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ABSTRACT

Past attempts to measure the impact of taxes on corporate debt policy have focused on larger firms. Given that the top statutory corporate tax rate has varied little in recent years, tax incentives vary among these firms, almost entirely due to current or prospective tax losses. Results are inevitably mixed, given that firms with losses or nondebt tax shields may have different propensities to borrow even ignoring taxes.

This paper uses *US Statistics of Income* balance sheet data on *all* corporations, to compare the debt policies of firms of different sizes. Given the progressivity in the corporate tax schedule, small firms face very different tax rates than larger firms. Relative tax rates have also changed frequently over time.

Our results suggest that taxes have had a strong and statistically significant effect on debt levels. In particular, the difference in corporate tax rates currently faced by the largest vs. the smallest firms (35% vs. 15%) is forecast to induce larger firms to finance an additional 8% of their assets with debt, compared with smaller firms.

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The realization that the tax deductibility of interest but not dividends creates an incentive for corporations to increase their use of debt finance dates back to Modigliani and Miller(1963).[1] Surprisingly, economists have had great difficulty providing evidence that taxes in fact lead to higher debt-equity ratios.

To test for the effects of corporate tax rates on firms' financial policy, one needs sufficient variation in tax incentives either over time or across firms in order to detect effects of taxes on financial policy. Most empirical studies, e.g. Auerbach (1985), Bradley, Jarrell, and Kim (1984), Graham (1996), Graham, Lemmon, and Schallheim (1998), Gropp (1997), and MacKie-Mason (1990), have focused on cross-sectional variation in corporate tax rates across firms, in order to test for tax effects. While virtually all publicly traded firms would face the same statutory tax rate in a given year if they earn anything approaching a normal rate of return,[2] marginal tax rates can vary across firms when some firms have tax losses.[3] Similarly, firms with unusually large deductions for depreciation are more likely to end up with tax losses in the future, for any given use of debt currently. These empirical studies then test to see if firms with tax loss carryforwards or large "nondebt tax shields" have less debt, as an indirect test of tax effects.

This approach identifies the effects of taxes, however, only if the underlying reasons why some firms have tax losses or larger depreciation deductions do not themselves affect the firm's choices for debt vs. equity. It is difficult to make this case. For example, recent investment not only generates large depreciation deductions but also provides good collateral for debt. Similarly, firms with tax losses often face cash pressures, leading them to borrow more to cover current operating expenses. It is not surprising, therefore, that the coefficient estimates for tax loss carryforwards and nondebt tax shields often have the wrong sign or are statistically insignificant.

A more direct way to test for tax effects would be to look at financial policy over time, as tax rates vary. Unfortunately, tax rates have not varied that much historically in the U.S. For example, from 1951 to 1986, the top U.S. corporate tax rate varied only

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[1] The personal tax advantage to equity, through the reduced tax rate on capital gains, partially offsets the corporate tax advantage to debt. However, at least large firms still appear to face a strong tax incentive on net to use debt rather than equity finance.

[2] In recent years, the top marginal corporate tax rate is imposed on all corporate income above $100,000. If a firm with $350 million in assets, the average for Nasdaq SmallCap Market Companies in March 1998, were to earn less than $100,000 in a year, its rate of return would be only 0.029%, whereas a typical ratio of taxable income to assets would be around 2% in the 1990's.

[3] When a firm has tax losses that it cannot use to offset taxable profits during the previous three years, it must carry these losses forward in time, hoping to offset them against future profits. Current interest deductions then become less valuable, since the resulting tax savings occur only in the future, when and if the firm earns sufficient taxable profits.

from 46% to 52%, making it difficult to identify tax effects on corporate financial policy. One alternative approach pursued by Taggart (1985) is to compare corporate use of debt before vs. after World War II, since tax rates were much lower before the war. While use of debt was low around the time of the war, Taggart found that debt-equity ratios were not that different earlier in the century from what they were after the war. Given the many institutional changes during the century that can also have affected debt-equity ratios, Taggart felt that he was unable to identify tax effects with any confidence.

Gordon (1982) noted that tax incentives to use debt are proportional to the product of the difference between corporate vs. personal tax rates and nominal interest rates. While tax rates may not have changed much over time, interest rates have. Variation in nominal interest rates, however, can proxy for business cycle factors that may have important independent effects on financial policy. In fact, any time-series study faces the problem that many factors change over time that affect financial policy, e.g. business cycles, and financial regulations, as well as inflation. Unless these other factors are controlled for directly, or are uncorrelated with tax rates, the estimated effects of taxes on financial behavior will be biased. These inherent difficulties in making use of either cross-section or time-series evidence to identify the effects of taxes on financial policy led Myers (1984) to argue: "I know of no study clearly demonstrating that a firm's tax status has predictable, material effects on its debt policy. I think the wait for such a study will be protracted."

The 1986 Tax Reform Act, two years after Myers' statement, did provide a new opportunity to test for tax effects on financial policy, given the large changes in tax rates enacted during 1987-8. Givoly et al (1992) and Gordon and Mackie-Mason (1990) examined the changes in corporate financial policy following the 1986 Act, and did find evidence that use of debt increased as expected.[4] However, the Act contained enough complicated aspects, e.g. restrictions limiting the deductibility under the personal tax of both nonmortgage interest payments and "passive" losses from noncorporate businesses, that it is difficult to use this evidence to forecast the behavioral effects of future tax rate changes.

Rajan and Zingales (1995) took a different approach by comparing financial policies across countries. While tax rates vary little over time within a country, they vary substantially across countries. Rajan and Zingales do find that use of debt seems to be higher in countries with higher corporate tax rates. Given the many institutional differences across countries, however, this evidence must be interpreted with caution.

The objective of this paper is to make use of a neglected data set, the *U.S. Statistics of Income (SOI) Corporate Income Tax Returns*, to test for tax effects on corporate financial policy. One advantage of this data set is that it covers a long time series, from 1954 to 1995, allowing for more changes in tax structure than are captured in the shorter time series contained in the *Compustat* data that were used in most past studies. More importantly, the *SOI* data contain summary information on *all* corporations, including very small firms that face much lower corporate tax rates due to the progressivity in the corporate tax law.[5] This variation in statutory rates across sizes of firms has not been exploited in the past

[4] The data sets used by Graham (1996), Graham, Lemmon, and Schallheim (1998), and Gropp (1997) also span the 1986 tax reform.

[5] For example, during the late 1970's, the corporate tax rate was only 22% on the first $50,000 of income, but 46% on any additional income.

to test for the effects of taxes on financial policy, since the *Compustat* data includes only publicly traded firms, that are large enough to face the top marginal rate except during business downturns. Small firms, in contrast, normally face a lower statutory tax rate. We do in fact find that small firms borrow less than medium-sized firms that are just large enough to face the top statutory tax rate, even though both borrow much more than larger firms.

Of course, small firms may differ in their use of debt for many nontax reasons. For example, potential lenders have a harder time monitoring small firms, so may demand a higher "lemons" premium. For the same reason, however, these firms may have even more difficulty raising outside equity finance, leaving the net effect on debt/assets unclear. Therefore cross-sectional evidence alone on differences in borrowing rates for small vs. large firms is at best suggestive of tax effects.

Fortunately, relative tax rates for small vs. large corporations have varied substantially over time, as have the real income levels at which marginal tax rates change. Our study will therefore focus on changes over time in debt/assets for small vs. large firms, to see if the difference between their debt/assets is bigger when the difference in the tax rates they face is bigger. To identify tax effects, all we need to assume is that the nontax factors affecting the relative use of debt for small vs. large firms do not change over time, or at least change in a way uncorrelated with relative tax rates.

The resulting "difference-in-difference" estimates, taken at face value, imply large and statistically significant tax effects for very small and for large firms, but much smaller effects for intermediate-sized firms. We present indirect evidence, however, that these differences in the estimated responsiveness of firms of different sizes result from measurement errors in our estimate of the expected marginal tax rate faced by firms in each size category.[6] The *SOI* data also provide a much longer time series on debt/assets than is available from the *Compustat* data, with data from 1954 to 1995. When we examine how debt/assets change over time, where measurement error is less of an issue, we find comparable effects of taxes on debt/assets for all sizes of firms. Estimated effects are rather large. For example, cutting the corporate tax rate by ten percentage points (e.g. from 46% to 36%), holding personal tax rates fixed, is forecast to reduce the fraction of assets financed with debt by 4%. By way of comparison, on average during our sample period, 19.4% of assets were financed with debt.

The rest of the paper is organized as follows. In the next section, we develop the specification that we use to estimate tax effects. The *SOI* data are described in section 2, preliminary evidence is reported in section 3, while the regression estimates are reported in section 4. The paper concludes with a brief summary.

1. Theory

To the extent that corporate income is taxed at a higher rate than personal income, taxpayers face an incentive to devise ways to convert corporate income into personal income

[6] Given that the only information we have about the distribution of earnings for firms in a given size category is their average rate of return, we set the expected marginal tax rate equal to the value appropriate for this average rate of return. As a result, we do not capture the effects of heterogeneity in rates of return across firms on the expected marginal tax rate, arising from the nonlinearity in the tax structure.

for tax purposes. The most obvious way is for the firm to change from corporate to noncorporate form, so that *all* of the income is taxed at personal rather than corporate tax rates. While Gordon and MacKie-Mason (1994) and MacKie-Mason and Gordon (1997) do find statistically significant changes in organizational form in response to tax incentives, these changes are very small. Their results indicate that the corporate form has important nontax advantages, pushing taxpayers to find other ways of converting corporate into personal income.

Use of debt rather than equity finance is a readily available alternative, since interest payments are deductible from corporate income and then taxed as personal income. As long as the effective tax rate on corporate income exceeds the marginal tax rate on personal income, taxpayers as a whole gain through this shift in the firm's financial policy.

As with changes in the organizational form of the firm, however, these changes in financial policy have a variety of nontax implications, limiting the extent to which firms are willing to change their financial policy to save on taxes. For example, more debt increases the risk of bankruptcy, generating real costs in the event of bankruptcy and creating agency problems due to the conflicting interests of debt vs. equity holders when there is risk of a future bankruptcy. Increases in debt may also be costly since a firm's desire to borrow may lead lenders to fear that the firm has unobserved economic problems.

Because of these offsetting costs, we expect that tax differences will generate a limited response by firms. The objective of the empirical work is to infer the degree to which firms do change their behavior in response to tax incentives. We will therefore compare the debt/assets choices of firms in each size interval s in year t with the tax and nontax incentives they face. Denote the debt/assets in size interval s by D_{st}/A_{st}, where D_{st} is the average book debt per firm and A_{st} is the average book assets.

To judge the effects of tax incentives, let τ_{st} represent the marginal corporate tax rate faced by firms of size s in year t, let z_t capture the effects of any additional personal taxes owed on this corporate income when it is paid out as dividends or capital gains, and let m_t equal the representative marginal personal tax rate faced by recipients of interest income.[7] Then, increasing debt by a dollar reduces the combined tax payments of the firm and its investors together by $\tau_{st} + z_t(1 - \tau_{st}) - m_t$.

There will be a variety of nontax factors that also affect the relative use of debt finance among firms of different sizes. Rather than try to capture these factors directly, we simply assume that there is some arbitrary function $f(A^r_{st})$ that measures desired debt/assets, ignoring tax incentives, for firms with real assets of $A^r_{st} \equiv A_{st}/CPI_t$ in year t, where CPI_t is the consumer price index (with 1992 as the base year). In the estimation, we approximate the function $f(A^r_{st})$ with a seventh-order polynomial function of $\log(A^r_{st})$.[8]

Desired debt/assets can also change over time due to changes in inflation rates, business cycle factors, etc. We capture these time varying factors simply through a set of time dummies, d_t.

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[7] We ignore any differences in the tax clienteles faced by large vs. small firms. To the extent that the clienteles vary with τ_{st}, this effect is implicitly captured in its coefficient.

[8] We continued adding powers to the polynomial as long as each additional power was statistically significant.

Since we have information about the asset composition of firms in each size category, we also control for the effects of the asset composition on desired debt/assets. In particular, we expect firms to have more (long-term) debt to the extent that they have land and depreciable assets that can be used as collateral. Similarly, cash reserves should lessen the need for short-term debt.

On net, this implies the following specification:

$$\frac{D_{st}}{A_{st}} = \sum_{i=0}^{7} \alpha_i \log (A^r_{st})^i + \beta\left[\tau_{st} + z_t(1-\tau_{st}) - m_t\right] + X_{st}\gamma + \sum_{t \neq 1954} \delta_t d_t + \epsilon_{st}, \qquad (1)$$

where X_{st} captures information about asset composition. In the estimation, however, we chose to ignore the z_t, given the many questions about how best to estimate this rate.[9] The key hypothesis is clearly that $\beta > 0$.

This specification in effect involves a "difference–in–difference" procedure. Through including time dummies, we are implicitly looking at the difference in debt/assets for small vs. large firms as a function of their relative tax rates at each date. By further controlling for size–of–firm effects, we end up looking at the change in the relative debt/assets for small vs. large firms over time as a function of the change in their relative tax rates.

The coefficients of the time dummies provide a second source of information that can be used to test for the determinants of corporate financial policy. These dummies capture the effects on financial policy of any factors that change over time, having already controlled for changing tax incentives, size of firm, and asset composition.

Two obvious time-varying factors that can affect financial policy are business cycles and nominal interest rates. Each can affect financial policy for multiple reasons, and in each case the sign of the net effect is unclear. During recessions, firms may face greater liquidity problems, so wish to borrow more. However, our dependent variable uses the book value rather than the preferred market value of assets. We therefore overestimate the size of debt/assets during boom periods (and underestimate it during recessions), suggesting a positive correlation between our measure of debt/assets and the business cycle. When the nominal interest rate is higher, each dollar's worth of debt saves more in taxes, since more interest income is shifted from the corporate tax base to the personal tax base. However, a higher nominal interest rate implies that debt comes due more quickly,[10] which may discourage borrowing to finance longer-term investments.

More importantly, with a time-series regression, we can also test to see if the evidence from the time-series regarding tax effects is consistent with the evidence found comparing

[9] While the tax rate on dividend income is clear, it is not clear why firms pay dividends. Bernheim (1991), for example, argues that the dividend tax imposes no net costs on the firm if dividends are paid to signal the financial status of the firm — the firm gains through having a costly signal, and can readjust the composition of dividends vs. repurchases that it uses as a signal to reacquire the desired cost of its signal when tax rates change. Effective capital gains tax rates are strongly affected by trading strategies. Constantinides (1983) finds that, with optimal trading rules and no trading costs, capital gains taxes can *increase* the value of shares, contrary to the results when trade is not contingent on the size of the capital gain.

[10] The fraction of debt that must be repaid each year equals $i_t D_t/[(1+\pi_t)D_t]$, where π_t is the inflation rate and i_t is the nominal interest rate in year t. Certainly if Fisher's law holds, so that $i_t = r_t + \pi_t$ for some exogenous real rate r_t, this expression is an increasing function of π_t.

small vs. large firms. In particular, by including a measure of tax incentives in the time-series regression, we can test to see if its coefficient is in fact zero, as it should be if we have adequately controlled for taxes already. To provide a comparison with prior studies, we also will report time series regressions of aggregate debt/assets against tax incentives and the same control variables.

In sum, the base specification we use to capture time-series variation in debt/assets is:

$$\hat{\delta}_t = a_0 + a_1(\bar{\tau}_t - m_t) + a_2 i_t + a_3 Z_t + a_4 d_{>86} + \nu_t, \tag{2}$$

where $\bar{\tau}_t$ is the average marginal corporate tax rate faced among the observations in our sample in each year, i_t represents the nominal interest rate in year t, and Z_t captures business cycle effects. We also include a dummy variable, $d_{>86}$, to capture any omitted aspects of the tax reform act of 1986.[11] We measured business cycle effects by the ratio of the Dow Jones Index to GDP, on the grounds that a stock index should capture any new information that can affect firm behavior.[12] [13]

2. Data sources

Data come from three sources: *SOI Corporate Returns*, *SOI Individual Returns*, and the Individual Model File (IMF).[14] All information about firms comes from the *SOI Corporate Returns*, which are available for 46 years from 1950 to 1995. These data report summary information taken from the corporate income tax returns each year, and cover all corporations in the US that file tax returns. While no information is available by firm, for confidentiality reasons, aggregate information for key variables is reported separately each year for between ten and fourteen different asset intervals.[15] Units of observation in our empirical analysis are these asset categories.

To calculate the marginal corporate tax rate faced by firms in each asset interval, we first calculate the average rate of return, $\bar{\rho}_{st}$, for firms in each interval, defined as taxable income divided by assets. We then assume a uniform distribution of firm assets across different asset levels within the interval, and assume that all firms earn the same rate of return. Given the resulting uniform distribution of taxable income, we calculate the

[11] For example, the 1986 Tax Reform Act restricted nonmortgage interest deductions under the personal tax, which may have led investors to substitute corporate borrowing for individual borrowing. In addition, the capital gains tax rate was raised from 40% of the ordinary tax rate to 100% of the ordinary tax rate, again encouraging corporate borrowing beyond what we capture through our measure of tax incentives.

[12] To calculate the yearly value for the Dow Jones Index, we took the average of the opening and closing price in each month, then averaged these monthly figures for each year.

[13] We also tried as an alternative business cycle measure $\Delta GDP_t^r/GDP_{t-1}^r$, the real percent change in GDP_t, to capture such factors as liquidity pressures from changes in sales or effects of changes in investment rates. However, its coefficient was tiny and insignificant, so we do not report these results.

[14] The IMF is a stratified sample of individual tax returns in the United States, made available for research purposes by the IRS, and is available from 1964 until 1993, except for 1965.

[15] The asset categories change slightly over time, but a typical breakdown is: (0, 0.025m), (0.025m, 0.05m), (0.05m, 0.1m), (0.1m, 0.25m), (0.25m, 0.5m), (0.5m, 1m), (1m, 2.5m), (2.5m, 5m), (5m, 10m), (10m, 25m), (25m, 50m), (50m, 100m), (100m, 250m), and (>250m).

average marginal tax rate for firms in this interval using the corporate tax law in that year. Denote this calculated tax rate by τ_{st}.

This measure captures the statutory tax rate faced by firms in each interval earning the average rate of return, but does not attempt to capture the effects on expected marginal tax rates of variation across firms in their rate of return.[16] In addition, it captures the current marginal tax rate and not the expected marginal tax rate in the future.[17] In particular, we expect that $E\tau_t(\tilde{\rho}_{st})$ varies much less with A_{st} than does $\tau_t(\bar{\rho}_{st})$, since the variability of rates of return will push all marginal tax rates towards the mean rate for all firms. This implies a downward bias in the coefficient of our measure of the tax variable, particularly for firms with expected taxable income near the level where marginal tax rates change.

As Graham, Lemmon, and Schallheim (1998) have emphasized, any measure of the marginal tax rate that depends on actual taxable income earned by a group of firms can suffer from endogeneity problems, since the firms' debt/assets affects their taxable income. We therefore chose to construct an instrument for τ_{st} to correct for any possible endogeneity bias. To construct this instrument, we first calculated the rate of return before interest deductions in each year, in order to eliminate any possible endogeneity arising from the close link between the size of interest deductions and book debt. Denote this rate of return by $\bar{\rho}_t^b \equiv \sum_s (Y_{st} + i_{st}D_{st}) / \sum_s A_{st}$, where $i_{st}D_{st}$ equals interest deductions. We then took the average of these rates of return, denoted by $\bar{\rho}^b$, over the years of the sample period, since the annual rate of return figures might serve as a proxy for other economic factors affecting firms or the economy as a whole at a particular date. We then calculated $\tau_t(\bar{\rho}^b A_{st})$ as before using this aggregate estimate for the rate of return. This instrument is simply a function of the assets held by firms in each category and the tax law at that date. It should therefore be exogenous. The correlation between this instrument and $\tau_t(\bar{\rho}_{st} A_{st})$ turns out to equal .991, implying very little room for endogeneity bias.

The amount of debt held by firms in each asset category is divided into short-term and long-term debt. Short-term debt equals the accounting book value of "mortgages, notes, and bonds payable in less than one year," while long term debt matures in a year or more. Total debt is simply the sum of the two. The book value of assets is reported directly.

Personal income tax rates are calculated using the Individual Model File, when available, and otherwise with data from the *SOI Individual Returns*. The representative tax rate for income reported under the personal income tax is defined to equal the weighted average marginal tax rate, weighting by taxable income. With the *IMF* file we used the individual data; with the *SOI* data, we had to use the aggregate data broken down into subgroups based on taxable income.[18]

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16 For example, firms with tax losses will face a lower expected marginal tax rate, while those with unusually high income may well face a higher statutory marginal tax rate.

17 If firms face adjustment costs in changing their debt levels, as is implicitly assumed by DeAngelo and Masulis (1980), then debt levels will be a function of past and future marginal tax rates, and not just current tax rates.

18 In theory, we would have preferred to use assets rather than taxable income as weights: based on the derivations in Gordon and Bradford(1980), assets is the correct weight when individuals have a common coefficient of relative risk aversion. Unfortunately, the available *SOI* tables do not allow any good approx-

One complication in capturing the effects of personal taxes on interest income is the role of pension funds and other institutional saving. These funds control a sizable share of household financial savings, yet are not subject to personal income tax.[19] Assuming that pensions are as likely to rebalance their portfolios in response to a change in corporate financial policy as households are on the financial portfolios they control directly, we set m_t equal to the weighted average tax rate calculated from personal tax returns multiplied by the fraction of household assets held outside of pensions and life insurance companies — the remaining assets to a first approximation face a zero marginal tax rate.

Since *SOI Individual Returns* are not available before 1954 and *SOI Corporate Returns* do not report short-term debt and the composition of assets in 1962 and 1966-1969, our sample consists of 37 years from 1954 through 1995 except for 1962 and 1966-1969.

3. Data summary

Table 1 reports summary information for all of the data series used in the analysis. As seen in the Table, the statutory corporate tax rates faced by firms in our sample vary from 15% to 52%, providing ample sources of identification for tax effects. The weighted average personal tax rate in comparison is 24.5%, implying a strong tax incentive for large firms to borrow but a moderate tax disincentive for small firms.

Our analysis focuses on the effects of these differences in the tax incentives faced by small vs. large firms on the relative debt/assets of small vs. large firms. Figure 1 graphs the corporate tax rate as a function of (nominal) taxable income during our sample period. As can be seen from the graph, the relative tax rates for small vs. large firms, as well as average tax rates, changed substantially over time. There were also important changes over time in the income brackets for each rate.

These differences in tax rates imply that firms with a lower taxable income have an incentive to use relatively less debt than firms with higher taxable income. Figure 2 shows that this prediction seems to be borne out in the *SOI* data. Notice that debt/assets increase in the asset range between $0.25 million and $5 million. Given a normal rate of return, the implied tax rate would grow from the minimum to the maximum over this asset range.[20] After assets become large enough for the top tax rate to apply, this upward trend disappears, and in fact reverses. The sharp change in the pattern of debt/assets around the size of firm that first faces the top marginal tax rate certainly suggests that taxes matter.

The drop in use of debt for firms with more than $5 million in assets cannot be due to firms larger than this having greater access to equity finance through being publicly

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imation of m_t with assets as a weight. We report a separate set of results below, confined to the years when the *IMF* data are available, where m_t is calculated using assets as a weight.

[19] More specifically, pension contributions are deductible, accruals within the pension plan are free of tax, while pension receipts are taxable. If the tax rate is constant over time, then no taxes are paid in present value. In contrast, interest income received outside of a pension plan/insurance policy is fully taxable.

[20] Taxable income over assets averages about 2% during our sample period, so that firms with $5 million in assets have real taxable income around $100,000. This has been the income range at which marginal tax rates jump in most years.

traded. The number of public firms listed in the U.S. stock market, including Nasdaq. OTC, NYSE, and regional exchange markets, was less than 10,000 during the 1980-1992 period. In contrast, 31,400 firms had $25 million or more in assets in the *SOI* in 1992. Apparently, even medium sized but closely held firms have better access to the equity market than smaller firms do.

4. Regression analysis

To investigate more formally the patterns of financial choices made by different size firms over time, we first used the available data to estimate equation 1. The results are reported in Table 2.

The first two columns simply report the raw correlation between $\tau_{st}-m_t$ and debt/assets. with or without controlling for time effects. As suggested by Figure 2, the raw correlation is strongly negative, contrary to the theoretical forecast. Time effects apparently play little role, having only a small effect on both the (adj.) R^2 and the tax coefficient.[21]

As seen in column 3, once we control for the size of firm and asset composition the tax coefficient instead becomes positive and statistically significant. While larger firms normally have lower debt/assets, these ratios are not quite so low during years when the relative corporate tax rate faced by large firms is higher. The forecasted effects of taxes are modest, however. For example, the difference in corporate tax rates faced by small vs. large firms during the 1970's (22% vs. 48%) is forecast to induce larger firms to finance 2.1% more of their assets with debt, relative to smaller firms. Column 4 reports results when we treat τ_{st} as endogenous, and use $\tau_t(\bar{\rho}^b A_{st})$ as the identifying instrument. As expected, given the high correlation of the instrument with τ_{st}, the coefficient is not much affected.

Columns 5 and 6 report equivalent results for both short-term and long-term debt.[22] Here, we find that taxes have twice as large an effect on use of short-term as on long-term debt. Since almost two-thirds of debt is long-term, these figures suggest that the elasticity of short-term debt is four times as large as that of long-term debt.

The control variables for firm size indicate that small firms have more debt (as a fraction of assets) than large firms do. There are many possible explanations for this pattern. For one, the largest firms are publicly traded, so have easier access to the equity market. Small firms are also more likely to be recent start-ups, that would need to rely much more on outside loans rather than retained earnings in order to finance new investment. In addition. lenders to at least very small firms may require the owner(s) to pledge personal as well as corporate assets as collateral, facilitating extra debt. The coefficients also indicate that small firms rely relatively more on short-term debt, which is not surprising given the higher failure rate for small firms.

The remaining control variables describe how debt/assets vary, depending on the composition of the firm's assets, where the omitted category is mainly "other" assets. As expected, firms with more depreciable assets have more debt, presumably because these

[21] Note that the effects of m_t are no longer independently identified when time dummies are included. so that the coefficient of the tax variable now depends only on the effects of τ_{st}.

[22] By construction, the sum of the coefficients in these two columns equals the coefficients in column 4.

depreciable assets are good collateral and also can be valued easily from outside the firm. This extra debt is almost entirely long-term, as would be expected given that these assets are illiquid. Land also supports more long-term debt than "other" assets. Cash appears to be a strong substitute for short-term debt, a pattern suggestive of the pecking order story of firm finance. In contrast, cash seems to make long-term borrowing slightly easier than having "other" assets instead.

One surprising and even puzzling result is that intangible assets lead to much more long-term debt. Part of the answer may be that existing amortization rules lead to an underestimation of the value of these assets. Also, since firms with large intangible assets are likely to grow more quickly, longer-term debt may be easier to justify.

We next examined the pattern of the coefficients of the year dummies, which capture variation over time in debt/assets left after subtracting off the estimated effects of tax rates, firm size, and the asset composition of firms. As seen in Figure 3, the coefficients of the time dummies grew steadily over time, until around 1990. For comparison, actual aggregate debt/assets also appear in the graph, scaled to have the same initial value.

The time pattern of the coefficients of these time dummies should reflect the effects of business cycles, changes in interest rates, and any other time varying factors that affect debt/assets. To test whether tax incentives have been captured adequately in the results reported in Tables 2, we can also see if the average tax incentives, $\sum_s \tau_{st}/S - m_t$, help explain this time pattern. The results from estimating equation (2) are reported in Table 3.

Before turning to the coefficients of the tax variable, we should note briefly the nature of the coefficients for the other control variables. To begin with, debt/assets appear to be higher when nominal interest rates are high, consistent with the hypothesis in Gordon (1982). Given the negative coefficient on the Dow-Jones index, it appears that firms have more debt during recessions, perhaps due to the greater cash-flow pressures they face then. Finally, use of debt appears to have increased after the 1986 Tax Reform, even controlling for changes in tax rates. Given the limitations on nonmortgage interest deductions under the personal tax that were newly enacted in 1986, and the increase in capital gains tax rates, this is exactly what would be expected.

Our main interest, though, is in the coefficient of the tax variable. While the correlation between $\tau_t - m_t$ and the time dummies is negative, as seen in column 1, once we control for other time-varying factors the coefficient becomes positive, large in magnitude, and statistically significant — the estimated effect of taxes found using the "difference-in-difference" procedure in Table 2 is not sufficient to explain the relation between taxes and aggregate debt/assets seen in the time-series. Given that the dependent variable is measured net of the estimated effects of taxes found in Table 2, the IV estimates suggest that for each point increase in $\tau_t - m_t$ average debt/assets should increase by $.293+.062 = .355$ points. This combined coefficient implies, for example, that the difference in corporate tax rates faced by small vs. large firms during the 1970's (22% vs. 48%) would induce larger firms to finance 9.2% more of their assets with debt, relative to smaller firms.

Why do tax effects continue to show up in the time series estimates, given that the time dummies are measured net of the tax effects estimated in the "difference-in-difference" regressions? One possible explanation is measurement errors in m_t, due to the use of taxable income rather than assets as weights, since the effects of m_t show up only in Table 3. These measurement errors likely bias the coefficient of m_t upwards, since the key changes in the top marginal tax rates faced by the wealthiest individuals get too small weight when taxable income rather than assets is used as a weight:[23] the estimated coefficient then needs to be larger to compensate. To test for such a pattern in the data, we first included τ_t and m_t separately. As seen in column 4 of Table 3, the coefficient of m_t is indeed larger, though the coefficient of τ_t also remains significantly different from zero.

To confirm the role of possible measurement errors in m_t, we reestimated the model restricted to the IMF sample, in order to compare the effects of using taxable income vs. assets as weights in calculating m_t. These results are reported in columns 5 and 6 of Table 3. When assets are used as weights, the coefficient of m_t is indeed lower, and now is very close to that for τ_t. However, both remain significantly different from zero.

Coefficients in any time series regression are likely to be sensitive to the set of included variables. Therefore, one possible explanation for the large coefficients of the tax variables in Table 3 is that the coefficients for τ_t and m_t are both nonzero simply because they are serving as a proxy for some omitted factors (e.g. financial regulatory policies) that independently affect aggregate debt/assets. To see that such a bias can be large, compare the coefficients of $\tau_t - m_t$ in columns 1 and 2. We find it unlikely, however, that the omitted-variable bias will be virtually identical for the coefficients of both τ_t and m_t.

Instead, we find it more likely that the coefficient of τ_{st} in Table 2 is biased downwards. (Such a bias would affect equally the coefficients of τ_t and m_t in Table 3.) As described above, we measured τ_{st} by $\tau_t(\bar{\rho}_{st})$, whereas a preferable measure would be $\mathrm{E}\tau_t(\tilde{\rho}_{st})$.[24] Unfortunately, the *SOI* Tables provide no information about the distribution of taxable income over time for a given firm, or across firms at a given date. Any attempt to assess the nature of the possible bias due to mismeasurement of the marginal tax rate has to be indirect.

If measurement error in τ_{st} is important, the nature of the bias should vary with the size of firm. In particular, the measurement error in τ_{st} should be less important for the largest firms, since these firms would remain in the top tax bracket unless their rate of return is substantially below its expected value. The same should be true for the smallest firms, with the added argument that the reduction in their marginal tax rate when losses occur will be offset by the increase in their marginal tax rate when such firms earn unusually high profits. However, for firms of intermediate size, their marginal tax rate will be very sensitive to their actual rate of return, so that heterogeneous rates of return across firms imply an expected marginal tax rate that can be very different than our estimate for τ_{st}. In particular, the true expected marginal tax rate will vary much less with firm size than does τ_{st}, so that the estimated coefficient of τ_{st} will be pushed downwards to compensate.

[23] The wealth distribution is far more skewed than the income distribution.

[24] Given tax-loss carrybacks and carryforwards, calculating the expected marginal tax rate on current taxable income is very complicated, depending on each firm's past taxable income as well as the probability distribution of its future taxable income. Restrictions on use of the investment tax credit create further complications. Graham (1996), for example, simulates each firm's taxable income over the following fifteen years in order to estimate the firm's *current* marginal tax rate.

This implies that the coefficient of τ_{st} should be a U-shaped function of the size of the firm, with a minimum around the size of firm whose taxable income is near the discontinuity in the tax schedule (currently at a taxable income of \$100,000.

To test for this pattern, we interacted τ_{st} with the function $f(A^r_{st})$, and reestimated equation (1). The resulting coefficient estimates for τ_{st}, as a function of A^r_{st}, are graphed in Figure 4a. Here, we find exactly the type of pattern forecast. For the largest and the smallest firms, the coefficient is between .3 and .4, so just around the size of .355 found previously combining the results from Tables 2 and 3. The minimum coefficient is for firms with assets of about five million dollars, so expected taxable income of just about \$100,000, exactly as forecast.

Of course, the smaller coefficient on τ_{st} for intermediate sized firms could be interpreted instead to suggest that these firms are simply less responsive to the tax law. As a further test that the smaller coefficient is due to measurement error, we add $\bar{\tau}_t$ to the equation, also interacted with $f(A^r_{st})$. Even if τ_{st} does a mediocre job of measuring the relative marginal tax rates faced by different sized firms at any date, the variable $\bar{\tau}_t$ should still capture well for all firms the effects of changes over time in the corporate tax law. If the coefficient of τ_{st} already fully captures the impact of taxes on behavior, then adding $\bar{\tau}_t$ to the specification should have no impact. But if the coefficient of τ_{st} is biased downwards for intermediate sized firms, then we should find that $\bar{\tau}_t$ matters for intermediate sized firms, but not so much for the smallest and the largest firms. Its coefficients should therefore have an inverse U-shaped pattern, as a function of firm size.

When we add $\bar{\tau}_t - m_t$ as well to equation 1,[25] the resulting coefficients are graphed in Figure 4b. Here we find that the coefficients of $\bar{\tau}_t - m_t$ broadly have an inverse U-shaped pattern, as expected, with the pattern being roughly a mirror image of the coefficients on $\tau_{st} - m_t$. In particular, the sum of the coefficients varies between .2 and .6, with typical values around .4, consistent with our prior results. Some of the other details are not as sharply consistent with our forecasts. For example, the minimum value for the U-shaped pattern for the coefficients of τ_{st}, and the maximum value for the inverse U-shaped pattern for the coefficients of $\bar{\tau}_t$, are now at a larger size firm than we would have expected. The negative coefficients on τ_{st} for intermediate sized firms, and the small coefficient for the largest firms are also not quite as forecast. Given that at this point we are estimating sixteen coefficients for the tax variables, however, the standard errors are large so that we do not feel that the data are sufficient to pin down such details.

Finally, to provide some comparison with prior studies, Table 4 reports time-series regressions of aggregate debt/assets (aggregate corporate debt divided by aggregate corporate assets each year) against the same independent variables as appeared in Table 3.[26] The coefficient of the tax variable is small, statistically insignificant, and very different

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25 The function $f(A^r_{st})$ includes a constant term as well as a polynomial in $\ln(A^r_{st})$. As before, the interaction of the constant term with $\bar{\tau}_t - m_t$ is not identified, given the presence of the time dummies. We therefore also reestimated equation (2) in order to estimate this additional coefficient.

26 The tax incentive variable, however, rather than equaling the average corporate tax rate each year for the observations in our sample, instead equals a weighted average corporate tax rate, weighting by the size of corporate assets in each category. As a result, the value for τ_t shows much less variability than is present in the Table 3 results.

from our estimated effect of taxes found combining results from Tables 2 and 3. Further testing shows that this difference in results is not due to weighting D_{st}/A_{st} and τ_{st} by A_{st} when calculating aggregate figures. Instead, the difference is caused by not controlling for changes in firm size and asset composition in Table 4, biasing the coefficient of τ_t but leaving that for m_t largely unaffected. When we estimate coefficients for τ_t and m_t separately, we find in column 4 that the coefficient on m_t is comparable to what we found above, while the coefficient on τ_t remains very small. Once we control for firm size and asset composition, we return to the specification reported above.

5. Conclusions

This study makes use of a previously neglected source of variation in tax incentives across firms to identify the effects of taxes on corporate debt/assets. In particular, due to the progressivity of the corporate tax schedule, small corporations face much lower marginal tax rates than larger firms; the difference in their marginal tax rates has also varied substantially over time. Since small firms are almost never publicly traded, however, they have not been included in past empirical studies, which almost entirely rely on the *Compustat* data for publicly traded firms. However, the *US Statistics of Income* data report taxable income and accounting balance sheet data, broken down by firm size, for *all* U.S. corporations, yearly since 1950. With these data, we were able to compare the financial policies of small vs. large firms, to see how they respond to the differences in tax incentives they face. Small firms of course behave differently than large firms for many reasons, so the study compares the changes over time in debt/assets for small vs. large firms with the changes in the relative tax rates they face, using in effect a "difference-in-difference" procedure.

The results suggest that taxes have a large effect on corporate use of debt for the smallest and the largest firms in our sample, but much less effect for firms of intermediate size. We provide indirect evidence that this lower estimated responsiveness to taxes for intermediate-sized firms is due to measurement error in the tax variables. In particular, having data only on the average rate of return earned by firms in each size category, we set the marginal tax rate for a firm with a given amount of assets equal to the value it would face if it earns the average rate of return. As a result, we did not capture the effects of heterogeneity in rates of return across firms on the average marginal tax rate, arising from nonlinearity in the tax schedule. These effects would be much more important for intermediate-sized firms, whose taxable income is near the point where tax rates change dramatically.

The evidence we report suggests that this measurement error is sufficient to explain the smaller estimated effect of taxes for firms of intermediate size. In particular, based on the time series evidence, where measurement error is much less an issue, intermediate-sized firms respond comparably to tax incentives.

Estimated tax effects are rather large. For example, increasing the corporate tax rate by five points (from 35% to 40%), holding personal rates fixed, should result in the debt finance of an additional 2% of corporate assets. (On average during our sample period, 19.4% of assets were financed with debt.)

The results also indicate that small firms rely much more heavily on debt finance than large firms, so that it is essential to control for firm size when estimating the effects of taxes. Debt finance also increases during recessions and when interest rates are high. Finally, firms have more debt to the extent that their assets consist of land, depreciable assets, and intangibles.

REFERENCES

Auerbach, Alan J. 1985. "Real Determinants of Corporate Leverage," in Friedman. Benjamin M., ed. *Corporate Capital Structures in the United States* (University of Chicago Press, Chicago), pp. 301-22.

Bernheim, B. Douglas. 1991. "Tax Policy and the Dividend Puzzle," *Rand Journal of Economics* 22, pp. 455-76.

Bradley, Michael, Gregg Jarrell, and E. Han Kim. 1984. "On the Existence of an Optimal Capital Structure: Theory and Evidence," *Journal of Finance* 39, pp. 857-78.

Constantinides, George. 1983. "Capital Market Equilibrium with Personal Tax," *Econometrica* 51, pp. 611-36.

DeAngelo, Harry and Ronald Masulis. 1980. "Optimal Capital Structure Under Corporate and Personal Taxation," *Journal of Financial Economics* 8, pp. 3-29.

Givoly, Dan, Carla Hayn, Aharon R. Ofer, and Oded Sarig. 1992. "Taxes and Capital Structure: Evidence from Firms' Response to the Tax Reform Act of 1986," *Review of Financial Studies* 5, pp. 331-55.

Gordon, Roger H. 1982. "Interest Rates, Inflation, and Corporate Financial Policy," *Brookings Papers on Economic Activity* 2, pp. 461-491.

Gordon, Roger H. and MacKie-Mason, Jeffrey K. 1990. "Effects of the Tax Reform Act of 1986 on Corporate Financial Policy and Organizational Form," in Joel Slemrod, ed., *Do Taxes Matter?* (MIT Press, Cambridge), pp. 91-131.

Gordon, Roger H. and MacKie-Mason, Jeffrey K. 1994. "Tax Distortions to the Choice of Organizational Form," *Journal of Public Economics* 55, pp. 279-306.

Graham, John R. 1996. "Debt and the Marginal Tax Rate," *Journal of Financial Economics* 41, pp. 41-73.

Graham, John R., Michael L. Lemmon, and James S. Schallheim. 1998. "Debt, Leases, Taxes, and the Endogeneity of Corporate Tax Status," *Journal of Finance* 53, pp. 131-162.

Gropp, Reint E. 1997. "The Effect of Expected Effective Corporate Tax Rates on Incremental Financing Decisions," IMF Working Paper, No. 46.

MacKie-Mason, Jeffrey K. and Gordon, Roger H. 1997. "How Much Do Taxes Discourage Incorporation?" *Journal of Finance* 52, pp. 477-505.

MacKie-Mason, Jeffrey K. 1990. "Do Taxes Affect Corporate Financing Decisions?" *Journal of Finance* 45, pp. 1471-1493.

Modigliani, Franco and Merton H. Miller. 1963. "Corporate Income Taxes and the Cost of Capital: A Correction," *American Economic Review* 53, pp. 433-43.

Myers, Stewart C. 1984. "The Capital Structure Puzzle," *Journal of Finance* 39, pp. 575- 592.

Rajan, Raghuram, and Zingales, Luigi. 1995. "What Do We Know about Capital Structure? Some Evidence from International Data," *Journal of Finance* 50, pp. 1421-1460.

Taggart, Robert A., Jr. 1985. "Secular Patterns in the Financing of U.S. Corporations," in Friedman, Benjamin M., ed. *Corporate Capital Structures in the United States* (University of Chicago Press, Chicago), pp. 13-75.

United States Internal Revenue Service, *Statistics of Income: Individual Income Tax Returns*, various issues.

United States Internal Revenue Service, *Statistics of Income: Corporate Income Tax Returns*, various issues.

Table 1 Summary Statistics

Variable	Notation	Sources	Obs	Mean	st. dev.	Min	Max
Corporate debt-asset ratio							
Total debt / assets	D_{st} / A_{st}	*SOI: Corporate Returns*	434	25.18	8.05	9.86	43.13
Long-term debt / assets		*SOI: Corporate Returns*	434	15.73	4.36	7.30	26.82
Short-term debt / assets		*SOI: Corporate Returns*	434	9.45	4.07	0.79	17.34
Tax rates							
Corporate income tax rate – personal tax rate * the fraction of household assets outside of pensions and life insurance	$t_{st} - m_t$	Authors' calculation using *SOI: Corporate Returns, SOI: Individual Returns, Flow of Funds Accounts in the United States*	434	13.04	12.72	-12.41	28.49
Corporate income tax rate	t_{st}	Authors' calculation using *SOI: Corporate Returns*	434	37.57	13.15	15	52
Corporate income tax rate based on the average profits before interest deductions	$\hat{t}_{st}$	Authors' calculation using *SOI: Corporate Returns*	434	37.97	12.81	15	52
Corporate assets							
Real assets per return	A^r_{st}	*SOI: Corporate Returns*	434	386.7	1064	0.03	4803
Net depreciable assets / assets		*SOI: Corporate Returns*	434	20.79	6.32	5.82	35.66
Land / assets		*SOI: Corporate Returns*	434	3.66	2.46	0.11	8.31
Cash / assets		*SOI: Corporate Returns*	434	9.50	4.00	2.80	25.25
Account receivable / assets		*SOI: Corporate Returns*	434	22.83	4.53	9.58	34.39
Intangible assets / assets		*SOI: Corporate Returns*	434	1.12	1.08	0.08	5.40
Yearly variables							
Yearly average of $t_{st} - m_t$	$\bar{t}_t - m_t$	Authors' calculation using *SOI: Corporate Returns, SOI: Individual Returns*	37	12.64	5.49	5.20	22.90
Personal tax rate * the fraction of household assets outside of pensions and life insurance	m_t	Authors' calculation using *SOI: Individual Returns, Flow of Funds Accounts in the United States*	37	24.49	2.36	20.25	29.41
Three-year Treasury Bill rate		*Economic Report of the President*	37	6.76	3.02	1.63	14.44
Average Dow Jones index / GDP		GDP from *Economic Report of the President*	37	0.67	0.34	0.27	1.27

Note: 1. Units of the variables are percents except for real assets per return and average Dow Jones index / GDP, for which units are million US $ and a fraction, respectively.
2. Dow Jones indices are downloaded from www.forecasts.org and *The Flow of Funds Accounts in the United States* are download from the Federal Reserve Board's wet site (www.bog.frb.fed.us).
3. A small discrepancy between the means of $t_{st} - m_t$ and of $\bar{t}_t - m_t$ occurs because the number of asset groups varies by year.

Table 2a. D/A Ratio on Corporate Marginal Tax Rate, OLS and IV.

Dependent variables are the ratio of debt to total assets in percent, where debt is total, short-term, or long-term debt.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	*total* D_{st} / A_{st}	*total* D_{st} / A_{st}	*total* D_{st} / A_{st}	*total* D_{st} / A_{st}	*short-term* D_{st} / A_{st}	*long-term* D_{st} / A_{st}
Estimation method	OLS	OLS	OLS	IV	IV	IV
$t_{st} - m_t$	-0.419**	-0.393**	0.079**	0.062**	0.041*	0.02
	(0.018)	(0.020)	(0.019)	(0.021)	(0.018)	(0.014)
$\log(A^r_{st})$			1.853**	1.985**	0.571*	1.414**
			(0.355)	(0.370)	(0.287)	(0.270)
$(\log(A^r_{st}))^2$			-0.641**	-0.644**	-0.031	-0.613**
			(0.135)	(0.135)	(0.096)	(0.082)
$(\log(A^r_{st}))^3$			-0.568**	-0.586**	-0.386**	-0.200**
			(0.068)	(0.071)	(0.055)	(0.045)
$(\log(A^r_{st}))^4$			0.085**	0.086**	0.034**	0.052**
			(0.009)	(0.009)	(0.007)	(0.005)
$(\log(A^r_{st}))^5$			0.019**	0.020**	0.014**	0.006*
			(0.004)	(0.004)	(0.003)	(0.002)
$(\log(A^r_{st}))^6$			-0.004**	-0.004**	-0.002**	-0.002**
			(0.001)	(0.001)	(0.001)	(0.000)
$(\log(A^r_{st}))^7$			0.0002**	0.0002**	0.0001*	0.0001**
			(0.000038)	(0.00004)	(0.00003)	(0.00002)
Net depreciable assets / total assets			0.320**	0.326**	0.004	0.322**
			(0.058)	(0.059)	(0.033)	(0.053)
Land / total assets			0.317	0.259	0.034	0.225
			(0.254)	(0.259)	(0.192)	(0.206)
Cash / total assets			-0.437**	-0.448**	-0.637**	0.189**
			(0.087)	(0.088)	(0.066)	(0.067)
Accounts receivable / total assets			-0.027	-0.023	-0.067*	0.044
			(0.040)	(0.040)	(0.031)	(0.024)
Intangible assets / total assets			1.447**	1.427**	-0.046	1.473**
			(0.341)	(0.346)	(0.279)	(0.208)
Constant	30.646**	25.572**	20.992**	21.364**	18.823**	2.541
	(0.243)	(1.289)	(2.187)	(2.206)	(1.813)	(1.505)
Year dummies included?	No	Yes	Yes	Yes	Yes	Yes
No. of observations	434	434	434	434	434	434
R^2	0.437	0.433	0.972	0.972	0.931	0.967

White-corrected standard errors in parentheses. * significant at 5% level; ** significant at 1% level.

Table 3. Unexplained Yearly Variation, OLS and IV.

Sample years are from 1954 to 1995 except 1962 and 1966-69.
Dependent variables are year dummies from column (4) of Table 2.

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation method	OLS	OLS	IV	IV	IV	IV
$\bar{t}_t - m_t$	-0.332**	0.264**	0.293**			
	(0.045)	(0.094)	(0.097)			
$\bar{t}_t$				0.242*	0.262*	0.256*
				(0.101)	(0.101)	(0.092)
m_t				-0.507**	-0.399**	-0.220**
				(0.129)	(0.131)	(0.070)
Three year Treasury Bill rate		0.502**	0.516**	0.466**	0.251	0.245
		(0.148)**	(0.146)**	(0.126)**	(0.157)	(0.162)
Dow Jones index / GDP		-4.546**	-4.741**	-5.331**	-4.833**	-2.949**
		(1.485)	(1.513)	(1.222)	(0.974)	(0.914)
Dummy for post 1986		3.313**	3.503**	1.960	2.090**	1.720*
		(0.692)	(0.700)	(0.970)	(0.696)	(0.714)
Constant	8.950**	0.191	-0.187	8.094*	3.386	-0.954
	(0.657)	(1.978)	(1.968)	(3.934)	(3.976)	(4.209)
No. of observations	37	37	37	37	25	25
R^2	0.57	0.84	0.84	0.86	0.67	0.66

White-corrected standard errors in parentheses.
* significant at 5% level; ** significant at 1% level.
Note: m_t in column (5) is a weighted average, weighting by the size of taxable income. m_t in column (6) is a weighted average, weighting by the size of assets.

Table 4. Actual Yearly Variation of D/A, OLS and IV.

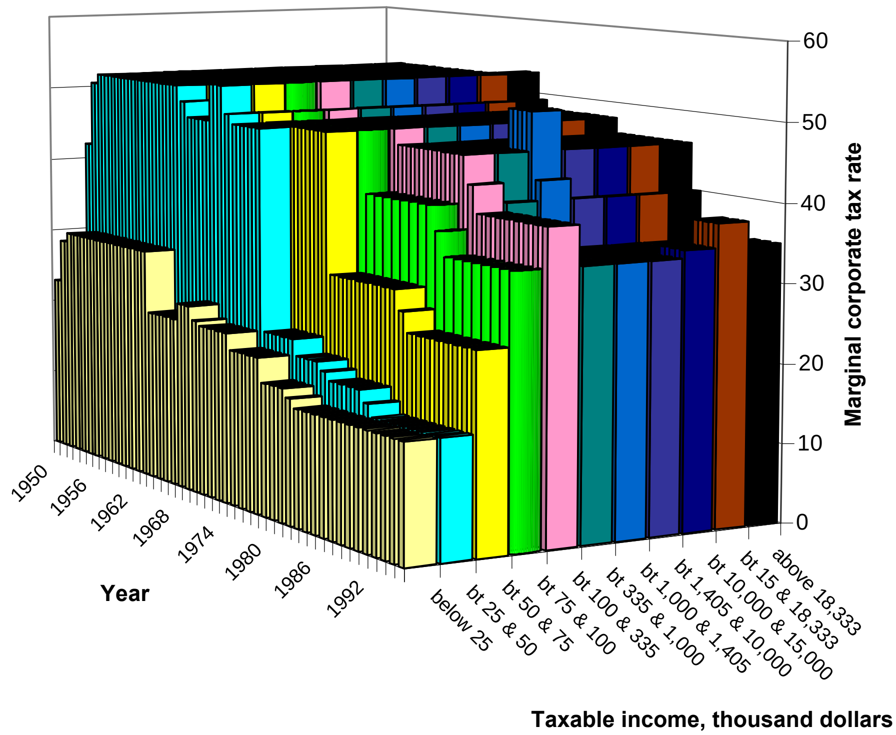
Sample years are 37 years from 1954 to 1995 except 1962 and 1966-69.

	(1)	(2)	(3)	(4)
Dependent variable	$\sum_s D_{st} / \sum_s A_{st}$			
Estimation method	OLS	OLS	IV	IV
$\bar{t}^a_t - m_t$	-0.415**	0.092	0.110	
	(0.045)	(0.130)	(0.136)	
$\bar{t}^a_t$				0.066
				(0.058)
$\bar{t}_t$				
m_t				-0.553**
				(0.122)
Three year Treasury Bill rate		0.357	0.363*	0.304**
		(0.180)	(0.177)	(0.102)
Dow Jones index / GDP		-2.474	-2.563	-4.066**
		(1.446)	(1.462)	(0.941)
Dummy for post 1986		3.705**	3.829**	1.308*
		(1.106)	(1.155)	(0.497)
Constant	27.550**	15.778**	15.419**	30.281**
	(0.867)	(3.223)	(3.287)	(2.935)
No. of observations	37	37	37	37
R^2	0.63	0.80	0.80	0.88

White-corrected standard errors in parentheses.
* significant at 5% level; ** significant at 1% level.

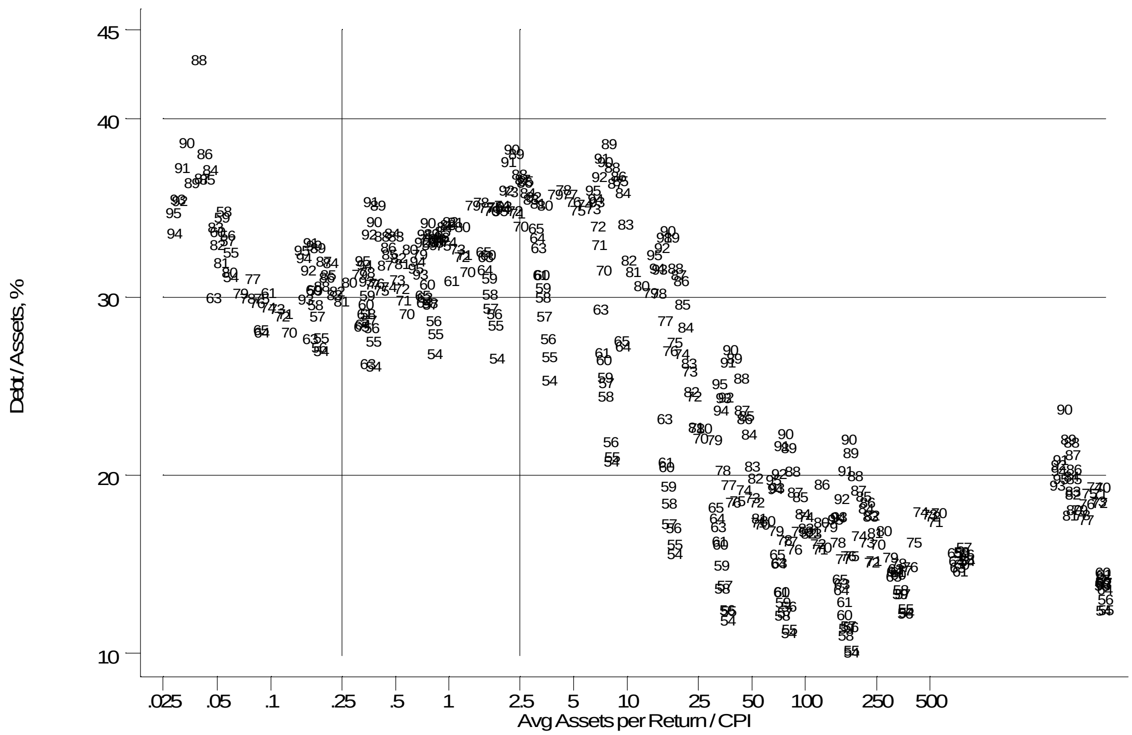
Note: Since the dependent variable is an asset-weighted average of the debt-asset ratios, the tax incentive variable, $\bar{t}^a_t - m_t$, is now a weighted average corporate tax rate, weighting by the size of corporate assets in each category. The instrument is also constructed as an asset-weighted average of $\hat{t}_{st} - m_t$.

Figure 1. US Corporate Tax Rate Structure, 1950-1995



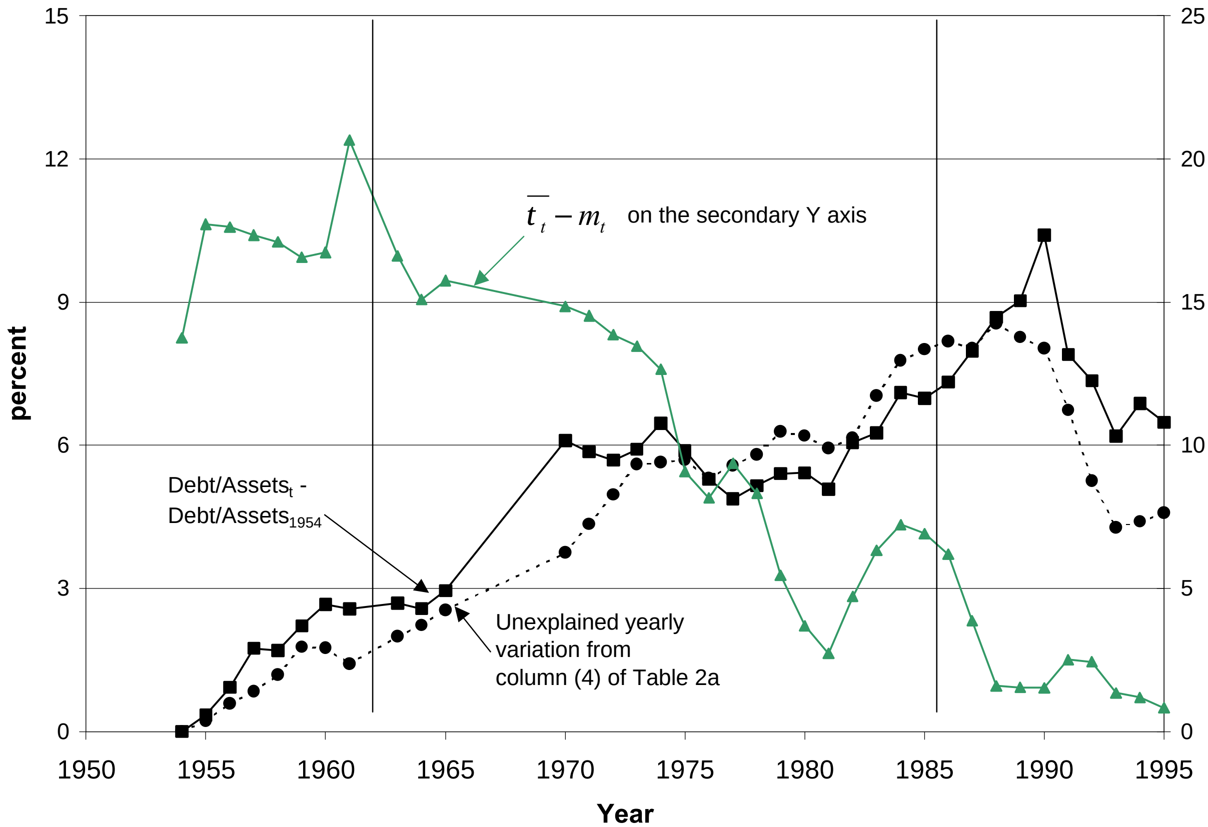
Note: Surtaxes have been imposed in a certain range of taxable income since 1984.

Figure 2. Debt-Asset Ratios on Size of Firm, 1954-1995



Note: Log scale is used for the x-axis. The label is the year of the observation.
Source: Authors' calculation using *SOI Corporate Returns.*

Figure 3. Unexplained Yearly Variation in Debt-Asset Ratio and $\bar{t}_t - m_t$, 1954-1995.



Note: Here, debt/assets is calculated as $\sum_s D_{st} / \sum_s A_{st}$ for each year.

Source: Authors' calculation using *SOI Corporate Returns* and *Economic Report of the President.*

Figure 4a. The Estimated Tax Effect as a Function of Asset Size

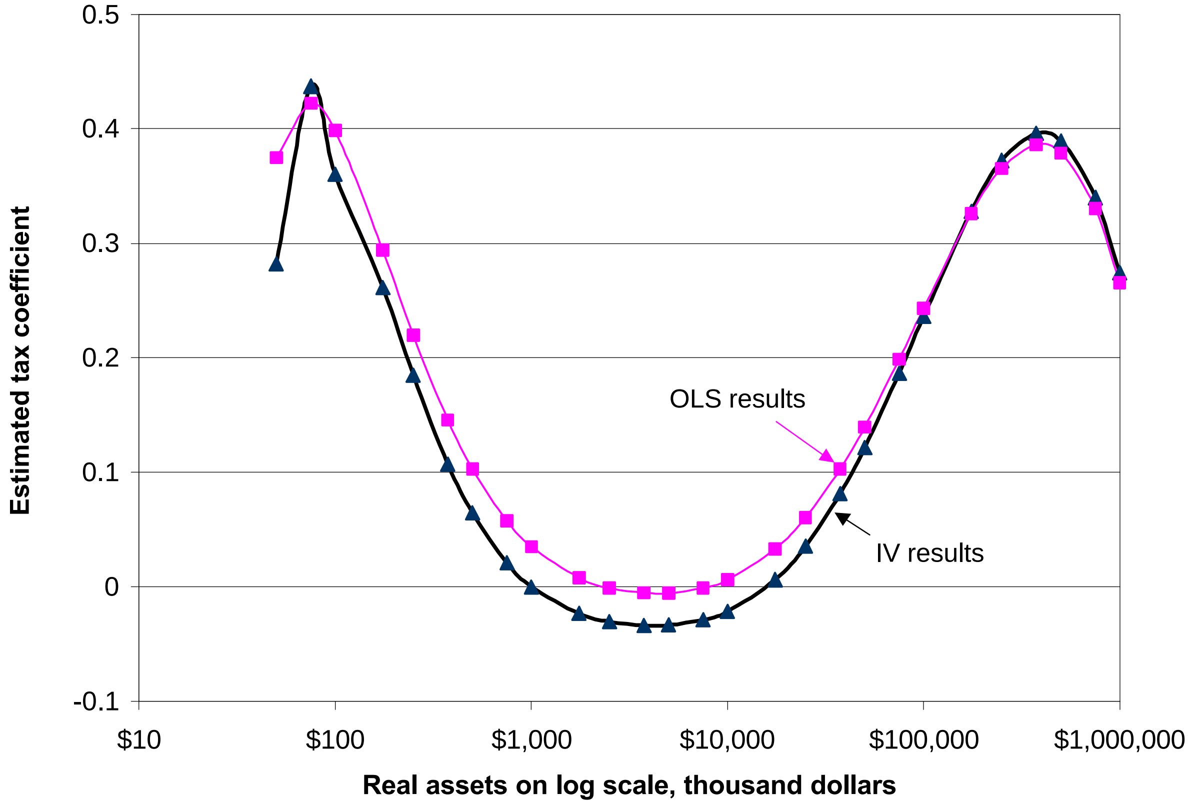


Figure 4b. The Estimated Tax Effect As a Function of Assets Size