DO TAXES AFFECT CORPORATE DEBT POLICY?
Evidence from U.S. Corporate Tax Return Data

by

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Abstract. This paper uses *U.S. Statistics of Income (SOI) Corporate Income Tax Returns* balance sheet data on *all* corporations, to estimate the effects of changes in corporate tax rates on the debt policies of firms of different sizes. Small firms face very different tax rates than larger firms, and relative tax rates have also changed frequently over time, providing substantial information to identify tax effects. The results suggest that taxes have had a strong and statistically significant effect on debt levels. 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 around 3.5%. Since small firms normally rely much more heavily on debt finance yet face much lower tax incentives to use debt, the estimated effect of taxes would be strongly biased downwards without controls for firm size.

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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). Surprisingly, however, economists have had great difficulty providing evidence that taxes in fact affect debt/asset ratios.

To test for the effects of taxes on firms' financial policy, one needs sufficient variation in tax incentives either over time or across firms. Most empirical studies, e.g. Auerbach (1985), Bradley, Jarrell, and Kim (1984), Graham (1996), Graham, Lemmon, and Schallheim (1998), Graham (1999), Gropp (1997), and MacKie-Mason (1990), have focused on cross-sectional variation in corporate tax rates across firms 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,[1] marginal tax rates can vary across firms when some firms have tax losses.[2] 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.[3]

Using cross–sectional variation in expected tax rates, however, identifies the effects of taxes 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, so that identification is based simply on statutory changes. 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 from 46% to 52%, making it difficult

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[1] In recent years, firms face a marginal tax rate much below the top marginal corporate tax rate only if their profits are under \$75,000. If a firm with \$350 million in assets, the average for Nasdaq SmallCap Market Companies in March 1998, were to earn less than \$75,000 in a year, its rate of return would be only 0.021%, whereas a typical ratio of taxable income to assets would be around 2% in the 1990's.

[2] 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.

[3] Some of these studies simply include these indicator variables directly. Others calculate expected tax rates as a function of this information, and then test for effects of these variables indirectly, through their implications for expected tax rates.

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/assets 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/assets 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 nontax factors that affect financial policy change over time, 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 increase in the incentives to use debt finance due to the fall in personal relative to corporate tax rates and the jump in the tax rate on capital gains. 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 tax rate changes per se.

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

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

law.[5] The differing patterns over time in tax rates for small vs. large firms provides much more time-series variation to identify tax effects than has been used in the past. Such variation in statutory rates across sizes of firms has not been exploited in the past to test for the effects of taxes on financial policy, since the *Compustat* data include 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 from large firms 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.[6]

Identifying the effects of taxes using tax rate variation arising from firm size therefore suffers from the same type of problem faced when using tax rate variation arising from current tax losses: in both cases the cause of the variation in tax rates can have independent effects on financial policy. By including flexible controls for any effects of firm size per se on financial policy, our study will focus on changes over time in debt/assets for each size category of firms, to see if their debt/assets ratio is bigger when the tax incentives they face are bigger.

Initially, we also choose not to make use of variation in *average* tax rates over time, given the possible correlation with business cycles. By including time dummies to control for any business cycle or other aggregate fluctuations, we focus on how the *relative* tax rates faced by small vs. large firms affects their relative debt/assets choices. 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, providing much more variation in statutory tax rates than has been used in the past, where only the average (or top) tax rate was used.

While we allow the normal financial policy to differ by size of firm, however, we initially assume that all firms are equally responsive to tax incentives. However, this assumption can easily be questioned, since the financial options available to say a local auto dealership can differ substantially from those available to a large auto manufacturing firm. We therefore also explore whether the responsiveness of financial policy to taxes differs across size categories of firm.

The resulting estimates, taken at face value, imply large and statistically significant tax effects for small and for large firms, but much smaller effects for intermediate-sized firms, suggesting that the responsiveness to taxes differs substantially by size of firm. However, one alternative explanation for these results is that the lower estimated responsiveness of

[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.

[6] Some small firms, however, are part of larger organizations, so may be in a more comparable position to larger firms. In particular, until 1975 and then after 1978 the tax law gave business owners substantial flexibility to divide their businesses into multiple units, so that each unit could take advantage of the initial brackets in the corporate tax rate schedule. See Sommerfeld (1981) for further discussion.

firms of intermediate size results from measurement errors in our measure of the marginal tax rate faced in particular by these intermediate-sized firms.[7]

Since the above estimates make no use of variation over time in average tax rates vs. average financial policy, due to the use of time dummies, we also report aggregate time-series regressions to see if the implications of the aggregate data are consistent with those found using the "difference-in-difference" estimates. Compared with the *Compustat* data, the *SOI* data cover a broader set of firms and provide a much longer time series on debt/assets, with data from 1954 to 1995. These estimates, while more tentative due to possible biases from omitted time-varying factors, are very much consistent with the "difference-in-difference" estimates. In particular, once we control for business cycle factors and for changes over time in the size distribution of firms, we find corporate tax effects comparable to those found in the "difference-in-difference" estimates. Here, we can identify the separate effects of personal vs. corporate taxes,[8] and find statistically significant effects of each tax rate of the expected sign and size, given previous results.

The coefficient estimates from both the "difference-in-difference" and the time-series results suggest that 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 around three to four percent. By way of comparison, on average during our sample period, 19.4% of assets were financed with debt. Short-term debt is found to be far more responsive to tax incentives than long-term 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 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

[7] 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 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. This heterogeneity in profit rates by firm should have small effects on the average marginal tax rate for the smallest and the largest firms since their rate of return would need to change substantially to put them in a different tax bracket. For intermediate-sized firms, however, their marginal tax rate will be very sensitive to their reported rate of return, so that the marginal tax rate at the average income can differ substantially from the average marginal tax rate in a given size category of firms.

[8] Since we assume that the representative lender is in the same tax bracket regardless of the size of firm receiving the loan, the only variation in personal tax rates is over time. The coefficient of the personal tax rate is therefore not identified in the "difference-in-difference" estimates, due to the presence of time dummies.

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 a 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 incentives they face. Denote the debt/assets in size interval s in year t 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 retained, thereby generating taxable capital gains, and let m_t equal the representative marginal personal tax rate faced by recipients of interest income. Then, increasing interest payments by a dollar reduces the combined tax payments of the firm and its investors together by $T_{st} \equiv \tau_{st} + z_t(1 - \tau_{st}) - m_t$.

Our aim is to identify the effects of T_{st} on the debt/assets choices of firms. The key problem is to find sources of variation in T_{st} that provide a reliable source of identification. Measured corporate tax rates, τ_{st}, necessarily are a function of observables in the *SOI* data. If, in particular, $\tau_t(.)$ denotes the corporate tax schedule in year t, A^r_{st} measures the assets of firms in each category s, and $\bar{\rho}_{st}$ is the reported average rate of return earned by these firms, then $\tau_{st} \equiv \tau'_t(\bar{\rho}_{st} A_{st})$ measures the marginal tax rate faced by a representative firm in that size category in that year.

What source of variation in τ_{st} provides a reliable identification of the effects of taxes on behavior? To begin with $\bar{\rho}_{st}$ can be endogenous for many reasons. As emphasized by Graham et al (1998), this profit rate is measured net of interest deductions so is directly linked to the dependent variable. In addition, $\bar{\rho}_{st}$ can be affected by the inflation rate and by business cycles, and these variables may have independent effects on corporate use of debt. Variation in τ_{st} resulting from variation in $\bar{\rho}_{st}$ we therefore view to be an unreliable source of identification, even though it has been the main source of variation used in most prior studies. To deal with this endogeneity, we use as an instrument $\tau'_t(\bar{\rho}^b A_{st})$, where $\bar{\rho}^b$ is the average profit rate, before interest deductions, for all firms over the entire sample period.

As argued above, variation in τ_{st} arising from differences in firm size is also a problematic source of identification, since small firms may behave differently than large firms for many reasons. A standard way to deal with this problem would be to include dummies for each size category of firm, so that identification is based solely on changes over time in D_{st}/A_{st} within each size category as the tax law changes, rather than based on comparisons across size categories. Unfortunately, the size categories in the data are not comparable across years.[9] Instead, to capture any direct effects of firm size on financial policy, we add to the specification a function $f(A^r_{st})$ that is intended to capture any effects of firm size per se on debt/assets. Here, A^r_{st} equals the firms' real assets: $A^r_{st} \equiv A_{st}/CPI_t$ in year t, where CPI_t is the consumer price index (with 1992 as the base year). In the estimation, we make this function very flexible, intending that all of the differences in D_{st}/A_{st} arising simply from differences in firm size are captured by this function rather than by the tax variables.[10]

Given these extra control variables, the identification of the effects of taxes on D_{st}/A_{st} comes solely from variation in the tax law itself. One remaining concern, however, is that the tax law may, perhaps by chance, be correlated with any of a number of other time-varying factors that affect financial decisions. For example, use of debt can vary over the business cycle. Also, the inflation rate can affect the incentive to use debt, as argued in Gordon (1992). The timing of tax changes may be correlated with these and other time-varying factors. One strategy would be to include direct controls for any such variables that we can measure and think important. Instead, we adopted a more conservative approach and simply included time dummies, d_t, to control for any and all such time varying factors.

With these controls, 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.

Our estimates can still be subject to bias, however, if omitted time varying factors are correlated with relative tax rates and affect relative debt/asset ratios. For example, business cycles can affect small and large firms differently and possibly be correlated with relative tax rates. To test for this, we included a measure of the business cycle, interacted with $\log A^r_{st}$. 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 base specification:

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

[9] The boundaries for each size category are defined in nominal dollars, so change in real terms due to inflation. In addition, the boundaries themselves change on occasion.

[10] In particular, we approximated the function $f(A^r_{st})$ with a polynomial function of $\log(A^r_{st})$, and continued adding powers to the polynomial as long as each additional power was statistically significant.

where B_t is a measure of the business cycle and X_{st} captures information about asset composition. The key hypothesis is clearly that $\beta > 0$.

In equation (1), we implicitly assume that all firms are equally responsive to tax incentives, even though we allow nontax factors affecting financial policy to vary with the size of the firm. This assumption of equal responsiveness to taxes can certainly be questioned. Small firms presumably rely for credit primarily on bank loans (or loans from shareholders in the firm), while the largest firms can also issue commercial paper or corporate bonds. Smaller firms are also more likely to be credit constrained, since problems of asymmetric information between borrowers and lenders are likely to be worse for smaller firms. Conversely, smaller firms can rely more heavily on credit from insiders in the firm, who are likely to be much more responsive to tax incentives.

As a result, we also estimate the following specification, in which the responsiveness to taxes differs by size of firm:

$$\frac{D_{st}}{A_{st}} = \sum_{i=0}^{n} (\alpha_i + \beta_i T_{st}) \left[\log \left(A^r_{st} \right) \right]^i + \theta \log(A^r_{st}) B_t + X_{st}\gamma + \sum_{t \neq 1954} \delta_t d_t + \epsilon_{st}. \qquad (2)$$

Here, by interacting the coefficient of the tax variable with a flexible function of firm size, we identify the effects of taxes separately for each size category of firm, based on the changes over time in tax incentives for that size category compared with its chosen financial policy.[11]

One additional potential source of bias is measurement errors in the tax variable. In particular, we set τ_{st} equal to the marginal tax rate appropriate given the average rate of return earned by firms in each size category in a given year, i.e. $\tau_{st} = \tau'_t(\bar{\rho}_{st} A_{st})$. Actual rates of return will differ substantially across individual firms, however, so that a more appropriate measure[12] of the expected marginal tax rate for any size category would equal $\mathrm{E}\tau'_t(\tilde{\rho}_{st} A_{st})$. Due to nonlinearities in the tax schedule our measure in general will differ from this preferred measure. Unfortunately, the *SOI* Tables provide no information about the distribution of taxable income across firms at a given date, or over time for a given firm.

If measurement error in τ_{st} is important, the size 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}.

[11] The coefficients are identified, in spite of the time dummies, given that tax incentives change differently over time for different sized firms.

[12] To simplify the discussion, we ignore here loss carryforwards and carrybacks and restrictions on use of the investment tax credit, complications emphasized by Graham (1996).

In particular, variability in income implies that τ_{st}, rather than being a step function, will vary smoothly as a function of A_{st}, so vary much less with firm size than does τ_{st} among intermediate-sized firms. The estimated coefficient of τ_{st} for intermediate-sized firms will be pushed downwards to compensate. This implies (assuming that the coefficient of the "true" tax measure is the same for all size categories) that the coefficient of our measure for 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 (typically at a real taxable income of around $100,000). We could see no way, given the data we had, to approximate the preferred measure directly.

Throughout the above specifications, we have included time dummies. As a result, the above specifications make no use of the aggregate time-series variation in debt/asset ratios compared with average tax incentives. We therefore decided to explore the implications of the aggregate time-series information, to see if the aggregate time-series evidence on the effects of taxes on financial policy is consistent with the inferences from the "difference-in-difference" estimates. While the time-series estimates have the disadvantage relative to the difference-in-difference estimates that they are subject to potential bias from any omitted time-series factors that also affect financial policy, they have the advantage that the average tax rates in each year should be subject to much less measurement error than our calculated values for the average marginal tax rate within each size category.

Our time series is much longer than those used in most past studies, giving us more chance of identifying tax effects using simply time-series information. The problem remains to control for all other important time-varying factors affecting financial policy. Given the importance of the effects of firm size and asset composition as well as size-dependent effects of the business cycles, as seen in the results below, we decided to subtract off their effects from the dependent variable in the time-series regression, based on the coefficients estimated in equation (1).[13] Two obvious time-varying factors that can affect financial policy, so should be controlled for, are business cycles and nominal interest rates (or inflation). Each can affect financial policy for multiple reasons, and in each case the sign of the net effect is unclear.[14] [15]

The base specification we use to capture time-series variation in debt/assets is:

$$(D_t/A_t)_c = a_0 + a_1(\bar{\tau}_t - m_t) + a_2 i_t + a_3 B_t + a_4 d_{>86} + \eta_t, \tag{3}$$

where,

$$(D_t/A_t)_c \equiv \sum\nolimits_s \Big[D_{st}/A_{st} - \sum_i \hat{\alpha}_i \big[\log(A^r_{st})\big]^i - \hat{\theta}\log(A^r_{st})B_t - X_{st}\hat{\gamma} \Big] / S_t,$$

[13] Given the limited number of time series observations, we could not realistically hope to estimate as many as thirteen additional coefficients reliably, to control for these variables.

[14] Firms may face greater liquidity problems, so wish to borrow more, during recessions. However, our dependent variable uses the book value rather than the preferred market value of assets. To this extent, the *measured* size of debt/assets will be higher during boom periods, and lower during recessions.

[15] 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, which may discourage borrowing to finance longer-term investments.

$\bar{\tau}_t$ is the average marginal corporate tax rate in each year, i_t represents the nominal interest rate in year t, and S_t is the number of size categories in year t. We also include a dummy variable, $d_{>86}$, to capture any omitted aspects of the Tax Reform Act of 1986.[16] With this specification, we can separately test for effects of $\bar{\tau}_t$ and m_t.[17]

As emphasized by one referee, we should also acknowledge the possibility that statutory tax rates themselves are endogenous. In particular, Congress sets these rates knowing the recent performance of the economy, including information about recent corporate financial policies. Plausibly, when corporate debt/asset ratios are high, Congress will lean towards cutting corporate tax rates in order to relieve the financial pressure on firms and to reduce the tax distortion to financial policy. If so, this would lead to a downward bias in the coefficient of the tax variable, since it suggests a negative correlation between τ_{st} and the residual. While in principle one could test to see if past financial policy affects corporate tax rates, we did not feel confident pursuing this given how few important statutory tax rate changes occur during our sample period.[18]

2. Data sources

Data come from three sources: *SOI Corporate Returns*, *SOI Individual Returns*, and the Individual Model File (IMF).[19] 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.[20] 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

[16] 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.

[17] Note that in equation (1), the coefficient of m_t would not be identified, due to the time dummies, while in equation (2) the available data would not be sufficient to identify separate interactions of $\bar{\tau}_{st}$ and m_t with size of firm effects.

[18] The only major changes in the top corporate tax rate occurred during 1987-8, while the only major changes in the minimum corporate rate occurred in 1964 and 1979. This does ignore the changes each year in the real income at which rates change, though we could see no clear patterns to these changes in bracket locations.

[19] 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.

[20] 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), where "m" indicates millions of (nominal) dollars.

of return. Given the resulting uniform distribution of taxable income, we calculate the 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}.

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 ratio 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, so is not affected by any endogeneity in $\bar{\rho}_{st}$. 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 (accounting) 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.[21]

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.[22] 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

[21] As seen for example in Gordon and Bradford (1980), the effective personal tax rate on interest income embodied in market prices should be a weighted average of the marginal tax rates faced by different investors, with weights equaling their assets divided by their coefficient of relative risk aversion. Unfortunately, the available *SOI* tables do not allow any good approximation of m_t with assets as a weight, and we saw no good reason to question the simplifying assumption of constant relative risk aversion. We do, however, report one set of results below, confined to the years when the IMF data are available, where m_t is calculated using assets as a weight.

[22] 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 on funds added to a pension plan. In contrast, interest income received outside of a pension plan/insurance policy is fully taxable.

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.[23]

One other potential question is how to deal with the role of financial intermediaries in the market for corporate debt. Given the importance of banks in providing loans to corporations, it is worth addressing this issue explicitly. Individuals investors have the option of buying corporate debt directly, e.g. through mutual funds, or indirectly through bank deposits. At the margin, the two must be equally attractive, even though the bank deposit rate, r_d, may be much different than the rate of return on corporate loans, $\tilde{r}$. The difference must reflect the combined value to depositors of the services they receive from banks (e.g. checking accounts) and the protection they receive from the risk inherent in corporate loans. If s denotes the marginal value of the bank services to individuals per dollar of deposits, p denotes the risk premium on a corporate bond, and $\tilde{\epsilon}$ its random return, then in equilibrium $\tilde{r} = r_d + s + p + \tilde{\epsilon}$. The tax base for the bank generated by an extra dollar of loans financed by a dollar of deposits then equals $\tilde{r} - r_d = s + p + \tilde{\epsilon}$. As argued in Gordon (1986), a tax on $p + \tilde{\epsilon}$ is neutral since the tax base has zero market value. The corporate tax base then simply equals the value, s, of financial services provided to households, and does not depend on the amount of credit provided to firms. While the corporate tax must therefore be taken into account when judging the tax treatment of the consumption of bank services,[24] the appropriate tax rate on extra savings invested in corporate loans remains the personal tax rate of the depositor.[25]

Is there any reason for m_t to differ by size of firm? For example, small firms may obtain a much larger fraction of their loans from their shareholders than do larger firms, and the shareholders in these firms may not be representative of purchasers of corporate bonds more generally. Whether small business shareholders tend to be in higher or lower tax brackets is unclear. We saw no way to deal with this. To the extent that the appropriate value of m_t differs systematically between small and large firms, this will be captured by the function $f(A^r_{st})$.

We also need to measure the effective personal tax rate, z_t, on income from corporate equity. Given the theoretical difficulties in coming up with an appropriate measure for z_t, in most of the results reported below we simply ignored z_t.[26] As a sensitivity test, however, we also tried the more conventional alternative of setting z_t equal to $d_t m_t + (1 - d_t) a_t g_t m_t$,

[23] As a sensitivity check, however, we also tried setting m_t equal to the weighted average tax rate (ignoring pensions) or to zero (on the assumption that pensions rebalance their portfolios much more easily than households, perhaps due to the lack of any capital gains tax).

[24] Consumption of bank services is implicitly deductible under the personal tax, but subject to further implicit taxation due to interest-free reserve requirements, so that measuring the overall tax treatment of bank services is complicated.

[25] We ignore here any bank loans financed with bank equity, where the net tax treatment would be different.

[26] 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

where d_t denotes the aggregate dividend payout rate in year t,[27] g_t measures the fraction of capital gains that must be included in taxable income based on the tax law in that year,[28] while a_t measures the gains from deferral of capital gains until realization and the tax exemption of capital gains at death. Following Feldstein, Dicks-Mireaux, and Poterba (1983), we set a_t equal to .25.

In addition, we need some measure of business cycles in the time-series estimation. We tried two. Mainly, we measured business cycle effects by the ratio of the Dow Jones Index to GDP, on the grounds that behavior can change as soon as new information arrives about changing economic trends, and not just when these changes materialize.[29] We also tried as an alternative business cycle measure $\Delta GDP^r_t/GDP^r_{t-1}$, 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.

Finally, we need a measure of the nominal interest rate, i_t. Here, we used the average three-year Treasury-Note rate for each year.

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. With about twelve asset categories on average per year, we end up with 434 observations.

3. Data summary

Table 1a 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%. 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.

Table 1b provides a breakdown of these figures by broad size category of firm. With respect to the corporate tax rate, the key change in tax rate typically occurred at asset levels around \$5 million.[30] As a result, firms with assets above \$5 million almost always face the top corporate tax rate whereas smaller firms generally face much lower rates. Roughly 43% of the size categories have real assets below \$5 million.

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

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increase the value of shares, contrary to the results when trade is not contingent on the size of the capital gain.

[27] As a sensitivity test, we also tried more extreme values of d_t, on the argument that firms that are not publicly traded (the vast bulk of our sample) can behave very differently than large firms.

[28] During 1994 and 1995, shares in small businesses held for five years are subject to a lower capital gains tax rate, so that in these years we used a different value of g for small vs. large firms.

[29] 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.

[30] 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 real income level at which marginal tax rates jump in most years.

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. 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 primarily to firms larger than this having greater access to equity finance through being publicly 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, 94,089 firms had \$5 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

Difference-in-difference estimates

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

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.[31]

Column 3 reports the impact of adding $\log(A^r_{st})$ alone, column 4 adds the asset composition and business cycle variables, while column 5 reports the results when we add powers of $\log(A^r_{st})$ as long as they are statistically significant, leading us to choose a seventh–order polynomial.[32] In all these regressions, the tax coefficient was positive and very significant statistically. However, as we added terms to the polynomial, the size of the tax coefficient dropped from .302 in the regression with $\log(A^r_{st})$ only, to .067 in the regression with a seventh-order polynomial. Without these flexible controls for firm size, the coefficient of

[31] 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}.

[32] Further terms added to the polynomial were insignificant, and had no meaningful effect on the tax coefficient.

the tax variable largely appears to be capturing direct effects of firm size on financial policy. Even with extensive controls, however, taxes still have a significant effect on financial policy.

The positive tax coefficient implies that, while large firms normally have lower debt/assets ratios than small firms, their 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 1.7% more of their assets with debt, relative to smaller firms (i.e. (.48-.22).067 = .017).

Column 1 in Table 2b 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 2 and 3 in Table 2b report equivalent results for both short-term and long-term debt.[33] Here, we find that taxes have a 50% larger 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 *three times* as large as that of long-term debt. The much greater responsiveness of short-term debt to taxes is hardly surprising, however, given that short-term debt is much easier to adjust in response to year to year fluctuations in tax rates.

In all of the above results, we set $z_t = 0$. In column 4 in Table 2b, we report results under the more conventional assumption that $z_t = d_t m_t + (1-d_t) a_t g_t m_t$. The tax coefficient increases slightly, perhaps to compensate for the fact that τ_{st} is now weighted by $(1-z_t) < 1$.[34]

Consistent with Figure 2, 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 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 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

[33] By construction, the sum of the coefficients in these two columns equals the coefficients in column 1.

[34] In the reported results, we use aggregate data to measure the dividend-payout rate each year. As a sensitivity test, we tried varying d_t in the range $[0, 1]$. With $d_t = 1$, the tax coefficient increased further to .068 (.030), again perhaps simply offsetting the now smaller multiplier $1 - z$. With $d_t = 0$, the tax coefficient dropped to .041 (.024). In both cases, its standard error was a bit larger than with $z_t = 0$.

of firm finance. In contrast, cash seems to make long-term borrowing slightly easier than having "other" assets instead.

One surprising 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. A plausible alternative explanation, suggested by a referee, is that intangible assets largely represent goodwill arising from mergers and acquisitions.[35] The large coefficient of intangibles (goodwill) then suggests that mergers are heavily financed with debt, an unsurprising inference.

Finally, the control variable for business cycles suggests that large firms have more cyclical financial policy than small firms.[36] In particular, we find that large firms reduce their debt more than small firms do during boom periods, and add more debt during recessions.

So far, all of the results have assumed that small and large firms are equally responsive to tax incentives. There is no good justification for this assumption. We therefore next estimated equation 2, where we add to the specification in column (1) of Table 2b the interactions of T_{st} with $f(A^r_{st})$. Since the joint effects of eight tax coefficients are difficult to interpret, we present the combined effect of T_{st} on the dependent variable graphically, as a function of the size of the firm. The results, along with a 95% confidence interval, appear in Figure 3.

As seen in the Figure, the implied tax coefficient is between .3 and .45 for the largest and the smallest firms. However, for intermediate sized firms, the coefficient is very small. One obvious explanation for this pattern is simply that intermediate-sized firms are less responsive to taxes than either small firms (where perhaps insiders in the firm are the marginal lender, and can be very responsive to tax incentives) or large firms (which are much less likely to be credit constrained than intermediate-sized firms).

Why is the average size of the tax coefficient in Figure 3 so different from the estimated coefficients in Tables 2a and 2b? When we assume the same sized coefficient for firms of all sizes, the key variation in T_{st} comes from the jump in corporate tax rate that occurs around an income level of $100,000, or asset levels of around $5 million dollars given that reported rates of return average close to 2%. As seen in Figure 3, the variation in T_{st} in this range has little impact on the financial policy of affected firms. While Figure 3 shows that financial policy is very sensitive to the much smaller changes in tax rates over time for either small firms or for large firms, these tax changes apparently are too small to play much role in the results in Tables 2a and 2b.

That the minimum coefficient in Figure 3 is for firms with assets of about $5 million dollars where expected taxable income of just about $100,000, is exactly as forecast if measurement error explains the pattern of results. This suggests that the true tax coefficient for intermediate-sized firms should be much larger, and closer to those estimated for small and for large firms.

[35] When the purchase price of the firm exceeds the market value of tangible assets, the difference is generally called goodwill.

[36] The coefficient of the business cycle variable became insignificant, however, when the percent change in GDP rather than the return on the Dow-Jones was used to measure business-cycle effects. This occurred as well in the time-series results, reported below.

Time-series estimates

We turn next to the results using simply the aggregate time series information. We have not used this information so far, due to the inclusion of time dummies in all past results. While any evidence from the time series will be more tentative, given the possible correlation of the tax variable with other time trends that affect financial policy, we still feel it appropriate to report the implications of the time-series evidence, if only to provide comparability to some past studies. Recall that we do have a much broader sample of firms and a longer time series than has been available in such past studies.

The results from estimating equation (3) are reported in Tables 3 and 4. Our main interest is in the coefficient of the tax variable. While the raw correlation between $\tau_t - m_t$ and financial policy 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. Using instrumental variables has little effect on the coefficient. The estimated coefficient is broadly comparable to those reported in Figure 3 for small and large firms.

In all the results so far, we estimated a coefficient for T_{st}, so *assumed* that the effects of corporate and personal tax rates were equal and opposite. We could not test this assumption in the above results, but can easily do so here. Column 4 reports estimates in which τ_t and m_t are entered separately. Here, we find that both coefficients are large and of the forecasted sign.

However, the coefficient on m_t is twice the absolute value of that on $\bar{\tau}_t$.[37] One possible explanation is measurement errors in m_t, due to the use of taxable income rather than assets as weights. 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.[38] The estimated coefficient then needs to be larger to compensate.

To test the role of possible measurement errors in m_t, we reestimated the model restricted to the IMF sample (years 1964 and 1970–93), in order to compare the effects of using taxable income vs. assets as weights in calculating m_t. The results with taxable income as weights are reported in column 5 of Table 3, while those with assets as weights are reported in column 6. When assets are used as weights, the coefficient of m_t is indeed lower, and now is very close to that for $\bar{\tau}_t$. Both remain significantly different from zero.

These results provide clear evidence that personal as well as corporate tax rates matter.[39] The estimated size of the tax effects are closely comparable to those found for small and large firms in the "difference-in-difference" estimates.[40] Based on the coefficient estimate in column (3) of Table 3, we forecast that a drop in the corporate tax rate from .46

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[37] If we ignored pensions when constructing m_t, the results change in only minor ways, with the coefficient of $\bar{\tau}_t$ dropping to .262 and that for m_t changing to -.619. The fact that the coefficient estimate is large and statistically significant is a clear rejection of the hypothesis that $m_t = 0$ due to pensions dominating the market for bonds.

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

[39] For some prior evidence that personal tax rates affect financial policies, see Graham (1999).

[40] Measurement error in τ_{st} may well explain why the results for intermediate firms are so different.

to .34 would lead to firms to reduce the fraction of their assets they finance with debt by 4.3%.

Since time-series estimates cannot normally control for the asset composition of firms, or for changes in the size distribution of firms, we also report results in Table 4 in which no correction is made for these variables (or for size-dependent business-cycle effects) in the definition of the dependent variable. In column 1, we find that the coefficient on T_{st} drops substantially, while in column 2 we find that the omitted variable bias primarily affects the coefficient of $\bar{\tau}_t$, not that of m_t. These results are replicated in columns (3) and (4), but with the dependent variable and the tax variables constructed using a weighted (rather than simple) sum across size categories, weighting by assets in each size category. We find that the choice of weighting has no impact.

The results in Table 4 suggest that past results using time series data may be substantially biased when firm size and asset composition effects are ignored. Without these controls, the coefficient at least on the corporate tax rate is strongly biased downwards, given that larger firms have lower debt/assets ratios for nontax reasons yet face stronger tax incentives to use debt.

We should also 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, and less debt during boom periods when internal finance is easier. Finally, use of debt appears to have increased considerably 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.

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 over time of firms of each size, to see how they respond to changes in tax incentives. 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 corporate tax rates 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 hypothesize that measurement error[41] in the corporate tax rate may well explain the smaller estimated effect of taxes for firms of intermediate size.

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 around an additional 1.8% of corporate assets. (On average during our sample period, 19.4% of assets were financed with debt.) These estimates are high compared with those found in the past literature. Recall that as of 1984, Myers (1984) felt that the past literature provided no evidence of tax effects on financial policy. Since then, Gropp (1997) and Graham (1999), using more detailed cross-section evidence, forecast that the same tax change would lead to around a 0.3% to 0.6% increase in the fraction of assets financed with debt. For the reasons described above, however, we doubt that the variation used in these studies is truly exogenous, given the possible independent effects of tax losses and recent investment rates on corporate financial policy.

We also used aggregate time-series data to estimate the separate effects of personal and corporate tax rates on average debt/assets. The coefficient of the corporate tax rate was very much consistent with those found for small and large firms using the "difference-in-difference" approach, while the coefficient of the personal tax rate (not identified in the "difference-in-difference" specification), was also statistically significant and, as forecast by the theory, of opposite sign and of roughly the same absolute value.

The results also indicate that small firms rely much more heavily on debt finance than large firms, independent of tax policy. It is therefore essential to control for firm size when estimating the effects of taxes — without such controls, tax coefficients are biased downwards since small firms face lower corporate tax rates but use more debt for nontax reasons.

In addition, taxes primarily affect use of short-term debt. In particular, the estimated elasticity of short-term debt to taxes is three times that for long-term debt.

[41] 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 earned 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.

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