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EVIDENCE ON THE RELATION BETWEEN INTEREST TAX BENEFITS, FIRM CHARACTERISTICS, AND LEVERAGE DECISIONS

by

Ming-Chin Chen

A Dissertation Presented in Partial Fulfillment
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ABSTRACT

Interest expense is the second largest deduction item on corporate income tax returns. Under the current U.S. tax system, the deductibility of interest can be regarded as a tax subsidy for debt financing. This dissertation provides new evidence on factors associated with firms' ability to utilize the tax benefit of interest deductions and on a mutual-causal relation between tax benefits and leverage, by controlling for the endogeneity problem and firms' unobservable heterogeneity.

A panel of firms from 1990 to 1993 is used to examine the relation between interest tax benefits, leverage decisions, and firm characteristics. It is found that interest tax benefits are associated with firms' characteristics such as financing and investment decisions, operating profitability, and firm size. Leverage and investment tax shields have a positive impact on interest tax benefits. However, for firms with low effective tax rates, the magnitude of the impact of investment tax shields on interest tax benefits is smaller. Profitability is positively associated with interest tax benefits. Finally, large firms are likely to utilize more interest tax benefits.

The empirical results also indicate that tax incentive and leverage have a mutual-causal relationship, and that tax incentive has a significant impact on the mix of short- and long-term leverage. Firms with greater tax benefits of interest deductions are more likely to commit themselves to long-term leverage. The results of this study also show that debt securability, operating risks, profitability, growth opportunity, and firm size are important factors associated with leverage. Finally, this study contributes new evidence that firms with higher liquidity are more likely to use short-term debt.

DEDICATION

To the memory of my mother, Tsai-Hsueh Chen

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I. INTRODUCTION

Interest expense is an important source of corporate deductions. According to the Statistics of Income Bulletin, interest was the second largest deduction item on corporate income tax returns and accounted for about 5.3% of all corporate deductions in 1992 (SOI, 1995).[1] Furthermore, corporate interest payments have grown substantially over the past four decades, from 0.3% of GDP in 1950 to 2.3% in 1993 (Slemrod and Bakija, 1996, p. 27).

Under the current U.S. income tax system, the tax deductibility of interest can be regarded as a tax subsidy of debt financing. The current U.S. tax system is more neutral in corporate investment decisions. Corporations may deduct the cost of investments in either tangible or intangible assets through depreciation or amortization.[2] However, the current tax system "distorts" corporate financing decisions in that interest is tax-deductible while dividends are not and thus corporate earnings distributed to shareholders are taxed twice (U.S. Department of Treasury, 1992, preface). For example, in a report on integration of the individual and corporate tax system, the Department of Treasury (1992, p. 1) stated:

> The Tax Reform Act of 1986 (TRA 86) made the U.S. tax system significantly more neutral in its impact on business decisions about capital investment by reducing tax rates and tax preferences. TRA 86, however, did not address tax related distortions of business organizations and financing decisions (U.S. Department of Treasury, 1992, p. 1).

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[1] Total deductions are about $11,330 billion, of which cost of sales and operations is the first largest deduction item (about 60% of the total deductions), and depreciation is the third (about 3% of total deductions).

[2] IRC §197 allows for the deduction of amortization of goodwill and other purchased intangible assets ratably over a 15-year period beginning with the month in which the tangible was acquired.

The above discussions suggest that interest expense is an important corporate tax shield and that the tax benefit of interest deductions is an important factor in corporate leverage decisions. The main motivation of this study is to examine the relation between the tax benefit of interest deductions and firm characteristics. Despite the growing importance of interest expense on corporate income tax returns, few studies directly examine factors affecting firms' ability to utilize the tax benefit of interest deductions.[3] Studies on the policy debate on corporate tax burdens show that different firms' characteristics are likely to affect their effective tax rates (ETRs) (Siegfried, 1974; Stickney and McGee, 1982; Zimmerman, 1983; Porcano, 1986; Gupta and Newberry, 1997). However, ETRs are affected by the cumulative effect of various tax incentives (Gupta and Newberry, 1997), and thus may not reflect firms' ability to utilize interest tax shields.

This study examines the simultaneous relation between the tax benefit of interest deductions and firms' leverage decisions, and the impact of tax benefits on the mix of short-term and long-term leverage, allowing for their endogenous relationship and controlling for firms' unobservable heterogeneity. The potential endogeneity between tax benefits and firms' leverage has been a growing concern in the literature (Graham, 1996; Graham et al., 1997). Yet, most prior studies assumed the tax benefits of debt financing are an exogenous determinant of firms' leverage decisions, and used less plausible proxy

[3] The dependent variable in Dhaliwal et al. (1992) study is interest expense, which may not reflect the tax benefit of interest deductions. This study uses the tax benefit of interest deductions (ITB) as a measure of the tax benefits of debt financing. ITB is defined as the difference between current tax expenses before- and after-interest deductions, deflated by earnings before interest and taxes (EBIT).

variables, such as net operating losses and investment tax shields, for firms' tax status in examining the relation between the tax benefit of debt financing and leverage decisions. While prior studies provide insight into corporate leverage decisions, there remain several issues to be addressed further. The first issue is that the tax benefit of interest deductions is potentially an endogenous factor in explaining leverage decisions; that is, there may exist a feedback effect of the tax benefit on leverage decisions. OLS estimates could be biased if this potential endogeneity is ignored. Only a few studies are aware of this problem. For example, Manzon (1994), Graham (1996), and Graham et al. (1997) proposed the use of simulated MTRs to mitigate this endogeneity problem and found a positive relation between MTR and leverage.

The second issue that has been ignored in the previous studies is that firms may have different tax motives for long-term and short-term leverage. Tax incentives may be more important in long-term leverage decisions because long-term debt commits firms to a long-run stream of tax shields and it may be costly to reverse these decisions. Besides the differences in tax incentives, short-term debt and long-term debt may be subject to different extents of agency costs and information costs. In the presence of informational asymmetry, short-term debt can be a vehicle for firms with relatively high credit ratings to avoid the agency cost premium on long-term debt (Diamond, 1991), and to resolve agency problems between stockholders and debtholders (Myers, 1977).[4] The differences in the various costs and benefits associated with short-term and long-term debt suggest

[4] Short-term debt is less subject to agency costs such as risk-shifting and wealth-transferring behaviors.

that an optimal mix of short-term and long-term leverage is important in firms' value-maximizing capital structure decisions. Short-term debt has played an increasingly important role for American corporations (Taggart, 1985; Masulis, 1988).[5] However, most prior studies on corporate leverage consider only long-term debt. Thus, their empirical results may not be generalizable to short-term financing. Empirical evidence on the motives for choosing short-term and long-term debt is limited. "The relation between short-term debt and firm characteristics, such as the proportion of tangible assets and growth opportunities, would be of interest (Masulis, 1988, p. 43)."

This study addresses these three issues more closely to provide evidence on the relation between the tax benefit of interest deductions, firm characteristics, and leverage decisions. For this purpose, this study proposes and estimates a system of three simultaneous equations regarding the tax benefit of interest deductions, total leverage, and the mix of short-term and long-term leverage. In particular, a panel data approach is used to control for firms' unobservable individual heterogeneity. Firms' unobservable effects such as corporate cultural, credit reputation, and management preference are likely to affect managers' incentives to utilize the tax benefit of interest deductions and managers' choices of short- and long-term financing (Myers, 1984; Diamond, 1991; Gupta and Newberry, 1997). These individual effects are unlikely to be homogenous across firms and may be correlated with explanatory variables in the regression model,

[5] Taggart (1985) and Masulis (1988) analyzed aggregate time-series data for 1926-1979 and 1946-1986, respectively. Both concluded that corporate debt constitutes a large and steadily increasing fraction of the corporate sources of funds, and that short-term debt has increased substantially as a source of capital. Recently, according to the Statistics of Income Bulletin (SOI, 1995), about 8% and 13.5% of the 1992 total book value of assets are financed by interest-bearing short- and long-term debt, respectively.

and thus may cause the standard instrumental variable estimates to be biased. This problem can be dealt with if panel data are available. Cornwell et al. (1992) provides a panel data econometric method which concurrently resolves the endogeneity and unobservable heterogeneity problems. This paper adopts their estimation approach.

The major empirical findings of this study are as follows. First, several firm characteristics are associated with the ability to utilize the tax benefit of interest deductions (ITB). Leverage and investment tax shields have a positive impact on ITB. However, the magnitude of the impact of investment tax shields on ITB is smaller for firms with low before-interest-deduction effective tax rates ($ETR_{before\text{-}interest}$).[6] Further, profitable firms, having enough taxable income to cover all tax shields, are more likely to have greater ITB. Finally, large firms, having greater debt capacity, are likely to take more ITB.

Second, this study provides direct evidence on the mutual-causal relation between leverage and ITB. Further, the results indicate that capital intensity, growth opportunity, profitability, earnings variability, and firm size are important factors for leverage decisions. Third and more importantly, this study provides evidence that the tax motives for short-term and long-term leverage are different. Given a total leverage, firms with a greater tax value of interest deductions tend to have a larger ratio of long-term leverage. Furthermore, firms with greater growth opportunities, having greater informational asymmetry, are more likely to rely on short-term debt, consistent with Myers' (1977)

[6] $ETR_{before\text{-}interest}$ is defined as the current income tax expense before interest deduction divided by EBIT.

prediction. Finally, the empirical results of this study also provide new evidence on the determinants of leverage decisions that firms with better liquidity are more likely to use short-term debt, rather than long-term debt. This finding provides confirmation of Diamond's (1991) argument that firms trade off liquidity risk from short-term debt against the benefits of reduced interest costs in the choice of short-term and long-term financing. The different motives for short-term and long-term leverage imply that firms select their capital structure depending on attributes that determine the various costs and benefits associated with different financial instruments (Titman and Wessels, 1988).

The remainder of this dissertation is organized as follows. Section II reviews previous studies on the factors associated with interest tax benefits, the relation between tax incentive and leverage, and corporate capital structure theory. Section III develops the research hypotheses. Section IV details the research methods including econometric methods, empirical models, and sample selection. This is followed by empirical results. Finally, section VI provides concluding remarks including a brief summary and a discussion of limitations.

II. LITERATURE REVIEW

This section reviews prior research related to factors associated with the ability to utilize interest tax benefits (ITB) and corporate capital structure theory. Section 2.1 contains a review of the studies related to the relation between interest tax benefits and firm characteristics. Section 2.2 reviews literature on the relation between tax incentives and corporate leverage, and Section 2.3 reviews studies on the theory of capital structure.

2.1 Interest Tax Benefits and Firm Characteristics

Prior studies suggest that a firm's ability to utilize interest tax shields is related to investment tax shields (DeAngelo and Masulis, 1980; Trezevant, 1994), income realization (Dammon and Senbet, 1988; Shevlin and Porter, 1992), and effective tax rates (Zimmerman, 1983; Shevlin and Porter, 1992; Gupta and Newberry, 1997). There are three important issues to be considered in examining firms' ability to utilize interest tax benefits.

Substitution Effect of Investment Tax Shields for Debt Tax Shields

Investment tax shields would lower a firm's probability of utilizing interest deductions and thus increase the after-tax cost of debt financing if the firm does not have sufficient earnings to cover all tax shields (DeAngelo and Masulis, 1980). Consequently, in equilibrium, firms with larger investment tax shields (holding before-tax earnings constant) may use less debt in their capital structures, suggesting a substitution effect of investment tax shields for debt tax shields.

The substitution effect of investment tax shields for debt tax shields implies that low tax rate firms with a higher probability of losing the deductibility of interest will use less debt. For firms that consistently have enough income to cover all tax shields, the substitution effect may not be observed. By partitioning firms into those having high and low probability of losing the deductibility of tax shields, Dhaliwal et al. (1992) and Trezevant (1992) found that low ETR firms exhibit a substitution effect between investment- and debt-related tax shields, holding before-tax earnings constant.[7] The substitution effect implies that low tax rate firms having a higher probability of losing the immediate deductibility of tax shields may utilize less interest tax benefits.

Income Effect of Earnings Realization

While the substitution effect may decrease the use of debt tax shields, the income effect from increased output will expand a firm's debt capacity. Consequently, the overall effect of an increase in investment tax shields on firms' leverage depends on the tradeoff between the substitution effect and the income effect associated with the increase in optimal investment (Dammon and Senbet, 1988). Therefore, the income effect predicts a positive impact of earnings realization on interest tax benefits. Profitable firms, having a lower probability of losing the tax deductibility of interest, may utilize more interest tax benefits.

[7] Trezevant (1994) extended the substitution effect to examine a portfolio of noninvestment tax shields and found that provisions for bad debt, pension expenses, advertising expenditures, interest expenses, and labor costs have a substitution effect for the investment tax shields.

Corporate Effective Tax Rate

The tax value of interest deductions depends on a firm's before-interest deduction ETR ($ETR_{before\text{-}interest}$). The first-dollar tax benefit of interest deductions is related to $ETR_{before\text{-}interest}$. A firm may not utilize the tax benefit of interest deductions if its $ETR_{before\text{-}interest}$ is exhausted (equal to zero).[8] Besides investment tax shields, earnings realization, and ETRs, firm size is likely to be associated with interest tax benefits in that large and small firms may have different economies of scales to use debt financing and thus may differ in their ability to utilize interest tax benefits.

2.2 Tax Incentives and Corporate Leverage

Traditional financial theories suggest that an optimal debt ratio can be obtained by a tradeoff between bankruptcy costs and the tax benefits of leverage, holding constant a firm's investments (DeAngelo and Masulis, 1980). The ability to utilize the tax benefit of interest deductions depends on a firm's tax status. Cordes and Sheffrin (1983) find that marginal tax rates for interest deductions (MTRs) vary among firms.[9] Auerbach and Poterba (1987) also find that net operating losses (NOLs) are significant and persistent. They, therefore, conclude that it is unlikely for a firm without NOLs to incur a NOL and it is also unlikely for a firm with NOLs to "escape" and become taxable again, suggesting

[8] See Callihan (1994) for a detailed literature review on ETR.

[9] They found that only 56% of corporate revenues in 1978 accrued to firms that paid the maximum statutory corporate tax rate on marginal earnings.

that NOL firms' current MTRs are close to zero.[10] The variations in MTRs suggest that the marginal tax benefits of debt financing vary across firms and thus each firm may have an optimal capital structure depending on its MTR.

Prior studies found mixed results on the relation between tax incentives and firm leverage. Appendix B summarizes prior empirical results of corporate leverage. Most of prior studies use tax proxy variables to examine the relation between tax incentives and firms' leverage decisions. These tax proxies include:

1. nondebt tax shields to proxy (inverse) for MTRs (Bradley et al., 1984; Auerbach and Poterba, 1987; Titman and Wessels, 1988; Bathala et al., 1995);
2. dummy variables to proxy for low MTRs when a firm has a NOL carryforward (Scholes et al., 1990; MacKie-Mason, 1990; Barclay and Smith, 1995a); and
3. dummy variables for firms in a low quantile of average tax rates (Dhaliwal et al., 1992; Trezevant, 1992).

The results of the proxy MTRs are mixed. Studies based on nondebt tax shields found no evidence of a relation between leverage and nondebt tax shields (Bradley et al., 1984; Auerbach and Poterba, 1987; Titman and Wessels, 1988; Bathala et al., 1995). However, some cautions seem to be required to correctly interpret these results. The rationale for using nondebt tax shields as proxy variables is that increasing nondebt tax shields may lower a firm's MTRs, resulting in a negative impact on leverage. Therefore, the estimated tax effect of nondebt tax shields on leverage is only indirect. Including

[10] They found that a firm without a NOL in period t has a probability to experience a NOL in period t+1 of about .026, while a firm with a NOL in period t has the probability of remaining in a loss-carryforward position in period t+1 of about .913. They also found that a significant proportion of firms that experience tax losses in a given year will continue to have such losses for at least four more years (e.g., for NOL firms in 1981, over 50% of them remained in the loss carryforward position through 1984. p. 318, Table 10.6).

nondebt tax shields directly in leverage decisions fails to distinguish between the direct and indirect relationship among nondebt tax shields, MTRs, and leverage. Furthermore, nondebt tax shields (e.g., depreciation, investment tax credits, etc.) are highly and positively correlated with firms' investment levels. The negative relation between leverage and nondebt tax shields can be offset by a confounding factor (e.g., the debt securability effect provided by fixed assets, which is positively related with leverage), resulting in insignificant or opposite results found in prior studies (e.g., Dammon and Senbet, 1988; Dhaliwal et al., 1992; Trezevant, 1994).

Scholes et al. (1990), MacKie-Mason (1990), Dhaliwal et al. (1992), Trezevant (1992), and Barclay and Smith (1995a) used NOLs and average tax rates to proxy for MTRs and found a positive relationship between MTRs and financing decisions. Scholes et al. (1990) found that banks with NOLs invest less in tax-exempt securities and tax-favored capital leases, and issue more tax-disfavored preferred and common stocks. MacKie-Mason (1990) and Barclay and Smith (1995a) also found that industry firms with NOLs are less likely to issue debt. Dhaliwal et al. (1992) and Trezevant (1992) show that firms with lower tax rates incur less interest expense, a surrogate for debt in their studies. However, these studies are also subject to some criticisms. In addition to the loss of information due to partitioning a continuous MTR variable into a categorical one, NOLs are likely to be confounded with financial distress.[11] Firms facing greater probabilities of financial distress are likely to use less debt financing. Therefore, the

[11] The analyses of Auerbach and Poterba (1987) show that NOLs are persistent and thus firms with large NOLs are also subject to a higher probability of financial distress.

results of prior studies using NOLs as a proxy for MTRs may be confounded with financial distress, and make it difficult to determine the tax effect of NOLs, especially if firms persistently incur NOLs.

Shevlin (1990) simulates MTRs over a forecasted stream of taxable income to account for the impacts of tax loss carryforwards and carrybacks. He defines the current period MTR as the change in the present value of the cash flow paid to (or recovered from) tax authorities as a result of earning one extra dollar of taxable income in the current tax period. Thus, the current period MTR depends on a firm's taxable income in prior and future years. Shevlin's results indicate that the assumption of MTR equal to the top statutory rate is violated when a firm has NOL carryforwards or high variability in its taxable income series (e.g., negative realizations of taxable income).

Graham (1996) incorporates the effects of investment tax credits and the alternative minimum tax, in addition to the NOL carryforward, in simulating MTRs. He finds that high tax rate firms are more likely to use debt financing than are low tax rate firms, and that small firms have relatively low MTRs when compared to large firms. Graham et al. (1997) use the first-dollar MTR to avoid the endogeneity problem. In two separate regression models, they show that the first-dollar MTR is positively related with leverage and the last-dollar MTR is negatively related with leverage.

Manzon (1994) provides a simplified model of Shevlin's (1990) MTR simulation for NOL firms. His measure of MTR reflects the present value of $1 of tax payable on additional income based on an estimate of the length of time a firm will be able to offset

taxable income with NOL carryovers.[12] A distinguishing feature of Manzon's MTR measures is the use of market value to estimate future income, which incorporates more current and comprehensive information than a pure random walk simulation. Manzon's method, however, introduces a bias by always projecting positive earnings even though a firm may have a history of NOLs.

2.3 Capital Structure Theory

The traditional definition of capital structure focuses on the mix of debt and equity as a fraction of firm value (Myers, 1988). Besides the tax benefit of debt financing, an optimal use of debt in capital structure decisions can increase a firm's value in reducing costs of informational asymmetry (Myers and Majluf, 1984), and reducing agency costs (Jensen and Meckling, 1976; Myers, 1977).[13]

Agency costs occur when managers overindulge in consuming perquisites or overexpanding firm size relative to the value maximization. Debt financing is viewed as an effective internal restraint to lower free cash flows, refraining managers from

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[12] Specifically, he defines MTR = $\frac{(\$1 * tr)}{(1+r)^n}$, and n = $\frac{NOL_{t-1}}{EFAI_{t-1}}$, where tr is the top statutory tax rate; r is a non-firm specific discount rate (assumed to be 10%), and n is the number of periods until the tax will have to be paid (the maximum n is restricted to 15 years). NOL_{t-1} is the net operating loss available at period t-1 to offset future taxable income, and EFAI is the market value of equity multiplied by discount rate (r) at period t-1. For firms with no NOLs, MTR is assumed to be equal to $1 multiplied by the maximum statutory rate. For firms with NOLs, n is equal to the number of periods the firm will have NOLs available to offset taxable income.

[13] See Harris and Raviv (1991) for a detailed literature review of corporate capital structure.

overindulging in perquisites and unprofitable expansionary tendencies (Jensen and Meckling, 1976; Jensen, 1986).

Myers and Majluf (1984) argue that debt can be used to mitigate inefficiencies in firms' investment decisions under informational asymmetry. Management, on behalf of equity owners, may not issue equity when it knows the firm's underlying value is higher than is currently reflected in stock value. Consequently, firms that rely on external funding may pass up positive net present value (NPV) projects, resulting in an underinvestment problem. This problem can be avoided if firms can finance new projects using securities that are not severely undervalued by the market (e.g., internal funds or short-term debt).

Short-term and Long-term Leverage Decisions

Short-term debt and long-term debt may be subject to different extents of agency costs (Myers, 1977) and informational asymmetry costs (Flannery, 1986; Diamond, 1991). Short-term debt is subject to higher transaction costs because of the higher costs of rollover. However, short-term debt is less subject to the costs of informational asymmetry than long-term debt because information on the true nature of the firm can be released and evaluated prior to the rollover of short-term debt. Thus, short-term debt can be rationalized as a means of resolving agency costs associated with wealth-transferring and underinvestment problems arising from informational asymmetry and moral hazard.[14]

[14] Bankruptcy risks and limited liability protections give stockholders an incentive to invest suboptimally because the up and down risks that shareholders bear are asymmetric.

Therefore, firms subject to the higher costs of informational asymmetry are predicted to use more short-term debt (Myers, 1977).

Short-term debt may be a device for relatively high credit-rated firms to avoid the agency cost premium on the long-term debt arising from informational asymmetry. Flannery (1986) argues that insiders of relatively high credit-rated firms will consider all the required default premiums by market to be excessive, and that the long-term debt is subject to more of an overcharged premium. Consequently, if the bond market cannot distinguish between "good" and "bad" bonds, insiders of good firms, in order to avoid excess premium on the long-term debt, will issue short-term debt, and insiders of relatively low credit-rated firms will issue long-term debt. Diamond (1991) also argues that borrowers with high credit ratings prefer short-term debt, those with somewhat lower ratings prefer long-term debt, and lower-rated borrowers can issue only short-term debt. Consequently, borrowers who rely heavily on short-term debt are a mix of the very high- and the very low-rated borrowers, with the middle-rated borrowers using more long-term debt.

Empirical evidence on the relation between the choices of the two forms of borrowing and firm characteristics is limited. Titman and Wessels (1988) decompose corporate debt into short-term debt, long-term debt, and convertible debt, and find that small firms tend to use more short-term debt than large firms. In addition, they find no evidence on the impacts of growth, nondebt tax shields, earnings volatility, and collateral value on the three leverage decisions. However, some caution seems to be required for correct interpretation of their estimation results. Separating short-term and long-term

borrowing decisions in the empirical model may be subject to a major econometric problem in that the two forms of decisions are heavily influenced by firms' individual effects such as credit reputation (Flannery, 1986; Diamond, 1991) and management preference (Myers, 1984).[15] Failing to control for these unobservable individual effects may cause OLS estimates to be biased.

Summary

Previous research shows that different firm characteristics are likely to affect corporate ETRs. ETRs, however, are a summary statistic for corporate tax burden and may not reflect firms' ability to utilize an important individual tax shield such as interest deductions. This study examines the relation between firm characteristics and interest tax benefits, which can be regarded as a tax subsidy for debt financing. Several firm characteristics may be associated with the ability to utilize interest tax shields. Low tax rate firms are more likely to exhibit the substitution effect and thus may utilize less interest tax benefits. Profitable firms having a lower probability of losing the tax deductibility of interest may utilize more interest tax benefits. Finally, large and small firms may differ in their ability to utilize interest tax benefits.

This study also differs from prior studies on corporate leverage in two ways. First, this study includes interest tax benefits as one of the dependent variables. Interest tax benefits are a direct measure of the tax savings of interest. Second, this study uses a

[15] Myers argues that firms may have a financing pecking order where firms prefer internal to external financing, safe securities to risky ones, and debt to equity.

simultaneous equations system to overcome the endogeneity problem in examining the relation between tax benefits and leverage.[16] Furthermore, panel data methods are used to control for firms' individual heterogeneity. In addition to total leverage, the equation system includes the mix of short- and long-term leverage. Unlike prior studies on debt maturity structure (Barclay and Smith, 1995a), this study classifies short-term and long-term debt based on their original financing purposes, as discussed in the Section 4.3.

[16] Graham (1996) and Graham et al. (1997) argue that the endogeneity of tax incentives may cause the OLS estimates to be biased and inconsistent, contributing to the inconsistent results found in prior studies.

III. RESEARCH HYPOTHESES

Interest Tax Benefits and Leverage Decisions

The tax benefit of interest deductions is a major advantage of debt over equity financing. Tax incentive has a positive impact on leverage, and leverage, in return, increases interest tax benefits. Thus, a testable hypothesis is:

H1: Interest tax benefits and total leverage have a mutual-causal relation, *ceteris paribus*.

Interest Tax Benefits and Investment Tax Shields

Low tax rate firms having a higher probability of losing the tax deductibility of interest may utilize less interest tax benefits. Furthermore, Dhaliwal et al. (1992) show that the substitution effect of investment tax shields for interest tax shields exists for low tax rate firms. Therefore, for low tax rate firms, increasing investment tax shields may lower the tax benefit of interest deductions. These hypotheses can be summarized as follows:

H2a: Interest tax benefits are negatively associated with firms' effective tax rates, *ceteris paribus*.

H2b: For low tax rate firms, interest tax benefits are negatively associated with investment tax shields, *ceteris paribus*.

Interest Tax Benefits and Profitability

The income effect predicts a positive relation between a firms' profitability and debt capability. Profitable firms, having sufficient taxable income to cover all tax shields, may utilize greater interest tax benefits. Stated formally:

H3: Interest tax benefits are positively associated with profitability, *ceteris paribus*.

Interest Tax Benefits and Firm Size

Large and small firms may have different economies of scale and transaction costs in the credit market and thus may differ in their ability to utilize interest tax shields. Therefore, the fourth hypothesis is proposed as follows:

H4: Interest tax benefits are associated with firm size, *ceteris paribus*.

Tax Motives for Short-term and Long-term Leverage Decisions

Tax motives may be different for short-term and long-term financing. Unlike short-term debt, long-term debt commits firms to a long-term tax shield and may cause firms to incur higher costs if they fail to utilize the tax shield. Therefore, firms are more likely to commit themselves to long-term financing if they can utilize the tax benefit of debt. In addition, short-term borrowing is constrained by cash and liquidity management; hence, tax incentive may be less important in short-term financing than in long-term financing. The last hypothesis indicates the potential relation between the tax benefit and the mix of short- and long-term leverage:

H5: The ratio of long-term leverage to total leverage is positively associated with interest tax benefits, c*eteris paribus*.

IV. RESEARCH METHODS

4.1 Econometric Methods

The foundation of this empirical study is a panel data model of three simultaneous equations regarding interest tax benefits (ITB), total leverage (TLEV), and the ratio of long-term leverage to total leverage (LD/TD). Interest tax benefits and leverage decisions are jointly endogenous variables in the model and are correlated with each other. ITB depends on the extent of total leverage, while both of the leverage decisions (TLEV and LD/TD) are affected by ITB. Specifically, the econometric model used in this study is given as follows:

$$ITB_{it} = X_{ITB,it}\beta_{ITB,1} + \beta_{ITB,2}TLEV_{it} + \mu_{ITB,it};\ \mu_{ITB,it} = \alpha_{ITB,i} + \varepsilon_{ITB,it} \quad (1)$$

$$TLEV_{it} = X_{TLEV,it}\beta_{TLEV,1} + \beta_{TLEV,2}ITB_{it} + \mu_{TLEV,it};\ \mu_{TLEV,it} = \alpha_{TLEV,i} + \varepsilon_{TLEV,it} \quad (2)$$

$$LD/TD_{it} = X_{LD/TD,it}\beta_{LD/TD,1} + \beta_{LD/TD,2}ITB_{it} + \mu_{LD/TD,it};\ \mu_{LD/TD,it} = \alpha_{LD/TD,i} + \varepsilon_{it} \quad (3)$$

Here subscript $i = 1, 2, \ldots, N$ indexes the individual firm, and $t = 1, \ldots, T$ indexes time. X's denote vectors of explanatory variables, β's represent vectors of parameters to be estimated, and μ's are error terms. Each μ consists of unobservable individual effects α and random noises ε. ε's are assumed to be independently and identically distributed over *i* and *t* while they may be correlated across equations. Consistent with the usual simultaneous equations model, X's are assumed to be exogenous to the equations system; that is, X's are uncorrelated with ε's. The unobservable individual effects α are assumed to be time-invariant.

There are several econometric issues regarding the estimation of the model described in equations (1)-(3). The first is the endogeneity among the three variables ITB, TLEV, and LD/TD. The endogeneity problem may result in biased OLS estimates of β's. A necessary condition for OLS estimates of an equation to be consistent is that all of the regressors in the equation are exogenous (i.e., all regressors are uncorrelated with the error term). However, equations (1)-(3) are likely to violate this condition. To see this, consider a simple case in which there are no individual effects (that is, $\alpha = 0$ for all *i*). Substituting equation (1) to equation (2) yields

$$\begin{aligned} TLEV_{it} &= \beta_{TLEV,1}X_{TLEV,it} + \beta_{TLEV,2}\beta_{ITB,1}X_{ITB,it} + \beta_{TLEV,2}\beta_{ITB,2}\mathbf{TLEV}_{it} \\ &\quad + \beta_{TLEV,2}\mu_{ITB,it} + \mu_{TLEV,it} \end{aligned} \tag{4}$$

The reduced form estimation can be obtained by solving equation (4) with respective to TLEV as follows:

$$\begin{aligned} TLEV_{it} &= \beta_{TLEV,1}/(1-\beta_{TLEV,2}\beta_{ITB,2})\bullet X_{TLEV,it} + \beta_{TLEV,2}\beta_{ITB,1}/(1-\beta_{TLEV,2}\beta_{ITB,2})\bullet X_{ITB,it} \\ &\quad + \beta_{TLEV,2}/(1-\beta_{TLEV,2}\beta_{ITB,2})\bullet\mu_{ITB,it} + 1/(1-\beta_{TLEV,2}\beta_{ITB,2})\bullet\mu_{TLEV,it} \end{aligned} \tag{5}$$

Equation (5) clearly illustrates that TLEV is a function of μ_{ITB}, the error term in equation (1). This means that TLEV fails to be an exogenous regressor in equation (4), and, thus, the OLS estimates of equation (1) will be biased ones. The same endogeneity problem that exists for equations (2) and (3) can be demonstrated by similar procedures.

The second econometric issue relates to the unobservable individual effects α's in the estimation of equations (1)-(3). The usual instrumental variables estimation methods such as two-stage least squares (2SLS) and three-stage least squares (3SLS) estimations can yield consistent estimate if such effects are not present in the model.[17] However, the individual effects are likely to be present in the equations system. For example, Gupta and Newberry (1997) argue that corporate effective tax rates (ETRs) may be correlated with omitted variables such as ownership structures, management compensation, and corporate culture. These omitted variables are also likely to affect managers' incentives to utilize the tax benefit of interest deductions. Furthermore, other unobservable firm characteristics such as credit history and management preference may also affect the choice of short-term and long-term financing (Myers, 1984; Diamond, 1991). These individual effects are heterogeneous across firms and are likely to be relatively constant over the sample period. Thus, the individual effects are consistent with the notation α_i in the system of equations (1)-(3). The usual 2SLS and 3SLS estimators without considering firms' individual heterogeneity may yield biased and inconsistent estimates of β's and/or biased standard errors.

[17] The first stage of the 2SLS estimation is to regress the endogenous regressors in a given equation on a given set of instrumental variables which includes all the exogenous variables in the equations system. The 2SLS estimates are obtained by replacing the endogenous regressors by the fitted values from the first stage. The 3SLS estimates are obtained by incorporating the contemporaneous correlation among the error terms (μ's). The relation of 2SLS estimator to 3SLS estimator is similar to the relation of OLS estimator for each equation to GLS estimator for the entire system of equations. If the error terms in an equations system are correlated across equations and at least one equation is over-identified, the 3SLS estimator is more efficient than the 2SLS estimator (Fomby et al., 1984, 506-507).

In response to the two econometric problems, this study adopts the panel data simultaneous equations methods developed by Cornwell et al. (1992). The choice of an appropriate panel method crucially depends on the assumption on the correlation between the individual effects (α's) and exogenous regressors (X's). This study considers two possible polar cases.[18] The first case assumes that all of the exogenous variables in equations (1)-(3) are uncorrelated with the individual effects--namely the random-effects assumption (Balestra and Nerlove, 1966). Under this assumption, the usual 2SLS and 3SLS estimators are unbiased, while their asymptotic standard errors are biased. Thus, their statistical inferences based on the usual *t* or Wald tests will be incorrect. This problem arises because the time-invariant individual effects α cause the error terms $\mu_{it} = \alpha_i + \varepsilon_{it}$ to be serially correlated even if ε_{it} are independently and identically distributed over time. Cornwell et al. (1992) provide two instrumental variables estimators for the random-effects case, the random-effects 2SLS and 3SLS estimators.

The second case assumes that the individual effects are correlated with all of the exogenous regressors--namely the fixed-effects assumption. The individual effects are "fixed" in the sense that they are no longer treated as random variables (Mundlak, 1977). Under this assumption, both the random-effects 2SLS and 3SLS estimators are biased even if sample size is large. The fixed-effects assumption leads to the fixed-effects 2SLS and 3SLS estimators. Cornwell et al. (1992) show that in the absence of further assumptions about the individual effects, the fixed-effects 3SLS estimator is efficient (the

[18] See Cornwell et al. (1992) for other possible assumptions.

most accurate). One defect of the fixed-effects model is that all time-invariant regressors (such as industry membership) are eliminated by the data transformation, so their coefficients cannot be estimated.

4.2 Empirical Model of Interest Tax Benefits

The empirical specification of interest tax benefits (ITB) is as follows:

ITB = *f* (investment tax shields, effective tax rates, profitability, earnings variability, firm size, leverage, year, industry membership).

The following subsection details the empirical model of ITB. Table 1 provides the operational definitions for the variables used in this empirical study.

4.2.1 **Dependent Variable**

This study uses firms' interest expenses and current tax rate schedules to estimate the tax savings of interest deductions (ΔTAX). ΔTAX denotes the difference between current tax expenses before- and after- interest deductions. The magnitude of ΔTAX varies among firms, depending upon their reliance on debt financing. Appendix A summarizes the assumptions and estimation procedures for ΔTAX. ITB is defined as $\frac{\Delta TAX_{it}}{EBIT_{i,t-1}}$, where $EBIT_{i,t-1}$ is prior year's earnings before interest and taxes. Trezevant (1994) suggests that tax shields be scaled by expected earnings (proxied by prior year's income) to control for the income effect. Thus, ITB is consistent with his suggestion.[19]

[19] Because ITB depends on interest expense, the scaling variable EBIT (earnings before interest and taxes) is used to avoid the endogeneity with ITB.

ITB is a direct measure of the tax benefit of debt financing and is measured at the margin. Accordingly, ITB incorporates the effects of all nondebt tax shields. Using the common denominator EBIT, ITB can be regarded as the difference between the before- and after-interest deduction effective tax rates (ETRs), as follows:

$$ETR_{after\text{-}interest} = \frac{CurrentTaxExpenseAfterInterest}{EBIT};$$

$$ETR_{before\text{-}interest} = \frac{CurrentTaxExpenseBeforeInterest}{EBIT} = \frac{CurrentTaxExpenseAfterInterest+\Delta TAX}{EBIT};$$

$$ITB = ETR_{before\text{-}interest} - ETR_{after\text{-}interest} = \frac{\Delta TAX}{EBIT}.$$

Therefore, ITB can be regarded as the tax savings of interest deductions, such that $ETR_{before\text{-}interest}$ is lowered to $ETR_{after\text{-}interest}$.

4.2.2 **Explanatory Variables**

Substitution Effect of Investment Tax Shields

DeAngelo and Masulis (1980) argue that investment tax shields could be a substitute for debt tax shield. Firms' investments can be either tangible (capital assets) or intangible (knowledge-based). In order to capture the substitution effects of investment tax shields on ITB, this study uses depreciation and R&D expenditure as explanatory variables. Depreciation expense (DEP) is the third largest deduction item on corporate tax returns, suggesting it is an important tax shield. R&D expenditure (RD) can be used

as an alternative tax shield because it is immediately deductible from current taxable income while its benefits are typically realized over a long period. Consistent with ITB, both variables are scaled by lagged EBIT.

Dhaliwal et al. (1992) and Trezevant (1992) show that low ETR firms exhibit the tax substitution effect for they have a higher probability of losing the deductibility of tax shields. Consequently, an indicator variable for firms in the bottom quantile of $ETR_{before\text{-}interest}$ (IETR) is included in the model to identify firms subject to a higher probability of losing the deductibility of interest tax shields. Finally, the interactions between IETR and the two nondebt tax shields (IDEP and IRD) are included in the model to examine whether the substitution effect has a negative impact on ITB. H2a and H2b predict that low tax rate firms are likely to utilize less ITB and are more susceptible to the tax substitution effect. Accordingly, the predicted signs on IETR, IDEP, and IRD are negative.

Income Effect of Earnings Realization

Profitable firms having enough taxable income to cover all tax shields may utilize more ITB. Returns on assets (ROA) are used to capture firms' profitability. ROA is defined as EBIT divided by total assets. As H3 hypothesized, the predicted sign on ROA is positive.

Earnings variability may increase the risk of losing the tax deductibility of interest; thus it may decrease the value of interest tax benefits. Therefore, firms with greater earnings variability are likely to benefit less from interest deductions. Variance of earnings (VEARN) is used to capture the impact of earnings variability on ITB. VEARN

is defined as the standard deviation of the past six years' ΔEBDIT, deflated by the mean assets over the same periods. ΔEBDIT is the difference between current and prior years' earnings before depreciation, interest, and taxes. The predicted sign on VEARN is negative.

Firm Size

The political cost hypothesis and political power hypothesis have opposing predictions on the relation between firm size and ITB. Further, large firms, having lower transaction costs of borrowing, may have greater debt capacity to utilize ITB. As H4 predicted, the predicted sign on firm size (SIZE) is uncertain. SIZE is measured by total assets, in natural logarithmic values.

Endogenous Variable-Total Leverage

Because interest expense is tax-deductible while dividends are not, ITB is predicted to be positively associated with a firm's total leverage level (TLEV). As H1 predicted, the predicted sign on TLEV is positive. TLEV is defined as the ratio of total debt to total assets.

Control Variables-*Year Effect, Industry Membership*

Aside from firm size, this study controls for year effects and industry membership. Micro-level factors such as interest rates and tax rules may also affect firms' leverage decisions and thus affect ITB. For example, the difference in interest rates over the sample years may cause firms' interest deductions to vary, directly

affecting their leverage ratios.[20] The dummy variables for sample years are added to control for the impact of macro-level factors on ITB.

Industry membership (IND) is used to control for firm risk and competition and to examine whether ITB varies among industries. The dummy variables for one-digit SIC codes are added to capture the industry effect. Industry membership, however, is time-invariant; therefore, the fixed-effects model can not directly estimate the coefficients of industry effects.

4.3 Empirical Models of Leverage Decisions

This study uses two empirical models to examine the relation between tax incentives and leverage decisions. The first model is about total leverage (TLEV). It examines the relation between tax incentive and total leverage. The second model specifies the ratio of long-term to total debt (LD/TD). It examines the impact of tax incentives on the mix of long-term and short-term debt, controlling for the relation between tax benefits and total leverage in the first model. The empirical specifications of these two leverage models are as follows:

TLEV = f (financial distress cost, asset mix, profitability, operating cash flow, tax incentive, firm size, year, industry membership).

LD/TD = f (financial strength, bankruptcy risk, asset mix, liquidity, operating cash flow, tax incentive, firm size, year, industry membership).

[20] "For 1992, the interest paid deduction dropped 18.5%...., the third consecutive year of decline. ....Like taxable interest income, the decline was largely driven by the decline in interest rates" (Statistics of Income Bulletin, 1995).

The following briefly discusses the two empirical models. Table 1 summarizes the operational definitions of the dependent and independent variables.

4.3.1 **Dependent Variables**

Total leverage (TLEV) is defined as the sum of short-term and long-term debt divided by total assets. To test the impact of tax incentive on the mix of short-term and long-term debt, this study uses LD/TD, which is defined as long-term debt divided by the sum of short-term and long-term debt. The classification of the two forms of borrowing is based on their original financing purposes. Therefore, long-term debt maturing within one year is classified as long-term debt.

4.3.2 **Explanatory Variables**

Tax Incentive

As discussed above, ITB takes into account the substitution effects of all nondebt tax shields on interest tax shield. ITB is used in the leverage equations as a direct measure of tax incentives of debt financing. The research design of this study excludes nondebt tax shields from the leverage equation, and thus avoids the confounding effects that nondebt tax shields may represent (e.g., debt securability). H1 hypothesizes a positive relation between leverage and ITB. Accordingly, the predicted sign on ITB is positive in the TLEV model.

Although ITB is hypothesized to have a positive effect on leverage, the relative importance of the tax incentive may be different for short-term and long-term financing

decisions. H5 posits that ITB is positively associated with the ratio of long-term leverage to total leverage, *ceteris paribus*. Therefore, the predicted sign on ITB is positive in the LD/TD model.

Financial Distress Costs

Earnings Variability (VEARN)

Prior studies used earnings variability and financial strength to proxy for the probability of financial distress (Bradley et al., 1984; Titman and Wessels, 1988; Friend and Hasbrouck, 1988; MacKie-Mason, 1990; Givoly et al., 1992; Manzon, 1994). Earnings variances (VEARN) represent operating risks and are predicted to be negatively related with leverage. The definition of VEARN is the same as in the ITB model.

Probability of Financial Distress (ZPRED)

Altman (1968) used Z-Score to proxy for the financial strength of a firm, and demonstrated the accuracy of Z-Score in predicting the probability of bankruptcy. Altman's Z-Score includes leverage in calculation. Thus, it is likely to be an endogenous regressor in the leverage equations. In response to this problem, MacKie-Mason (1990) modified the original Z-Score to avoid endogeneity when leverage is the dependent variable.[21] Consistent with his suggestion, this study uses Z-predictor (ZPRED) as a regressor, which is the inverse of the modified Z-Score (1/Z-Score). The higher the

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[21] $\text{Z-Score} = 3.3*\frac{\text{EBIT}_t}{\text{Assets}_t} + 1.0*\frac{\text{Sales}_t}{\text{Assets}_t} + 1.4*\frac{\text{RetainedEarnings}_t}{\text{Assets}_t} + 1.2*\frac{\text{WorkingCaptal}_t}{\text{Assets}_t}$.

ZPRED, the higher the probability of going bankrupt, and thus the higher the financial distress costs.

Diamond (1991) suggests that firms with very high credit ratings will choose short-term debt to avoid the agency cost premium on long-term debt, and firms with very low credit ratings can only issue short-term debt. Therefore, two indicator variables for firms in the top and bottom deciles of the ZPRED (HRISK and LRISK) are used to proxy for this nonmonotonic credit rating effect. HRISK is an indicator variable for firms having relatively high bankruptcy risk, and LRISK is an indicator variable for firms having relatively good financial strength. The predicted signs on both HRISK and LRISK are negative in the LD/TD model.

Asset Mix

Debt Securability

Asset mix reflects types of investments in either tangible or intangible assets. In contrast to intangible assets, tangible assets tend to have higher collateral value, less managerial discretion, less informational asymmetry, and higher liquidation value (Marsh, 1982; Friend and Hasbrouck, 1988; MacKie-Mason, 1990; Dhaliwal et al., 1992). Long-term financing decisions usually involve long-lived assets. The decisions, once made, are costly to reverse. Furthermore, firms are able to issue relatively more debt if the debt can be collateralized by fixed assets (Myers and Majluf, 1984; Dhaliwal et al., 1992). Consistent with this observation, this study uses firms' fixed assets scaled by total assets to proxy for the collateral value (CAPIN). The predicted sign on CAPIN is positive.

Age of Assets

Because of the transaction costs of acquiring debt, firms generally tend to have higher debt-to-asset ratios in the years immediately following a major capital expenditure (Wedig et al., 1988). Further, the construction of CAPIN is subject to differences in the book values and current costs of fixed assets. This difference can be either positively or negatively related to the age of the assets (AGE). AGE, defined as the cumulative depreciation divided by annual depreciation, is used to control for the differences in the age of fixed assets. The predicted sign on AGE is uncertain.

Growth Opportunity

Growth opportunities can be viewed as firms' call options for future investments. Bond values are more subject to managerial discretion and risk-shifting costs when a firm's value consists of a large portion of these call options (Myers and Majluf, 1984). In addition, transaction costs will prevent firms from paying out interest and continuing to borrow in the next period. Therefore, firms with growth opportunities will favor equity financing to keep funds available. In addition, such firms are subject to the higher costs of asymmetric information that will favor short-term debt over long-term debt.

Higher market value (including assets-in-place and call options) relative to the book value of assets (MV/BV) implies the firm is perceived by the market as having better growth opportunities. In addition, R&D expenditures (RD) can be inferred as the manager's inside information of the company's growth opportunities. Accordingly, the predicted signs on MV/BV and RD are negative.

Liquidity

Short-term debt increases liquidity risk because borrowers may be unable to refinance when bad financial news arrives. Consequently, the choice of short-term and long-term debt is affected by liquidity risk, by trading off the benefits of reduced interest costs from short-term debt against liquidity risk (Diamond, 1991).[22] Further, Myers (1977) and Marsh (1982) suggest that long-term debt is associated with fixed assets, while short-term debt is associated with current assets. Higher net working capital (WORKC) and shorter operating cycles (OPCYCL) indicate higher liquidity.[23] Firms with higher liquidity ratios can support more short-term debt. Thus, the predicted signs on WORKC and OPCYCL are negative in the LD/TD model.

Profitability

Total leverage depends more on the realization of operating profits, which are subject to informational asymmetry. Firms' returns on assets (ROA) are used to capture the impact of operating profitability on leverage decisions. The definition of ROA is the same as in the ITB model. Signaling theory and pecking order theory have opposing predictions on the impact of profitability on leverage. Signaling theory predicts a positive relationship between profitability and debt capacity, while pecking order theory predicts that profitable firms with internal funds will be less likely to borrow.

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[22] Liquidity risk from short-term debt is the risk that a solvent, but illiquid, borrower is unable to obtain refinancing in the event that lenders are unwilling to refinance when bad financial news arrives (Diamond, 1991).

[23] WORKC (working capital) = (Cash and Short-term investment + Receivables + Inventories - Accounts payable - Income taxes payable)/Assets;
OPCYCL (operating cycle) = (COGS/Average inventories) + (Sales/Average trade receivables).

Operating Cash Flow

Short-term debt allows financing terms to be reset at the intermediate date, reducing the informational disadvantage for lenders. Thus, short-term financing depends more on short-term cash flows which are less subject to informational asymmetry. More operating cash flows may provide higher liquidity to support more short-term financing. Further, pecking order theory predicts a negative relation between operating cash flows and leverage (Myers, 1984). Operating cash flows (OPCASH) are used to capture the impact of cash flows on leverage decisions. OPCASH is defined as pre-tax and interest operating cash flows, deflated by assets. The predicted sign on OPCASH is negative in both TLEV and LD/TD equations.

Control Variables

As in the ITB model, industry membership (IND), year effects (YEAR), and firm size (SIZE) are included as control variables in both leverage models. The definitions of IND, YEAR, and SIZE are the same as in the ITB model. Prior studies used industry membership to control for business competition and production technology (Dammon and Senbet; 1988), existence of target ratios (Marsh, 1982; Bradley et al., 1984), product uniqueness, and bankruptcy costs (Titman, 1984; Titman and Wessels, 1988). Transaction costs and economies of scale may favor large firms in the credit market (Marsh, 1982; Friend and Hasbrouck, 1988; Titman and Wessels, 1988; Barclay and Smith, 1995a, b; Graham, 1996). Finally, macro-level factors such as interest rates and yield spreads may have different impacts on leverage decisions over the sample years.

4.4 Sample Selection

The sample consists of 16,388 firm-year observations (4,097 firms * 4 years) which are selected from the 1994 Annual Compustat industrial files from 1990-1993. The monthly yield spreads between 3-month T-bills and 10-year T-bonds increased from virtually zero (in January 1990) to a peak of about 4% (in January 1993). The increase in yield spreads during the sample period will provide an opportunity to examine the impact of yield spreads on firms' leverage decisions. Consistent with prior studies, the following firms are deleted:

1. Financial institutions (SIC code 6xxx) and utilities (SIC code 4xxx): regulatory constraints may make these firms' behaviors and financial reporting rules systematically different from others (7,352 and 1,504 firm-years, respectively).

2. Foreign firms (state code 99): foreign (tax) rules may be different from the U.S. (688 firm-years).

3. Firms with net operating (NOL) carryforward (V52): Auerbach and Poterba (1987) show that NOL firms are highly persistent over at least four years, suggesting their tax benefits of interest deductions are close to zero (805 firm-years).

4. Firms missing data on assets (V6), sales (V12), and other required variables (398, 36, and 2,611 firm-years, respectively). Assets and sales are used as scaling variables. The variables in this study are summarized in Table 1.

5. Finally, to form balanced panel data, firms missing data on the required variables for one or more of the sample years (1,106 firm-years).

A total of 1,888 firm-years (472 firms*4 years) were selected for this study. The values of the variables are restricted to a reasonable range. Specifically, the scaled variables, DEP (depreciation), RD (R&D expenditure), TLEV (total leverage), LLEV (long-term leverage), and ITB (interest tax benefits), are restrained to the maximum value

of one. AGE (age of assets) is restrained to the maximum value of 40, and OPCYCL (operating cycle) is restrained to the maximum of 400 days.

V. EMPIRICAL RESULTS

5.1 Descriptive Statistics

Table 1 presents the industry composition of sample firms and all firms in the Compustat files from 1990-1993. The differences between sample firms' and all firms' industry compositions (row 3 and row 5) are not material. Table 2 provides the descriptive statistics and definitions of variables. Table 3 shows the Pearson correlation matrix for all of the variables used in this study. The results on table 3 indicate that ITB is positively related with TLEV, DEP, and RD; however, inconsistent with expectations, ITB is positively associated with IDEP and is negatively associated with ROA. Further, the relations between ITB and IRD and between ITB and SIZE do not appear to be significant. LD/TD is positively associated with ITB. The relation between ITB and the ratio of long-term leverage to total leverage remains positive, using a longer period of cut-off to classify long-term and short-term debt. Finally, consistent with expectations, TLEV is negatively associated with RD and MV/BV, and positively associated with CAPIN. AGE is negatively associated with TLEV, and SIZE is positively associated with TLEV and LD/TD. The reported correlation coefficients, however, may be insufficient and less informative because they fail to control for extraneous factors.

5.2 Simultaneous Estimation Results of Interest Tax Benefits, Total Leverage, and Long-term Debt/Total Debt

Specification Tests

In general, the instrumental variable estimates of a simultaneous equations model are sensitive to the model specification and the choice of instrumental variables. In order

to test the validity of the model specification and the legitimacy of the chosen instrumental variables, this study uses the Hansen (1982) statistic, which is computes as suggested by Ahn and Low (1996). The null hypothesis of the Hansen test is the joint hypothesis that the model to be tested is correctly specified and the chosen instrumental variables are exogenous to the error terms (μ's in equations (1)-(3)). Under this joint hypothesis, the Hansen statistic is asymptotically χ^2-distributed with degrees of freedom equal to the degrees of over-identification. If this joint hypothesis is correct, the Hansen statistic will be close to zero.[24] A large value of the statistic will indicate either the model to be tested is not well-specified or the chosen instrumental variables are not exogenous.

Tables 4 and 5 report the fixed-effects 3SLS and 2SLS estimates for the model detailed in section 4, respectively. Under the null hypothesis of no misspecification, the 3SLS estimator is consistent and efficient. However, under the 3SLS estimation any misspecification error in a single equation is transmitted throughout the system by the inconsistent estimated covariance matrix. The 2SLS estimator is consistent but less efficient under the null hypothesis of no misspecification error, while misspecification errors are confined to the misspecified equation. The reported Hansen statistics on tables 4 and 5 indicate that the model is well specified and the chosen instrumental variables are

[24] To understand the properties of the Hansen test, consider a single equation model $y_t = X_t\beta + u_t$. Suppose there are some instrumental variables Z_t such that $E(Z_t'u_t) = 0$; that is, Z_t is exogenous to u_t. The null hypothesis for the Hansen test is that $E[Z_t'(y_t-X_t\beta)] = 0$. If the hypothesis is correct, an optimally squared function of the sample mean of $Z_t'(y_t-X_t\beta)$, evaluated at an efficient instrumental variable estimator β under the null hypothesis, should be close to zero.

legitimate, suggesting that the reported results are consistent and unbiased.[25] The estimates reported on table 4 are qualitatively (in terms of signs and statistic significance) similar to those reported on table 5.

The same model is estimated under the random-effects assumption. Table 6 reports the random-effects 2SLS estimates.[26] As section 4 discussed, the coefficients of time-invariant regressors can be identified under the random-effects specification. Accordingly, the model is estimated using the overall intercept term and industry dummy variables as additional exogenous regressors. The random-effects estimator is more efficient under the assumption that firms' individual effects are uncorrelated with all of the exogenous regressors in equations (1)-(3). However, the reported Hansen statistics indicate strong evidence against the random-effects specification, suggesting that the exogenous regressors are correlated with the individual effects. These test results imply that the random-effects 2SLS estimates are biased ones because they are computed based on an incorrect assumption. For example, in accounting literature, firm size has been used to control for omitted variables; therefore, firm size is likely to be correlated with firms' unobservable individual effects. The comparison between tables 5 and 6 reveals the bias in the random-effects estimates. For example, consider the ITB equation, SIZE and ROA are insignificant on table 6 while they are significant and positive on table 5.

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[25] The exogenous time-varying regressors include DEP, RD, IETR, IDEP, IRD, ROA, VEARN, SIZE, ZPRED, HRISK, LRISK, CAPIN, AGE, MV/BV, WORKC, OPCYCL, OPCASH, and the YEAR dummy variables.

[26] The random-effects 3SLS estimates are not reported because the Hansen test results suggest to reject the random-effects 3SLS model specification.

The Hansen tests discussed above indicate that the model is consistent with the fixed-effects assumption. Further, the 3SLS estimator is more efficient than the 2SLS estimator; therefore, the following section discusses the empirical findings based on the fixed-effects 3SLS estimates (table 4).[27]

The ITB Equation

H1 posits a mutual-causal relation between ITB and TLEV. The empirical results provide evidence in support of H1. TLEV is positive in the ITB equation and ITB is also positive in the TLEV equation, indicating a feedback effect of leverage on interest tax benefits.

H2a predicts that low tax rate firms are likely to have less ITB. The results reported on table 4 do not support H2a. The coefficient on IETR is not significantly different from zero. H2b examines the impact of the substitution effect of investment tax shields on ITB. The results for H2b are somewhat mixed. The coefficients on DEP and RD are positive, consistent with Dammon and Senbet's (1988) argument that an increase in investment may increase firms' income, which, in return, expands firms' ability to utilize more interest tax shields. Inconsistent with the univariate results, the coefficient on IRD (the interaction term of RD and IETR) is negative, indicating that the substitution effect has a negative impact on ITB. Inconsistent with the univariate results, the

[27] Appendix C reports the reduced form estimation results of ITB, TLEV, and LD/TD using all the exogenous regressors. The estimates of the reduced form estimation represent the net (direct plus indirect) effects of the exogenous regressors. The results of the exogenous regressors in the reduced form estimation are similar (signs and significant levels) to those in the structural form estimation.

coefficient on IDEP is not significant, although its sign is consistent with prior prediction. These results indicate that investment tax shields have a positive impact on ITB; however, for low tax rate firms, the magnitude of the impact of investment tax shields is smaller. Although the evidence suggests the substitution effect has a negative impact on ITB, the sum of the coefficients on RD and IRD (DEP and IDEP) remains positive. Therefore, the evidence is not sufficient to conclude the substitution effect.

As H3 predicted, the coefficient on ROA is positive, inconsistent with the univariate results. Profitable firms, having a lower probability of losing the deductibility of interest tax shields, are able to utilize more interest tax benefits. While Trezevant (1994) argues that scaling tax shields by expected earnings provides controls for the income effect, this study shows that the income effect remains significant, even after scaling tax shields by expected earnings. Variance of earnings is predicted to have a negative impact on ITB because operating risks may lower the probability of utilizing interest deductions. However, inconsistent with prior expectation, the coefficient on VEARN is positive.

As H4 expected, the empirical results also indicate that firm size has a significant impact on ITB. Inconsistent with the univariate results, the relation between firm size and ITB is positive, reflecting the effect of economies of scale.

The TLEV Equation

As H1 predicted, the coefficient on ITB is positive, suggesting that tax incentive has a positive effect on firms' total leverage, after controlling for the potential

endogeneity problem and firms' individual effects. The results of the TLEV equation are generally consistent with prior expectations. The coefficient on CAPIN is positive. Capital assets provide greater collateral value and thus may support higher leverage. Inconsistent with the univariate results, the coefficient on AGE becomes insignificant, after controlling for firms' individual effects.[28] The coefficients on MV/BV and RD are negative, suggesting that growth firms with greater information costs tend to borrow less outside funds. Most of the prior studies on corporate leverage do not include profitability as an explanatory variable. In addition to operating cash flows, this study includes profitability as an explanatory variable. The results show that profitability has a significant impact on leverage, after controlling for operating cash flows. The coefficients on ROA and OPCASH are negative, indicating that profitable firms and firms with greater operating cash flows tend to rely less on debt, consistent with Myers' (1984) pecking order theory. As expected, the coefficient on VEARN is negative, suggesting that firms with higher operating risks tend to use less debt. VEARN is not significant in the univariate analysis but becomes negative in the regression results. Finally, the coefficient on SIZE is positive, suggesting that economies of scale favor large firms in the credit market. The year effects are negative and the absolute values of the coefficients steadily increase during the sample years, suggesting that firms facing an upward-sloping yield curve are likely to use less debt.

[28] As discussed later, AGE is significantly negative in the OLS and the usual 2SLS estimations (see Tables 8 and 9).

The LD/TD Equation

H5 posits that tax incentive is positively associated with the ratio of long-term leverage to total leverage. As expected, the coefficient on ITB is positive, suggesting that firms with greater tax benefits of debt financing are more likely to commit themselves to long-term leverage. This study shows that tax incentives are associated with firms' total leverage and the mix of short- and long-term leverage. The positive relation between LD/TD and ITB remains significant when TLEV is directly included in the LD/TD equation.[29]

The coefficient on RD is negative, suggesting that firms with greater growth opportunity, having higher costs of informational asymmetry, tend to prefer short-term debt to long-term debt, consistent with Myers' (1977) prediction that short-term debt may be a vehicle to reduce information costs. Prior studies on leverage did not include liquidity as an explanatory variable in the leverage decisions. This study includes liquidity as an explanatory variable in leverage decisions. The coefficient on WORKC is negative, suggesting that firms with greater liquidity are more likely to use short-term debt than long-term debt. This finding provides evidence for Diamond's (1991) prediction that the choice of short-term and long-term financing is affected by firms' liquidity risks. Firms with less liquidity risks are more likely to use short-term debt, rather than long-term debt. Finally, as expected, the coefficient on HRISK is negative, indicating that risky firms are more likely to use short-term debt than long-term debt.

[29] The coefficient on ITB remains significantly positive (p-value = 0.0977) when TLEV is directly included in the LD/TD equation. The coefficient on TLEV is positive but insignificant (p-value = 0.8592). The Hansen test result suggests not to reject the model (p-value = 0.3684).

The coefficient on LRISK does not appear to be significant. LRISK, however, is based on Z-score, which is used to predict firms' bankruptcy risks and, thus, may not capture firms' financial strength. OPCASH is significantly negative in the univariate analysis; however, it becomes insignificant in the regression results.

5.3 Additional Analysis

Simultaneous Estimation Results of Interest Tax Benefits, Short-term Leverage, and Long-term Leverage

The results reported on table 4 show that ITB has an impact on the mix of short-term and long-term leverage decisions, suggesting that the tax motives for the two forms of financing may be different. Table 7 reports the fixed-effects 2SLS estimation results for an alternative three simultaneous equations: ITB (interest tax benefits), LLEV (long-term leverage), and SLEV (short-term leverage). The results of the Hansen tests lead one to accept the model specifications for the ITB and LLEV equations, but indicate there may be potential specification errors in the SLEV equation (p-value = 0.066). In the ITB equation, leverage is separated into LLEV and SLEV. The results also confirm that tax incentive is a more important factor in long-term leverage than in short-term leverage. In the ITB equation, the coefficient on LLEV is positive, while the coefficient on SLEV is insignificantly different from zero. Further, the coefficient on ITB is positive in the LLEV equation, but is insignificantly different from zero in the SLEV equation.

Classification of Short-term and Long-term Debt

The classification of long-term and short-term debt in this study is based on firms' original financing purposes. To analyze the impact of the classification of short-term and long-term debt, long-term debt maturing within one year is reclassified as short-term debt, based on its classification on financial statements. LD/TD is replaced by LDTD1 in the estimation. LDTD1 is defined as the ratio of long-term debt maturing later than one year, excluding long-term debt maturing within one year. The results of the LDTD1 model are qualitatively the same as the previous results.[30] The coefficient on ITB remains positive (p-value = 0.0200) in the LDTD1 model. However, when using two years or longer as a cut-off period in classifying long-term and short-term debt, the coefficient on ITB becomes insignificant, inconsistent with the univariate results.

Estimation Results of OLS and 2SLS

To compare the impact of different estimators, Tables 8 and 9 report OLS and usual 2SLS estimation results for the ITB, TLEV, and LD/TD equations, respectively. The differences between the results of the fixed-effects 2SLS estimation and the results of the OLS and usual 2SLS are not trivial. In the ITB equation, the coefficient on ROA is positive in the panel data estimation but becomes insignificant in both OLS and usual 2SLS estimation. The coefficient on SIZE is positive in the panel data estimation; however it becomes negative in the OLS estimation. The coefficient on SIZE is

[30] The Hansen test result suggests not to reject the model (p-value = 0.5810). The results of the ITB and TLEV models are the same as discussed above, because the classification of short-term and long-term debt does not affect the two variables.

insignificant in the usual 2SLS estimation. These results suggest the importance of controlling for firms' heterogeneity in drawing inferences from the relation between ITB and firm characteristics, especially for profitability and firm size. Furthermore, the estimation results are also different for some variables in the leverage decisions. In the TLEV equation, the coefficients on VEARN is negative in the panel data estimation but becomes insignificant in the OLS and usual 2SLS estimations. The coefficient on ROA is negative in the panel data estimation but becomes insignificant in the 2SLS estimation. Conversely, the coefficient on AGE is insignificant in the panel data estimations, while it becomes negative in the 2SLS and OLS estimations which do not control for firms' individual effects. This finding suggests that AGE may be correlated with firms' individual effects and, hence, it becomes insignificant after controlling for firms' individual effects. Finally, in the LD/TD equation, the coefficients on OPCASH and LRISK become negative in the OLS and 2SLS estimations, while they are insignificantly different from zero in the panel data estimation.

VI. CONCLUSIONS

This study provides evidence that different firm characteristics are likely to affect the ability to utilize the tax benefit of interest deductions, a tax subsidy for debt financing. Prior research on corporate tax policy debate shows that several firm characteristics are associated with corporate ETRs, which are used as a summary statistic of overall tax burdens. This study documents further that firms also differ in their ability to utilize the interest tax shield. Although leverage is positively associated with interest tax benefits, tax motives are different for short-term and long-term leverage. Tax policy debate based on an aggregate measure such as ETRs or interest tax benefits could be misleading because some of the tax benefits that firms take (e.g., interest tax benefits from short-term debt) may not be driven by tax motives. Further, investment tax shields have a positive impact on interest tax benefits, possibly reflecting the increased income effect that the increased investment expands firms' debt capacity to utilize more interest tax shields (Dammon and Senbet, 1988). However, for low tax rate firms, the magnitude of the impact of investment tax shields on interest tax benefits is smaller. Although the evidence of this study shows that the substitution effect of investment tax shields has a negative impact on interest tax benefits for low tax rate firms, the economic significance of the impact does not appear sufficient to conclude the substitution effect. Profitable firms are likely to utilize more interest tax benefits. Finally, this study also shows that firm size is positively associated with the ability to utilize interest tax benefits, in support of the economies of scale hypothesis.

The empirical results also contribute evidence regarding the different tax motives for short-term and long-term financing. Firms are more likely to commit themselves to long-term leverage if they can utilize the tax benefit of interest deductions. Furthermore, this study contributes new evidence that firms with greater information costs are more likely to use short-term debt, and, conversely, firms with greater liquidity risks are more likely to use long-term debt, confirming Diamond's (1991) argument that firms trade off between the costs of liquidity risk and the benefits of reduced interest in choosing short-term and long-term financing. The different motives for short-term and long-term financing imply that firms select capital structure depending on attributes that determine the various costs and benefits associated with different financial instruments (Titman and Wessels, 1988).

The results of this study provide evidence on a mutual-causal relation between the tax benefits and firms' leverage. In addition, firms with greater capital assets tend to have higher leverage, consistent with the debt securability argument. Firms with greater operating risks tend to have lower leverage, reflecting the costs of financial distress; firms with greater growth opportunity tend to use less leverage, reflecting the costs of informational asymmetry. Furthermore, profitable firms tend to rely less on leverage, after controlling for operating cash flows, consistent with Myers' (1984) pecking order theory. A negative relation between profitability and leverage is consistent with the result found in Titman and Wessels (1988) but is inconsistent with the result found in Friend and Hasbrouck (1988). Prior research has provided mixed results regarding the relation between leverage and firm size. The results of this study suggest that economies of scale

favor large firms in the credit market, consistent with the results found in Barclay and Smith (1995a, b) and Graham (1996) but inconsistent with the results found in Marsh (1982), Titman and Wessels (1988) and MacKie-Mason (1990).

From a research design's perspective, this study uses a panel data simultaneous equations model which controls for the endogeneity problem and firms' unobservable individual effects. While the endogeneity problem is a growing concern in prior studies (Graham, 1996; Graham et al., 1997), the results of this study suggest that controlling for firms' specific-heterogeneity may have a greater impact in inferring empirical results. For example, in the ITB equation, the coefficient on ROA is not significant in the OLS and 2SLS estimations; however, it is positive in the 2SLS fixed-effects estimation. Firm size is negative in the OLS and 2SLS estimations; however, it becomes positive in the 2SLS fixed-effects estimation. Furthermore, in the TLEV equation the effects of ROA and VEARN become significant after controlling for firms' individual heterogeneity. Conversely, the significant effect of AGE in the TLEV equation and the significant effects of OPCASH and LRISK in the LD/TD equation disappear after controlling for firms' individual heterogeneity. Finally, the evidence of this study also shows that the income effect remains significant even after controlling for expected earnings, inconsistent with Dhaliwal et al. (1992) and Trezevant (1994) argument that scaling nondebt tax shields by expected earnings (proxied by lagged EBIT) controls for the income effect. Although this study includes ROA as a control for the income effect, ROA, admittedly, serves only a "rough" control for the income effect, and thus may

reduce the power of the test in finding the substitution effect. A better measurement for the income effect may merit future work.

The conclusions of this study are subject to several limitations. Although this study hypothesizes that tax incentives are different in short-term and long-term financing, the same tax benefit proxy is used for the two financing decisions, due to the data limitations and model complexity. The interest rate on short-term debt is usually lower than the rate on long-term debt; therefore, using the same ITB for both borrowings may overestimate the tax benefits of short-term borrowing. To the extent that tax motives are hypothesized to be less important in short-term financing, overestimating the tax benefits of short-term debt may weaken the power of the test. Furthermore, the tax benefit of interest deductions is calculated using explicit taxes only. With the omission of implicit taxes, the measurement of the tax benefit of debt financing may be overstated, because the tax benefit of debt is likely to cause firms to bear the higher costs of issuing debt instrument in the marketplace.

The classification of short-term and long-term debt is based on their original financing purposes. Long-term debt maturing in one year is classified as long-term debt. However, because of the data limitations, refinanced short-term debt maturing later than one year may be classified as long-term debt. This classification may be arbitrary and introduce measurement errors in the dependent variables. The sensitivity analyses suggest that the conclusions of this study may be subject to alternative classifications of short-term and long-term debt. Further, the sample firms are drawn from the Compustat industrial files which consist of companies of greatest investor interest, particularly those

traded on the New York Stock Exchange. The Compustat industrial firms may have different financing behavior from other firms, and, thus, the sample firms are subject to potential selection bias. Finally, the sample selection criteria eliminate NOL firms and firms with missing data for one or more of the panel years, and thus may limit the generalizability of this study.

Table 1

Descriptive Statistics: Industry Composition of Sample Firms

Panel A: Industry Composition of All Firms in Compustat Files from 1990-1993

	One-digit SIC	1	2	3	4	5	6	7/8	Total
1	# of firms	816	1,888	2,784	1,504	1,076	7,352	968	16,388
2	% of firms	4.98%	11.52%	16.99%	9.18%	6.57%	44.86%	5.90%	100%
3	% of firms[a]	10.83%	25.07%	36.96%	n/a	14.29%	n/a	12.85%	100%

[a]: Excluding financial institutions (SIC 6xxx) and utilities (SIC 4xxx).

Panel B: Industry Composition of Sample Firms in this Study

	One-digit SIC	1	2	3	4	5	6	7/8	Total
4	# of firms	156	440	736	n/a	320	n/a	236	1,888
5	% of firms	8.26%	23.31%	38.98%	n/a	16.95%	n/a	12.50%	100%

Table 2

Descriptive Statistics and Definitions of Variables

(N = 1,888 firm-years, 472 firms*4 years)

Variable	Mean	Std. Dev.	Minimum	Maximum
ITB (interest tax benefit)	0.1031	0.1533	0	1
DEP (depreciation)	0.4951	0.2917	0.0068	1
RD (R&D expenditure)	0.2133	0.3001	0	1
LLEV (long-term leverage including long-term debt maturing in one year)	0.2009	0.1668	0	1
LLEV1 (long-term leverage excluding long-term debt maturing in one year)	0.1840	0.1560	0	0.8078
SLEV (short-term leverage excluding long-term debt maturing in one year)	0.0309	0.0576	0	0.5089
SLEV1 (short-term leverage including long-term debt maturing in one year)	0.0478	0.0685	0	0.7304
TLEV (total leverage)	0.2318	0.1709	0	1
LDTD (proportion of long-term leverage to total leverage)	0.7847	0.3222	0	1
LDTD1 (proportion of long-term debt maturing later than one year to total debt)	0.705	0.318	0	1
LDTD2 (proportion of long-term debt maturing later than two years to total debt)	0.6107	0.3255	0	1

Table 2 cont.

LDTD3 (proportion of long-term debt maturing later than three years to total debt)	0.5296	0.3279	0	1
LDTD4 (proportion of long-term debt maturing later than four years to total debt)	0.4524	0.3285	0	1
LDTD5 (proportion of long-term debt maturing later than five years to total debt)	0.3875	0.3279	0	1
SIZE (firm size)	6.0838	1.8747	1.0743	12.4352
VEARN (variance of earnings)	0.0542	0.0565	0.0034	0.7405
ZPRED (1/Z-Score)	0.5748	1.5349	-15.5616	55.2
CAPIN (capital intensity)	0.3784	0.2163	0.003	0.9979
AGE (age of assets)	6.2883	3.7696	0.3518	40
MV/BV (market-to-book value of assets)	1.5072	1.2497	0.2453	14.6709
ROA (return on assets)	0.1143	0.0892	-0.9841	0.667
WORKC (working capital)	0.3521	0.1915	-0.0594	0.9695
OPCYCL (operating cycle)	46.2557	91.4785	0.4775	400
OPCASH (operating cash)	0.1583	0.101	-0.9423	0.8268

Table 2 cont.

Definitions of Variables and Compustat Data Items

ITB (interest tax benefits) = ΔTAX/Absolute value of lagged EBIT, where ΔTAX is the difference between before- and after-interest tax expenses, and EBIT is earnings before interest and taxes. (EBIT = V170 + V15 - V55 - V17)

DEP (depreciation) = Depreciation/Absolute value of lagged EBIT. (Depreciation = V14)

RD (R&D expenditure) = R&D/Absolute value of lagged EBIT. (R&D = V46)

IETR: An indicator (dummy variable) for firms with a high probability of losing the tax deductibility of interest expenses (in the bottom quantile of the $ETR_{before\text{-}interest}$ (< 0.2745) distribution). ($ETR_{before\text{-}interest}$ = (Current tax expense (V16 - V50) + ΔTAX)/EBIT)

IDEP (interaction of DEP and IETR) = IETR*DEP

IRD (interaction of RD and IETR) = IETR*RD

ROA (return on assets) = EBIT/Total assets (Total assets = V6)

LLEV (long-term debt including long-term debt maturing in one year) = (Long-term debt + Long-term debt maturing in one year)/Total assets = (V9 + V44)/V6

LLEV1 (long-term debt excluding long-term debt maturing in one year) = Long-term debt/Total assets = V9/V6

SLEV (Short-term debt excluding long-term debt maturing in one year) = Short-term debt/Total assets = V206/V6

SLEV1 (Short-term debt including long-term debt maturing in one year) = (Short-term debt + Long-term debt maturing in one year)/Total assets = V34/V6

TLEV (total debt) = Total debt/Total assets = LLEV + SLEV

LD/TD (proportion of long-term debt to total debt) = Long-term debt/Total debt = LLEV/TLEV

LDTD1 (proportion of long-term debt maturing later than one year to total debt) = LLEV1/TLEV

LDTD2 (proportion of long-term debt maturing later than two years to total debt) = (Long-term debt - Long-term debt maturing in two years)/Total debt = (V9 - V91)/(V9 + V34)

LDTD3 (proportion of long-term debt maturing later than three years to total debt) = (Long-term debt - Long-term debt maturing in three years)/Total debt = (V9 - V91 - V92)/(V9 + V34)

Table 2 cont.

LDTD4 (proportion of long-term debt maturing later than four years to total debt) = (Long-term debt - Long-term debt maturing in four years)/Total debt = (V9 - V91 - V92 - V93)/(V9 + V34)

LDTD5 (proportion of long-term debt maturing later than five years to total debt) = (Long-term debt - Long-term debt maturing in five years)/Total debt = (V9 - V91 - V92 - V93 - V94)/(V9 + V34)

SIZE (firm size) = log(Total Assets) = log(V6)

VEARN (variance of earnings) = Standard deviation of past six years' EBDIT/Mean value of past six years' assets, where EBDIT is earnings before depreciation, interest, and taxes. (EBDIT = V170 + V15 - V55 -V17 + V14)

ZPRED (Bankruptcy predictor) = 1/Z-Score, where

$$\text{Z-Score} = 3.3*\frac{EBIT_t}{Assets_t} + 1.0*\frac{Sales_t}{Assets_t} + 1.4*\frac{RetainedEarnings_t}{Assets_t} + 1.2*\frac{WorkingCapital_t}{Assets_t}$$

(Sales = V12; Retained earnings = V36; Working capital = V179)

CAPIN (capital intensity) = Net PP&E/Total assets = (V8/V6)

AGE (age of assets) = Accumulated depreciation/Depreciation expense = (V196/V14)

MV/BV (Market-to-book value of assets) = Market value of assets/Book value of assets (Market value of assets = V24*V25 + V130 + V9 + V34)

HRISK (high bankruptcy risk firms): indicator for firms in the top decile of ZPRED (> 0.8821)

LRISK (low bankruptcy risk firms): indicator for firms in the bottom decile of ZPRED (< 0.2729)

WORKC (working capital) = (Cash and Short-term investment + Receivables + Inventories - Accounts payable - Income taxes payable)/Assets
(Cash and short-term investment = V1; Receivables = V2; Inventories = V3;
Accounts payable = V70; Income taxes payable = V71)

OPCYCL (operating cycle) = (COGS/Average inventories) + (Sales/Average trade receivables)
(COGS = V41; Average inventories = $(V3_{t-1} + V3_t)/2$; Average trade receivables = $(V2_{t-1} + V2_t)/2$)

OPCASH (operating cash flow) = Pre-tax and interest operating cash flow/Assets
(Pre-tax and interest operating cash flow = V308 + V15 + V16 - V50 - V124)

Table 2 cont.

YEAR (yearly effect) is defined as follows:
YR90: dummy variable for the year 1990
YR91: dummy variable for the year 1991
YR92: dummy variable for the year 1992
YR93: dummy variable for the year 1993.

IND (industry membership) is defined as follows:
IND1: SIC code 1xxx (extractive resources)
IND2: SIC code 2xxx (non-durable manufacturing)
IND3: SIC code 3xxx (durable manufacturing)
IND5: SIC code 5xxx (trade)
IND78: SIC code 7xxx/8xxx (miscellaneous service/ professional service).

Table 3

Correlation Analysis

Pearson Correlation Coefficients / N = 1,888

	ITB	LD/TD	LDTD1	LDTD2	LDTD3	LDTD4	LDTD5	TLEV
ITB	n/a	0.1913*	0.2083*	0.1902*	0.1768*	0.1545*	0.1099*	0.5142*
LD/TD	0.1913*	n/a	0.9170*	0.7814*	0.6778*	0.5794*	0.5011*	0.3453*
TLEV	0.5142*	0.3453*	0.3790*	0.3572*	0.3301*	0.3001*	0.2453*	n/a
DEP	0.4674*	0.2519*	0.2286*	0.1509*	0.1128*	0.0700*	0.0470*	0.2238*
RD	0.0998*	-0.1152*	-0.1098*	-0.0931*	-0.0851*	-0.0707*	-0.0568*	-0.1046*
$ETR_{before\text{-}interest}$	0.0424	0.0169	0.0169	0.0111	0.0079	0.0026	-0.0033	0.0336
IETR	0.0328	0.0134	-0.0172	-0.0184	-0.0063	0.0030	0.0113	0.0662*
IDEP	0.1400*	0.0922*	0.0534*	0.0231	0.0215	0.0154	0.0152	0.0982*
IRD	-0.0131	-0.0402	-0.0580*	-0.0572*	-0.0429	-0.0206	-0.0128	-0.0633*
ROA	-0.2952*	-0.2130*	-0.1780*	-0.1357*	-0.1110*	-0.0932*	-0.0720*	-0.2680*
VEARN	0.0551*	-0.0567*	-0.0859*	-0.0930*	-0.0930*	-0.0917*	-0.0937*	-0.0058
SIZE	-0.0370	0.0829*	0.1379*	0.2048*	0.2218*	0.2321*	0.2287*	0.1159*
ZPRED	0.1462*	0.0351	0.0426	0.0530*	0.0573*	0.0647*	0.0703*	0.1253*
HRISK	0.2929*	0.0870*	0.0721*	0.0781*	0.0863*	0.0893*	0.0785*	0.3324*
LRISK	-0.1400*	-0.1298*	-0.1318*	-0.1393*	-0.1347*	-0.1235*	-0.1034*	-0.2392*
CAPIN	0.1476*	0.2850	0.2991*	0.2712*	0.2425*	0.2026*	0.1631*	0.2975*
AGE	-0.0375	-0.0622*	-0.0824*	-0.0734*	-0.0642*	-0.0465*	-0.0336	-0.1381*
MV/BV	-0.2130*	-0.2855*	-0.2725*	-0.2090*	-0.1636*	-0.1270*	-0.1083*	-0.2756*
WORKC	-0.1257*	-0.3385*	-0.3435*	-0.3114*	-0.2759*	-0.2409*	-0.1984*	-0.2880*
OPCYCL	0.0025	0.0353	0.0504*	0.0533*	0.0477*	0.0351	0.0285	0.0430
OPCASH	-0.1825*	-0.1015*	-0.0933*	-0.0767*	-0.0684*	-0.0630*	-0.0492*	-0.2009*

*: significant at the 0.05 level under H_0: Rho = 0.

Table 4

Fixed-Effects 3SLS Estimation Results of Interest Tax Benefits, Total Leverage, and Long-term Debt/Total Debt

(*t*-statistics in parentheses)

Model	ITB coefficient	TLEV coefficient	LD/TD coefficient
ITB		0.1525 (3.7893)***	0.2102 (1.8464)*
TLEV	0.5040 (2.7635)***		
DEP	0.2473 (11.7525)***		
RD	0.2524 (9.2867)***	-0.05427 (-2.5253)**	-0.1323 (-2.1740)**
IETR	-0.0115 (-0.7956)		
IDEP	-0.0022 (-0.1021)		
IRD	-0.0524 (-2.5907)**		
ROA	0.2049 (3.1242)***	-0.1382 (-3.9039)***	
VEARN	0.4444 (4.3038)***	-0.2501 (-4.2032)***	
SIZE	0.0345 (2.3397)**	0.0288 (3.3831)***	-0.0312 (-1.3246)
ZPRED		-0.0006 (-0.5704)	
HRISK			-0.0472 (-1.8932)*
LRISK			-0.0029 (-0.1060)
CAPIN		0.1995 (5.3192)***	0.0775 (0.6450)
AGE		0.0006 (0.5272)	
MV/BV		-0.0101 (-4.1288)***	
WORKC			-0.1771 (-1.9588)*
OPCYCL			-0.0001 (-0.9213)
OPCASH		-0.0951 (-4.0382)***	-0.0393 (-0.6354)
YR91	-0.0002 (-0.0295)	-0.0144 (-3.7787)***	0.0157 (1.5149)
YR92	-0.0064 (-0.7140)	-0.0279 (-6.9572)***	0.0153 (1.4146)
YR93	-0.0158 (-1.5096)	-0.0359 (-8.2123)***	0.0186 (1.5792)
Hansen Test *P-value (df)*	*29.6900* *0.1585 (23)*		

Table 4 cont.

***: significant at the .01 level.
** : significant at the .05 level.
* : significant at the .10 level.

1. The instrumental variables include all exogenous independent variables in the equation system.

2. Variable definitions:

ITB:	interest tax benefits.
TLEV:	total leverage.
LD/TD:	the proportion of long-term to short-term debt.
DEP:	depreciation expense.
RD:	R&D expenditure.
IETR:	indicator variable for firms in the bottom quantile of $ETR_{before\text{-}interest}$.
IDEP:	interaction of DEP and IETR.
IRD:	interaction of RD and IETR.
ROA:	returns on assets.
VEARN:	variance of earnings.
SIZE:	firm size.
ZPRED:	bankruptcy predictor.
HRISK:	indicator variable for firms in the top decile of ZPRED.
LRISK:	indicator variable for firms in the bottom decile of ZPRED.
CAPIN:	capital intensity.
AGE:	age of assets.
MV/BV:	market-to-book value of assets.
WORKC:	working capital.
OPCYCL:	operating cycle.
OPCASH:	operating cash flows.
YR91:	dummy variable for the year 1991.
YR92:	dummy variable for the year 1992.
YR93:	dummy variable for the year 1993.

Table 5

Fixed-Effects 2SLS Estimation Results of Interest Tax Benefits, Total Leverage, and Long-term Debt/Total Debt

(*t*-statistics in parentheses)

Model	ITB coefficient	TLEV coefficient	LD/TD coefficient
ITB		0.1477 (3.6361)***	0.2110 (1.8447)*
TLEV	0.4166 (2.2498)**		
DEP	0.2539 (11.8106)***		
RD	0.2508 (9.1273)***	-0.0524 (-2.3999)**	-0.1320 (-2.1596)**
IETR	-0.0070 (-0.4509)		
IDEP	-0.0066 (-0.2826)		
IRD	-0.0607 (-2.8109)***		
ROA	0.1868 (2.8134)***	-0.1275 (-3.5496)***	
VEARN	0.4231 (4.0568)***	-0.2527 (-4.2157)***	
SIZE	0.0376 (2.5266)**	0.0285 (3.3191)***	-0.0307 (-1.2971)
ZPRED		-0.0006 (-0.5661)	
HRISK			-0.0507 (-2.0145)**
LRISK			0.0005 (0.0173)
CAPIN		0.2074 (5.3080)***	0.0821 (0.6778)
AGE		0.0003 (0.2522)	
MV/BV		-0.0095 (-3.7153)***	
WORKC			-0.1803 (-1.9741)**
OPCYCL			-0.0001 (-0.9330)
OPCASH		-0.1104 (-4.4624)***	-0.0516 (-0.8277)
YR91	-0.0019 (-0.2602)	-0.0144 (-3.7529)***	0.0157 (1.5064)
YR92	-0.0096 (-1.0583)	-0.0279 (-6.8998)***	0.0151 (1.3903)
YR93	-0.0198 (-1.8646)*	-0.0360 (-8.1573)***	0.0182 (1.5413)
Hansen Test *P-value (df)*	*8.1753* *0.4165 (8)*	*9.9927* *0.1890 (7)*	*7.6364* *0.4698 (8)*

Table 5 cont.

***: significant at the .01 level.
** : significant at the .05 level.
* : significant at the .10 level.

1. The instrumental variables include all exogenous independent variables in the equation system.

2. Variable definitions:

ITB:	interest tax benefits.
TLEV:	total leverage.
LD/TD:	the proportion of long-term to short-term debt.
DEP:	depreciation expense.
RD:	R&D expenditure.
IETR:	indicator variable for firms in the bottom quantile of $ETR_{before\text{-}interest}$.
IDEP:	interaction of DEP and IETR.
IRD:	interaction of RD and IETR.
ROA:	returns on assets.
VEARN:	variance of earnings.
SIZE:	firm size.
ZPRED:	bankruptcy predictor.
HRISK:	indicator variable for firms in the top decile of ZPRED.
LRISK:	indicator variable for firms in the bottom decile of ZPRED.
CAPIN:	capital intensity.
AGE:	age of assets.
MV/BV:	market-to-book value of assets.
WORKC:	working capital.
OPCYCL:	operating cycle.
OPCASH:	operating cash flows.
YR91:	dummy variable for the year 1991.
YR92:	dummy variable for the year 1992.
YR93:	dummy variable for the year 1993.

Table 6

Random-Effects 2SLS Estimation Results of Interest Tax Benefits, Total Leverage, and Long-term Debt/Total Debt

(*t*-statistics in parentheses)

Model	ITB coefficient	TLEV coefficient	LD/TD coefficient
ITB		0.3637 (4.8723)***	0.5802 (3.3018)***
TLEV	0.3683 (6.5449)***		
DEP	0.2055 (11.9260)***		
RD	0.0429 (2.5242)**	-0.0675 (-3.0554)***	-0.0870 (-1.8425)*
IETR	0.0040 (0.2497)		
IDEP	-0.0217 (-0.8775)		
IRD	-0.0462 (-1.9919)**		
ROA	0.0036 (0.0708)	-0.0827 (-1.1137)	
VEARN	0.0838 (1.1872)	-0.0038 (-0.0368)	
SIZE	-0.0032 (-1.3646)	0.0095 (2.8676)***	0.0002 (0.0310)
ZPRED		0.0006 (0.2518)	
HRISK			-0.0981 (-2.1368)**
LRISK			-0.0692 (-1.7367)*
CAPIN		0.1594 (5.1492)***	0.0214 (0.2415)
AGE		-0.0071 (-4.5622)***	
MV/BV		-0.0216 (-4.4195)***	
WORKC			-0.4944 (-4.9163)***
OPCYCL			-0.0001 (-1.0692)
OPCASH		-0.1924 (-3.6874)***	-0.1639 (-1.6346)
YR91	-0.0034 (-0.5112)	-0.0048 (-1.0217)	0.0145 (1.2651)
YR92	-0.0020 (-0.3002)	-0.0165 (-3.4334)***	0.0051 (0.4449)
YR93	-0.0105 (-1.5027)	-0.0202 (-4.0743)***	0.0052 (0.4367)

Table 6 cont.

Intercept	-0.0837 (-3.0486)***	0.2237 (5.6300)***	0.9823 (9.7162)***
IND2	0.0111 (0.6548)	-0.0018 (-0.0711)	-0.0241 (-0.4354)
IND3	0.0159 (0.9520)	-0.0033 (-0.1292)	-0.0437 (-0.7909)
IND5	0.0173 (1.0006)	-0.0377 (-1.4558)	0.0035 (0.0608)
IND78	0.0165 (0.9075)	0.0152 (0.5637)	-0.0694 (-1.1979)
Hansen Test *P-value (df)*	*65.1786* *0.0000 (8)*	*49.6035* *0.0000 (7)*	*44.5960* *0.0000 (8)*

***: significant at the .01 level.
** : significant at the .05 level.
* : significant at the .10 level.

1. The instrumental variables include all exogenous independent variables in the equation system.

2. Hansen statistic for the random-effects 3SLS estimation is 160.9372 (p-value = 0.0000), which suggests to reject the model. To conserve space, the estimation results of 3SLS are not reported.

3. Variable definitions:

ITB: interest tax benefits.
TLEV: total leverage.
LD/TD: the proportion of long-term to short-term debt.
DEP: depreciation expense.
RD: R&D expenditure.
IETR: indicator variable for firms in the bottom quantile of $ETR_{before\text{-}interest}$.
IDEP: interaction of DEP and IETR.
IRD: interaction of RD and IETR.
ROA: returns on assets.
VEARN: variance of earnings.
SIZE: firm size.
ZPRED: bankruptcy predictor.
HRISK: indicator variable for firms in the top decile of ZPRED.
LRISK: indicator variable for firms in the bottom decile of ZPRED.
CAPIN: capital intensity.
AGE: age of assets.
MV/BV: market-to-book value of assets.
WORKC: working capital.
OPCYCL: operating cycle.
OPCASH: operating cash flows.
YR91: dummy variable for the year 1991.
YR92: dummy variable for the year 1992.
YR93: dummy variable for the year 1993.

Table 7

Fixed-Effects 2SLS Estimation Results of Interest Tax Benefits, Long-term Leverage, and Short-term Leverage

(*t*-statistics in parentheses)

Model	ITB coefficient	LLEV coefficient	SLEV coefficient
ITB		0.1469 (3.7149)***	-0.0018 (-0.0704)
SLEV	0.0441 (0.0702)	-0.5878 (-1.3720)	
LLEV	0.6042 (1.6962)*		-0.0123 (-0.1398)
DEP	0.2484 (10.5106)***		
RD	0.2623 (7.8118)***	-0.0575 (-2.6265)**	0.0131 (0.9674)
IETR	0.0013 (0.0645)		
IDEP	-0.0196 (-0.6175)		
IRD	-0.0625 (-2.8161)***		
ROA	0.1881 (2.7789)***	-0.1229 (-3.4842)***	
VEARN	0.4700 (3.6066)***	-0.2588 (-4.4113)***	
SIZE	0.0429 (2.4632)**	0.0207 (1.7809)*	0.0178 (3.5195)***
ZPRED		-0.0008 (-0.7523)	
HRISK			0.0102 (1.8795)*
LRISK			-0.0102 (-1.7400)*
CAPIN		0.1880 (4.3650)***	0.0490 (1.6531)*
AGE		0.0005 (0.3755)	
MV/BV		-0.0081 (-2.7484)***	
WORKC			-0.0124 (-0.6457)
OPCYCL			-0.0001 (-0.8591)
OPCASH		-0.0829 (-2.2161)**	-0.0696 (-4.7399)***
YR91	-0.0022 (-0.2943)	-0.0122 (-2.8104)**	-0.0066 (-2.8586)***
YR92	-0.0087 (-0.9209)	-0.0246 (-4.6714)***	-0.0095 (-3.4404)***
YR93	-0.0188 (-1.7231)*	-0.0313 (-4.8018)***	-0.0131 (-4.1193)***
Hansen Test *P-value (df)*	*7.4900* *0.3797 (8)*	*9.6292* *0.1412 (6)*	*13.2540* *0.0662 (7)*

Table 7 cont.

***: significant at the .01 level.
** : significant at the .05 level.
* : significant at the .10 level.

1. The instrumental variables include all exogenous independent variables in the equation system.

2. Variable definitions:

ITB:	interest tax benefits.
LLEV:	long-term leverage.
SLEV:	short-term leverage.
DEP:	depreciation expense.
RD:	R&D expenditure.
IETR:	indicator variable for firms in the bottom quantile of $ETR_{before\text{-}interest}$.
IDEP:	interaction of DEP and IETR.
IRD:	interaction of RD and IETR.
ROA:	returns on assets.
VEARN:	variance of earnings.
SIZE:	firm size.
ZPRED:	bankruptcy predictor.
HRISK:	indicator variable for firms in the top decile of ZPRED.
LRISK:	indicator variable for firms in the bottom decile of ZPRED.
CAPIN:	capital intensity.
AGE:	age of assets.
MV/BV:	market-to-book value of assets.
WORKC:	working capital.
OPCYCL:	operating cycle.
OPCASH:	operating cash flows.
YR91:	dummy variable for the year 1991.
YR92:	dummy variable for the year 1992.
YR93:	dummy variable for the year 1993.

Table 8

OLS Estimation Results of Interest Tax Benefits, Total Leverage, and Long-term Debt/Total Debt

(*t*-statistics in parentheses)

Model	ITB coefficient	TLEV coefficient	LD/TD coefficient
Intercept	-0.0647 (-4.2462)***	0.1894 (11.1162)***	0.9837 (18.8404)***
ITB		0.4892 (22.6052)***	0.3024 (6.2829)***
TLEV	0.4017 (23.2140)***		
DEP	0.1894 (14.5101)***		
RD	0.0470 (4.1546)***	-0.0600 (-5.5042)***	-0.0774 (-3.1434)***
IETR	0.0008 (0.0594)		
IDEP	-0.0187 (-0.8748)		
IRD	-0.0407 (-1.9875)**		
ROA	-0.0037 (-0.1030)	-0.0105 (-0.1763)*	
VEARN	0.0680 (1.3024)	0.0022 (0.0366)	
SIZE	-0.0041 (-2.5696)**	0.0098 (5.4672)***	0.0010 (0.2650)
ZPRED		0.0017 (0.8113)	
HRISK			-0.0690 (-2.777)***
LRISK			-0.0536 (-2.1891)**
CAPIN		0.1537 (9.6774)***	0.0768 (1.5353)
AGE		-0.0063 (-7.5510)***	
MV/BV		-0.0179 (-5.9402)***	
WORKC			-0.4916 (-8.3842)***
OPCYCL			-0.0001 (-1.4954)
OPCASH		-0.2231 (-4.7116)***	-0.3930 (-5.3517)***
YR91	-0.0028 (-0.3642)	-0.0047 (-0.5360)	0.0126 (0.6533)
YR92	-0.0005 (-0.0587)	-0.0179 (-2.0289)**	0.0040 (0.2063)
YR93	-0.0086 (-1.0950)	-0.0207 (-2.3309)**	-0.0009 (-0.0452)

Table 8 cont.

***: significant at the .01 level.
** : significant at the .05 level.
* : significant at the .10 level.

1. Variable definitions:

ITB:	interest tax benefits.
TLEV:	total leverage.
LD/TD:	the proportion of long-term to short-term debt.
DEP:	depreciation expense.
RD:	R&D expenditure.
IETR:	indicator variable for firms in the bottom quantile of $ETR_{before\text{-}interest}$.
IDEP:	interaction of DEP and IETR.
IRD:	interaction of RD and IETR.
ROA:	returns on assets.
VEARN:	variance of earnings.
SIZE:	firm size.
ZPRED:	bankruptcy predictor.
HRISK:	indicator variable for firms in the top decile of ZPRED.
LRISK:	indicator variable for firms in the bottom decile of ZPRED.
CAPIN:	capital intensity.
AGE:	age of assets.
MV/BV:	market-to-book value of assets.
WORKC:	working capital.
OPCYCL:	operating cycle.
OPCASH:	operating cash flows.
YR91:	dummy variable for the year 1991.
YR92:	dummy variable for the year 1992.
YR93:	dummy variable for the year 1993.

Table 9

2SLS Estimation Results of Interest Tax Benefits, Total Leverage, and Long-term Debt/Total Debt

(*t*-statistics in parentheses)

Model	ITB coefficient	TLEV coefficient	LD/TD coefficient
Intercept	-0.0496 (-2.9727)***	0.2111 (11.3361)***	0.9298 (16.8867)***
ITB		0.3382 (6.3377)***	0.7442 (6.1258)***
TLEV	0.3112 (7.2129)***		
DEP	0.1998 (14.3654)***		
RD	0.0401 (3.3975)***	-0.0509 (-4.4601)***	-0.1088 (-4.1226)***
IETR	0.0046 (0.3307)		
IDEP	-0.0226 (-1.0460)		
IRD	-0.0456 (-2.1987)**		
ROA	-0.0418 (-1.0385)	-0.0706 (-1.1165)	
VEARN	0.0709 (1.3465)	0.0057 (0.0949)	
SIZE	-0.0027 (-1.5614)	0.0094 (5.1229)***	0.0034 (0.8357)
ZPRED		0.0031 (1.4408)	
HRISK			-0.1232 (-4.2741)***
LRISK			-0.0427 (-1.6966)*
CAPIN		0.1698 (10.0449)***	0.0361 (0.6928)
AGE		-0.0069 (-7.9099)***	
MV/BV		-0.0197 (-6.3292)***	
WORKC			-0.4789 (-7.9783)***
OPCYCL			-0.0001 (-1.3582)
OPCASH		-0.2189 (-4.5608)***	-0.3050 (-3.8977)***
YR91	-0.0046 (-0.5887)	-0.0055 (-0.6179)	0.0151 (0.7656)
YR92	-0.0036 (-0.4530)	-0.0174 (-1.9449)**	0.0035 (0.1786)
YR93	-0.0124 (-1.5408)	-0.0215 (-2.3928)**	0.0039 (0.1960)

Table 9 cont.

***: significant at the .01 level.
** : significant at the .05 level.
* : significant at the .10 level.

1. Variable definitions:

ITB:	interest tax benefits.
TLEV:	total leverage.
LD/TD:	the proportion of long-term to short-term debt.
DEP:	depreciation expense.
RD:	R&D expenditure.
IETR:	indicator variable for firms in the bottom quantile of $ETR_{before\text{-}interest}$.
IDEP:	interaction of DEP and IETR.
IRD:	interaction of RD and IETR.
ROA:	returns on assets.
VEARN:	variance of earnings.
SIZE:	firm size.
ZPRED:	bankruptcy predictor.
HRISK:	indicator variable for firms in the top decile of ZPRED.
LRISK:	indicator variable for firms in the bottom decile of ZPRED.
CAPIN:	capital intensity.
AGE:	age of assets.
MV/BV:	market-to-book value of assets.
WORKC:	working capital.
OPCYCL:	operating cycle.
OPCASH:	operating cash flows.
YR91:	dummy variable for the year 1991.
YR92:	dummy variable for the year 1992.
YR93:	dummy variable for the year 1993.

REFERENCES

Ahn, S. C., and S. Low. 1996. A reformulation of the Hausman test for regression models with pooled cross-section—time-series data. *Journal of Econometrics* 71: 309-319.

Altman, E. 1968. Financial ratios, discriminant analysis, and the prediction of corporate bankruptcy. *Journal of Finance* 23 (September): 589-609.

Auerbach, A. J., and J. M. Poterba. 1987. Tax-loss carryforwards and corporate tax incentives, in M. Feldstein, ed. *The Effects of Taxation on Capital Accumulation.* Chicago, IL: University of Chicago Press, pp. 305-338.

Balestra, P., and M. Nerlove. 1966. Pooling cross-section and time-series data in the estimation of a dynamic model: The demand for natural gas. Econometrica 34: 585-612.

Barclay, M. J., and C. W. Smith. 1995a. The maturity structure of corporate debt. *Journal of Finance* 50 (June): 609-631.

_____, and _____. 1995b. The priority structure of corporate liabilities. *Journal of Finance* 50 (July): 899-917.

Bathala, C. T., O. D. Bowlin, and R. P. Rao. 1995. Debt structure, insider ownership, and dividend policy: A test of the substitutability hypothesis in an agency framework. *Research in Finance* 13: 237-260.

Bradley, M., G. A. Jarrell, and E. H. Kim. 1984. On the existence of an optimal capital structure: Theory and evidence. *Journal of Finance* 39 (July): 857-880.

Brealey, R. A., and S. C. Myers. 1991. *Principles of Corporate Finance.* 4th ed. New York: McGraw-Hill, Inc.

Callihan, D. S. 1994. Corporate effective tax rates: A synthesis of the literature. *Journal of Accounting Literature* 13: 1-43.

Cordes, J. J., and S. M. Sheffrin. 1983. Estimating the tax advantage of corporate debt. *Journal of Finance* 38: 95-105.

Cornwell, C., and P. Rupert. 1988. Efficient estimation with panel data: An empirical comparison of instrumental variables estimations. *Journal of Applied Econometrics* 3: 149-155.

_____, P. Schmidt, and D. Wyhowski. 1992. Simultaneous equations and panel data. *Journal of Econometrics* 51: 151-181.

Dammon, R. M., and L. W. Senbet. 1988. The effect of taxes and depreciation on corporate investment and financial leverage. *Journal of Finance* 43: 357-373.

DeAngelo, H., and R. Masulis. 1980. Optimal capital structure under corporate and personal taxation. *Journal of Financial Economics* 8 (March): 3-29.

Dhaliwal, D., R. Trezevant, and S. Wang. 1992. Taxes, investment-related tax shields and capital structure. *The Journal of the American Taxation Association* 14 (1): 1-21.

Diamond, D. W. 1991. Debt maturity structure and liquidity risk. *Quarterly Journal of Economics* 106 (August): 709-737.

Flannery, M. J. 1986. Asymmetric information and risky debt maturity choice. *Journal of Finance* 41 (March): 19-37.

Fomby T. B., Hill R. C., and Johnson S. R. 1984. *Advanced Econometric Methods.* Springer-Verlag New York Inc.

Friend, I., and J. Hasbrouck. 1988. Determinants of capital structure. *Research in Finance* 7: 1-19.

Givoly, D., C. Hayn, A. R. Ofer, and O. Sarig. 1992. Taxes and capital structure: Evidence from firms' response to the Tax Reform Act of 1986. *The Review of Financial Studies* 5 (2): 331-355.

Graham, J. R. 1996. Debt and the marginal tax rate. *Journal of Financial Economics* 41: 41-73.

_____, M. L. Lemmon, and J. S. Schallheim. 1997. Debt, leases, taxes and the endogeneity of corporate tax status. *Journal of Finance*: Forthcoming.

Gupta, S., and K. Newberry. 1997. Determinants of the variability in corporate effective tax rates: Evidence from longitudinal data. *Journal of Accounting and Public Policy* 16: 1-34.

Hansen, L. P. 1982. Large sample properties of generalized method of moments estimations. *Econometrica* 50 (July): 1029-1054.

Harris, M., and A. Raviv. 1991. The theory of capital structure. *Journal of Finance* 46 (March): 297-355.

Hausman, J. A. 1978. Specification tests in econometrics. *Econometrica* 46: 1251-1271.

_____, and W. Taylor. 1981. Panel data and unobservable individual effects. *Econometrica* 49: 1377-1398.

Jensen, M., and W. H. Meckling. 1976. Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics* 3 (October): 305-360.

Jensen, M. C. 1986. Agency costs of free cash flow, corporate finance, and takeover. *American Economic Review* 76: 323-339.

MacKie-Mason, J. K. 1990. Do taxes affect corporate financing decisions? *Journal of Finance* 45: 1471- 1493.

Manzon, Gil B., Jr. 1994. The role of taxes in early debt retirement. *The Journal of the American Taxation Association* 16 (Spring): 87-100.

Marsh, P. 1982. The choice between equity and debt: An empirical study. *Journal of Finance* 37 (March): 212-144.

Masulis, R. W. 1988. *The Debt/ Equity Choice*. New York: Ballinger Publishing Company.

Mundlak, Y. 1978. On the pooling of time series and cross section data. *Econometrica* 46: 69-85.

Myers, S. C. 1977. Determinants of corporate borrowing. *Journal of Financial Economics* 5 (November): 147-175.

_____. 1984. The capital structure puzzle. *Journal of Finance* 39 (July): 575-592.

_____, and N. S. Majluf. 1984. Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics* 13 (June): 187-221.

Porcano, T. 1986. Corporate tax rates: Progressive, proportional, or regressive. *The Journal of the American Taxation Association* 7 (Spring): 19-31.

Scholes, M. S., G. P. Wilson, and M. A. Wolfson. 1990. Tax planning, regulatory capital planning, and financial reporting strategy for commercial banks. *Review of Financial Studies* 3: 635-650.

_____, and M. A. Wolfson. 1992. Taxes and business strategy: A planning approach. Englewood Cliffs, NJ: Prentice-Hall.

Shevlin, T. 1990. Estimating corporate marginal tax rates with asymmetric tax treatment of gains and losses. *Journal of the American Taxation Association* 12 (Spring): 51-67.

_____, and S. Porter. 1992. The corporate tax comeback in 1987: Some further evidence. *The Journal of the American Taxation Association* 14 (Spring): 58-79.

Siegfried, J. J. 1974. Effective average U. S. corporation income tax rates. *National Tax Journal*: 245-259.

Slemrod, J., and I. Bakija. 1996. Taxing ourselves: A citizen's guide to the great debate over tax reform. The MIT Press.

Statistics of Income (SOI) Bulletin. Summer, 1995. Vol. 15, No. 1. Washington, D. C. IRS.

Stickney, C. P., and V. E. McGee. 1982. Effective corporate tax rates: The effect of size, capital intensity, leverage, and other factors. *Journal of Accounting and Public Policy* 1 (2): 125-152.

Taggart, R. A. 1985. Secular patterns in the financing of U.S. corporations. In B. Friedman, ed., *Corporate Capital Structure in the United States*. Chicago: University of Chicago Press.

Titman, S. 1984. The effect of capital structure on a firm's liquidation decision. *Journal of Financial Economics* 13 (March): 137-151.

_____, and R. Wessels. 1988. The determinants of capital structure choice. *Journal of Finance* 43 (March): 1-19.

Trezevant, R. 1992. Debt financing and tax status: Tests of the substitution effect and the tax exhaustion hypothesis using firms' response to the Economic Recovery Tax Act of 1981. *Journal of Finance* 47 (September):1557-1568.

_____. 1994. How did firms adjust their tax-deductible activities in response to the Economic Recovery Tax Act of 1981? *National Tax Journal* 47: 253-271.

U.S. Department of Treasury. 1992. *Report of the Department of the Treasury on Integration of the Individual and Corporate Tax System—Taxing business income once*. Washington, D.C.: U.S. Government Printing Office (January).

Wedig G., F. A. Sloan, M. Hassas, and M. A. Morrisey. 1988. Capital structure, ownership, and capital payment policy: The case of hospital. *Journal of Finance* 43 (March): 21-40.

Zimmerman, J.L. 1983. Taxes and firm size. *Journal of Accounting and Economics* 5 (August): 119-149.

APPENDIX A

ESTIMATION OF TAX SAVINGS OF INTEREST DEDUCTIONS

APPENDIX A

Estimation of Tax Savings of Interest Deductions

In order to calculate the tax savings of interest deduction (ΔTAX), some assumptions are as follows:

1. All the interest expense is fully deductible and used in calculating actual income tax expense.
2. All the interest expense will only affect the current portion of income tax expense, not the deferred portion of income tax expense.

ΔTAX is estimated using the following procedures:

1. Current income tax expense is used to reconstruct the "deemed current taxable income" (after interest deductions) using the applicable current year's tax rate schedule.
2. Interest expense is added back to the results in (1), and then the before-interest-deduction income tax expense is calculated based on the "add-up income" (before interest deductions) and the current year's tax rate schedule.
3. The difference between current income tax expense and before-interest-deduction income tax expense is the tax savings of interest expense (ΔTAX).
4. In 1993, if firms' current income tax expense is negative, the negative tax expense is regarded as a tax refund. Accordingly, the 1992 statutory tax rate schedule is used to calculate the before-interest-deduction income. (The statutory tax rates in the year 1992, and before, were the same in the sample periods.) If the added-up income is negative, the 1992 tax rates are used to calculate the before-interest-deduction tax refund. The difference is ΔTAX.

APPENDIX B

SUMMARY OF EMPIRICAL RESULTS OF CORPORATE LEVERAGE

APPENDIX B

Summary of Empirical Results of Corporate Leverage

(predicted signs in parentheses)

	Marsh (1982)	Bradley, Jarrell, Kim (1984)	Friend and Hasbrouck (1988)	Titman and Wessels (1988)	MacKie-Mason (1990)
Dep. Variable	Pr (Equity/Debt)	level of debt	level of debt	level of debt	Pr (debt/equity)
Indep. Variable					
Tax Incentive					
Tax rate					dummy for NOL (-)*
Nondebt tax shields		depreciation & ITC (-)		ITC (-); Depreciation (-)	ITC (+)*; ITC/ZPROB (-)*
Financial distress cost	(Fixed charge - EBT) (+)	std dev of ΔEBIDT (-)*	std. dev. of ROA (-)*	Intangibles (-) std dev of Δoper income (-)	st dev of EBIDT (-)*; st dev of ΔEBIDT (-)* ZPROB (-)*
Asset Mix					
Tangible assets	PP&E (-)*		PP&E (+)*	Inventory + PP&E (+)	PP&E (+)*
Growth opportunity		R&D & AD (-)*		Capital expenditure (-) ΔAssets (-); R&D (-)	R&D (-)*; AD(-)
Agency Cost					
Free cash flow					cash deficit (-)
Dividend payout					dummy for dividend paying firm (-)
Informational Asymmetry					
Regulated industries					dummy for regulated industries (-)*
Insider holding			Insider ownership (-); Insider market value (-)*		
Profitability			ROA (?)	Oper income (-)*	
Target leverage ratio	dev from industry long-term debt(-)*; dev from industry short-term debt (+)*				
Timing/Market	predicted equity level (+)*; predicted debt level (-)*; excessive common stock return (+)*				Δstock price (-)*
Control Variable					
Firm size	ln (assets) (-)*		ln (Asset) (+)*	ln (sales) (+)	Assets-CL
Industry		2-digit SIC	2-digit SIC (?)	Specialized industry (-)*; R&D (-)*; AD (-)* Employee quit rate (+)*	2-digit SIC
Year					yearly dummies

*: significant as predicted

APPENDIX B cont.

(predicted signs in parentheses)

	Givoly, Hayn, Ofer, and Sarig (1992)	Dhaliwal, Trezevant, and Wang (1992)	Trezevant (1992)	Manzon (1994)
Dependent Variable	Δdebt	Interest/Oper earnings	ΔInterest/Oper earnings	Δdebt
Indep. Variable				
Tax Incentive				
Tax rate	10-year average tax rate (-)*	dummy for low ETR firms (+)*	dummy for low ETR firms (+)*	simulated MTR (+)*
Nondebt tax shields	depreciation (-)*; ITC (-)*; NOL (-)*	(Depreciation + ITC) (+)*; Interaction of low ETR and nondebt tax shield (-)*	(Depreciation + ITC + R&D + lease expense) (+)*; Interaction of low ETR and nondebt tax shield (-)*	
Financial distress cost	std dev oper income (-)*	std dev of ΔEBIDT (-); R&D (-)*; AD(-)		std. dev. of income (-)
Asset Mix				
Tangible assets		PP&E (+)*		BV equity - Intangibles (+)
Growth opportunity	BV/MV (-)*			
Agency Cost				
Free cash flow				
Dividend payout	Dividend/Price (-)*			
Informational Asymmetry				
Regulated industries				
Insider holding				
Profitability				
Target leverage ratio			dummy for high debt firms relative to industry (-)	dev. from industry (-)*
Timing/Market				
Control Variable				
Firm size	ln (Assets) (?)	Asset (?)		log (Asset) ?
Industry		2-digit SIC (?)		
Year				

*: significant as predicted

APPENDIX B cont.

(predicted signs in parentheses)

	Bathala, Bowlin, and Rao (1995)	Barclay and Smith (1995a)	Barclay and Smith (1995b)	Graham (1996)
Dependent Variable	level of debt	% of long-term debt matures > 3 years	level of debt	Δdebt
Indep. Variable				
Tax Incentive				
Tax rate			dummy for NOL (-)*	simulated MTR (+)*
Nondebt tax shields	(depreciation + PP&E) (-)			Δdepreciation (-); ΔITC (-); ΔRD (-); ΔAD (-)
Financial distress cost	coefficient of variation (-)*			ZPROB (-)
Asset Mix				
Tangible assets	Inventory & PP&E (+)			ΔPP&E (+)
Growth opportunity	MV/BV (-)*	MV/BV (-)*	MV/BV (-)*	
Agency Cost				
Free cash flow	oper cash flow - capital expenditure (-)*			EBIT - Investment & debt, equity issue (-)*
Dividend payout	payout ratio (-)*			
Informational Asymmetry				
Regulated industries		dummy (+)	dummy (+)*	
Insider holding	insider shareholding (-)			
Profitability				
Target leverage ratio				
Timing/Market	excessive return on common stock (-)*	ΔEPS/Stock price (+)*	ΔEPS/Stock price (+)	
Control Variable				
Firm size		ln (Assets) (+)*	ln (Assets) (+)*	ΔSales (+)*
Industry				
Year				
Other		yield spread (-)		

*: significant as predicted

APPENDIX C

REDUCED FORM ESTIMATION RESULTS OF INTEREST TAX BENEFITS, TOTAL LEVERAGE, AND LONG-TEM DEBT/TOTAL DEBT

APPENDIX C

Reduced Form Estimation Results of Interest Tax Benefits, Total Leverage, and Long-term Debt/Total Debt

(*t*-statistics in parentheses)

Model	ITB coefficient	TLEV coefficient	LD/TD coefficient
DEP	0.2628 (12.3162)***	0.0358 (2.8232)***	0.0264 (0.7406)
RD	0.2429 (8.7841)***	-0.0186 (-1.1297)	-0.0802 (-1.7344)*
IETR	-0.0099 (-0.6305)	-0.0062 (-0.6622)	-0.0664 (-2.5284)**
IDEP	-0.0035 (-0.1468)	0.0013 (0.0891)	0.0866 (2.1819)**
IRD	-0.0572 (-2.6254)***	0.0045 (0.3444)	0.0209 (0.5734)
ROA	0.1076 (1.7240)*	-0.1031 (-2.7785)***	0.0152 (0.1460)
VEARN	0.3710 (3.7425)***	-0.1847 (-3.1361)***	0.0962 (0.5806)
SIZE	0.0528 (3.7083)***	0.0351 (4.1550)***	-0.0242 (-1.0167)
ZPRED	-0.0011 (-0.5971)	-0.0011 (-1.0141)	-0.0032 (-1.0174)
HRISK	0.0347 (2.3024)**	0.0242 (2.7018)***	-0.0364 (-1.4422)
LRISK	-0.0162 (-0.9743)	0.0037 (0.3725)	-0.0063 (-0.2266)
CAPIN	0.0879 (1.2280)	0.2236 (5.2573)***	0.0903 (0.7549)
AGE	0.0019 (0.8920)	0.0007 (0.5479)	-0.0011 (-0.3146)
MV/BV	-0.0075 (-1.7104)*	-0.0107 (-4.1332)***	-0.0004 (-0.0618)
WORKC	0.0212 (0.3864)	-0.0016 (-0.0490)	-0.1781 (-1.9422)*
OPCYCL	-0.0001 (-0.6255)	-0.0001 (-2.2033)**	-0.0001 (-1.1360)
OPCASH	0.0351 (0.8310)	-0.1054 (-4.2025)***	-0.0493 (-0.6987)
YR91	-0.0082 (-1.2507)	-0.0156 (-4.0326)***	0.0144 (1.3232)
YR92	-0.0212 (-3.0417)***	-0.0303 (-7.3251)***	0.0124 (1.0628)
YR93	-0.0353 (-4.6440)***	-0.0409 (-9.0597)***	0.0133 (1.0455)

APPENDIX C cont.

***: significant at the .01 level.
** : significant at the .05 level.
* : significant at the .10 level.

1. Variable definitions:

ITB:	interest tax benefits.
TLEV:	total leverage.
LD/TD:	the proportion of long-term to short-term debt.
DEP:	depreciation expense.
RD:	R&D expenditure.
IETR:	indicator variable for firms in the bottom quantile of $ETR_{before\text{-}interest}$.
IDEP:	interaction of DEP and IETR.
IRD:	interaction of RD and IETR.
ROA:	returns on assets.
VEARN:	variance of earnings.
SIZE:	firm size.
ZPRED:	bankruptcy predictor.
HRISK:	indicator variable for firms in the top decile of ZPRED.
LRISK:	indicator variable for firms in the bottom decile of ZPRED.
CAPIN:	capital intensity.
AGE:	age of assets.
MV/BV:	market-to-book value of assets.
WORKC:	working capital.
OPCYCL:	operating cycle.
OPCASH:	operating cash flows.
YR91:	dummy variable for the year 1991.
YR92:	dummy variable for the year 1992.
YR93:	dummy variable for the year 1993.