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As certain as debt and taxes: Estimating the tax sensitivity of leverage from state tax changes[☆]

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ABSTRACT

Using staggered corporate income tax changes across U.S. states, we show that taxes have a first-order effect on capital structure. Firms increase leverage by around 40 basis points for every percentage-point tax increase. Consistent with dynamic tradeoff theory, the effect is asymmetric: leverage does not respond to tax cuts. This is true even within-firm: tax increases that are later reversed nonetheless lead to permanent leverage increases. The treatment effects are heterogeneous and confirm the tax channel: tax sensitivity is greater among profitable and investment-grade firms which respectively have a greater marginal tax benefit and lower marginal cost of issuing debt.

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1. Introduction

Debt confers a tax benefit on firms when interest payments can be deducted from taxable income. While

this tax advantage of debt has been a cornerstone of corporate finance since at least [Modigliani and Miller \(1963\)](#), its empirical relevance continues to be debated: opinions in the literature range from irrelevance to the belief that taxes are the key driver of debt policy. A related debate concerns whether static or dynamic tradeoff models best describe firms' capital structure choices. Dynamic models combine the familiar static tradeoff between the benefit of tax shields and the cost of default with an explicit contingent-claims model for how the firm's debt is priced.

We contribute to these debates by empirically quantifying the tax sensitivity of firms' debt policies and by evaluating which class of tradeoff model best describes firm behavior. Using a difference-in-differences approach that exploits 121 changes in corporate income tax rates across U.S. states over the period 1989–2011, we find that taxes are an important determinant of capital structure choices. To illustrate, firms increase long-term leverage by

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around 40 basis points for every percentage point increase in the tax rate. For the average tax increase, this corresponds to a debt increase of \$32.5 million from a pre-treatment average of \$570 million. Total assets are unchanged, implying that firms swap debt for equity when tax rates rise. When tax rates fall, on the other hand, firms leave leverage unchanged. This asymmetry favors dynamic tradeoff models.

To understand why, consider first what happens following a tax rise. At the firm's current level of debt, the marginal tax benefit now exceeds the marginal default cost and so shareholders are better off if they increase leverage. Unless there are covenants in place that prevent them from doing so (for example, if the firm is already highly leveraged), shareholders will approve a debt issue. Empirically, this is precisely what happens. How much additional debt they raise depends on the shape of their marginal cost curve. Our estimates suggest that the average firm faces a fairly flat marginal cost curve, with an estimated slope of \$403 in extra cost for every \$1 million in new debt.

When tax rates fall, the marginal cost exceeds the marginal benefit: given the reduced tax benefit that its current debt confers, the firm now has too much default risk, so firm value would be higher if it had less debt. In dynamic models, this will not happen. The reason is twofold: reducing debt would reduce the value of shareholders' option to default; and the value of the debt would rise to the point where the firm's current debtholders captured the entire benefit of the reduction in risk, leaving shareholders with no incentive to reduce leverage.

Our finding that firms respond to tax increases but not to tax cuts is hence consistent with dynamic tradeoff models. It implies a marginal cost-of-debt curve that exhibits a kink at the firm's current debt level. A corollary of asymmetry is that over time, even tax rises that are later reversed should increase leverage permanently: if shareholders fail to reduce debt even when doing so would increase firm value, leverage will ratchet up over time. Our data confirm this. Leverage not only responds asymmetrically to tax changes but also is path-dependent and so exhibits hysteresis.

Empirically identifying the effect of taxes on capital structure is challenging owing to a variety of endogeneity problems. Using variation in state corporate income taxes helps overcome these challenges. Unlike changes in federal tax rates, which occur infrequently and affect all firms at the same time, changes in state tax rates are both numerous and affect only a subset of firms at a time: those doing business in the state concerned. The staggered nature of state tax changes thus provides a set of counterfactuals for how leverage would have evolved in the absence of a tax change and so allows us to disentangle the effect of taxes on leverage from other forces shaping debt policy.

A simple example serves to illustrate the essence of our identification strategy and potential challenges to it. In 1991, North Carolina raised its top corporate income tax rate from 7% to 8.06%. Following this tax rise, firms headquartered in NC increased long-term leverage from 18.8% to 20.8% on average. The tax rise is plausibly exogenous

from the viewpoint of an individual firm in NC: for a start, firms presumably do not lobby for tax increases.¹ But this is not sufficient to establish causality since other coincident developments could be responsible for the leverage increase. For example, investment opportunities in NC may have changed in 1991 in a way that made an increase in debt desirable, regardless of the tax rise.

To control for such contemporaneous developments, we compare leverage changes among North Carolina firms to the contemporaneous changes in leverage among firms located in states without tax changes in 1991, say, in South Carolina. To the extent that SC firms face similar investment opportunities as NC firms, the contemporaneous change in their leverage provides a counterfactual estimate of how NC firms' leverage would have evolved absent the tax increase. The difference-in-differences, i.e., the difference across firms in different states of the within-firm change in leverage, gives the desired estimate of the tax sensitivity of corporate debt policy.

The identifying assumption central to a causal interpretation of our diff-in-diff estimates is that treated and control firms share parallel trends. Our tests show that their pre-treatment trends are indeed indistinguishable. The question, as in any diff-in-diff set-up, is whether post-treatment trends would have continued to be parallel had it not been for the tax change. Our empirical design takes several steps to mitigate the concern that they may not have been.

First, we include industry-year fixed effects. This ensures that we are comparing treated and control firms operating in the same industry, allowing us to difference away unobserved time-varying industry shocks to post-treatment trends in leverage. Second, we condition on changes in standard firm-level covariates of leverage (such as profits or asset tangibility) that could cause trends to diverge post-treatment for reasons unrelated to the tax changes. We find that adding such controls has virtually no effect on the estimated tax sensitivity. This implies that the tax shocks are close to random at the firm level, such that they do not coincide systematically with changes in firm characteristics. Third, we exploit the fact that many firms are treated repeatedly over our long sample period. This allows us to difference away unobserved firm-specific trends in leverage levels.

These design choices deal with firm- and industry-level challenges to the parallel-trends assumption. Two further challenges remain. The first is that state tax changes may be triggered by observed or unobserved factors that in turn cause firms to adjust their leverage for reasons unrelated to the tax change itself. For example, we show that tax rises are more likely when the state runs a budget deficit, and vice versa for tax cuts. This suggests that tax changes are countercyclical at the state level. [Korajczyk and Levy \(2003\)](#) show that leverage also tends to move countercyclically. It is thus possible that local business cycle variation triggers both tax changes and leverage changes.

¹ Unions might conceivably do so, but as we will show, this does not appear to be the case. We will address other potential confounds at length throughout the paper.

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