2.95)	5.21 (3.25)
Yield (%)		-38.79*** (7.90)	-48.20*** (7.05)
<i>Control Variables</i>			
Firm Characteristics	X	X	X
Macro Variables	X	X	X
Credit Rating FEs			X

Panel A presents the average marginal effect of a one standard deviation change in the statutory tax rate and imputed yield (in %). Panel B presents the relative average marginal effect of a one standard deviation change in the statutory tax rate and imputed yield (in %). The relative average marginal effect is the percent change in probability of issuance; the average marginal effect is the percentage-point change in probability of issuance. Specification 3 includes credit rating fixed effects. Standard errors in parentheses. An * denotes significance at the ten percent level; ** denotes significance at the five percent level; *** denotes significance at the one percent level.

Table 10: Cost of Debt Sensitivity

Panel A: Average Marginal Effect			
Specification	(1)	(2)	(3)
<i>Private Debt</i>			
Marginal Tax Rate		-0.14 (0.12)	-0.14 (0.13)
<i>Public Debt</i>			
Marginal Tax Rate		0.35** (0.15)	0.45*** (0.14)
<i>Control Variables</i>			
Firm Characteristics	X	X	X
Macro Variables	X	X	X
Credit Rating FEs			X
Panel B: Relative Average Marginal Effect			
Specification	(1)	(2)	(3)
<i>Private Debt</i>			
Marginal Tax Rate		3.90 (4.10)	2.80 (3.52)
<i>Public Debt</i>			
Marginal Tax Rate		-18.58 (18.46)	-18.23* (9.96)
<i>Control Variables</i>			
Firm Characteristics	X	X	X
Macro Variables	X	X	X
Credit Rating FEs			X

Panel A presents the average marginal effect of a one standard deviation change in the marginal tax rate and imputed yield (in %). Panel B presents the relative average marginal effect of a one standard deviation change in the marginal tax rate and imputed yield (in %). The relative average marginal effect is the percent change in probability of issuance; the average marginal effect is the percentage-point change in probability of issuance. Specification 3 includes credit rating fixed effects. Standard errors in parentheses. An * denotes significance at the ten percent level; ** denotes significance at the five percent level; *** denotes significance at the one percent level.

Table 11: Quantity of Debt Chosen

	$100 * (\Delta Debt_t / Assets_{t-1})$		
	Specification		
	(1)	(2)	(3)
Marginal Tax Rate	0.07** (0.03)	0.07** (0.03)	0.03 (0.04)
Yield (%)		0.07 (0.06)	-0.47** (0.23)
<i>Control Variables</i>			
Firm Characteristics	X	X	X
Macro Variables	X	X	X
2SLS			X

The marginal effect of a one standard deviation change in the marginal tax rate and imputed yield (in %) on the change in the firm's total debt, scaled by lagged book assets. Specification 1 does not include the pre-tax cost of debt. Specification 2 includes the pre-tax cost of debt with no instrumentation. Specification 3 instruments the cost of debt using a two-stage least squares procedure with loan charge-offs and LAE ratios as instruments. Standard errors in parentheses. An * denotes significance at the ten percent level; ** denotes significance at the five percent level; *** denotes significance at the one percent level.