Taxes Depress Corporate Borrowing: Evidence from Private Firms*

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Abstract

We re-examine the relation between taxes and corporate leverage, using variation in state corporate income tax rates. In contrast with prior research, we document that corporate leverage rises after tax cuts for both privately-held and publicly-listed firms. We use an estimated dynamic equilibrium model to show that tax cuts result in lower default spreads and more distant default thresholds. These effects outweigh the loss of benefits from the interest tax deduction and lead to higher leverage, especially for privately-held firms. Overall, debt tax shields appear to be a secondary capital structure consideration.

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1. Introduction

A fundamental question in financial economics is how corporate taxes affect business borrowing. Despite the extensive literature on the topic since Modigliani and Miller (1963), nearly all empirical evidence is based on samples of large public companies. (Titman and Wessels 1988; Graham 1996; Heider and Ljungqvist 2015; Faccio and Xu 2015). These studies document a positive association between corporate taxes and business leverage, consistent with public firms placing high value on debt interest tax shields. Yet, the majority of economic activity occurs in smaller, bank-dependent, privately-held companies that are significantly less well-capitalized than public firms (Brown et al. 2020). For example, the majority of new job creation occurs in privately-held companies (Smith 2007). Moreover, informational frictions faced by private firms imply that, in contrast to large public firms, they cannot borrow against their future market value. Thus, taxes affect not only the benefits of borrowing, but the costs. In particular, as we show in a structural model, taxes lower lender recovery in default, as well as default thresholds via their effect on firm profitability. Both effects cause firms to decrease leverage. Consequently, the effect of corporate taxes on business borrowing is an open empirical question.

We attempt to fill this void by investigating both privately-held and publicly-listed companies. We study the evolution of corporate borrowing around changes in state corporate income taxes since the 1980s, relying on event study techniques in the spirit of Borusyak and Jaravel (2017). Our results indicate that corporate taxes depress business borrowing and that companies adjust capital structure shortly after the enactment of state corporate income tax changes. These tax changes typically become effective one to two years after enactment, translating into significant firm leverage responses up to two years prior to the effective year. We find that the average private firm increases leverage up to 3% following tax cuts, while public firms exhibit a leverage increase of about 2%. Using a comprehensive sample of corporate borrowing from the syndicated loan market since 1992, we corroborate these findings for the case of tax hikes. These dynamics appear to be driven by tax cuts (hikes) alleviating (tightening) default thresholds and spreads. Overall, debt interest tax shields appear to be a secondary consideration for the relation between corporate taxes and borrowing for both private and public firms.

In addition to the Compustat database, we use two confidential supervisory data sets that provide us with a convenient empirical setting to examine how corporate taxes and borrowing are related. Our primary data set comes from the Federal Reserve's Y-14 Collection and covers privately-held bank-dependent firms in the United States since 2011. These data provide one of the most detailed accounts of private firms' balance sheets that is currently available to researchers. In robustness tests we also rely on the Shared National Credit database that provides comprehensive coverage of both private and public firms reliant on the syndicated loan market, which accounts for the vast majority of corporate commercial borrowing.

We first investigate how tax changes affect privately-held firms, relying on detailed financial statement data for small and mid-sized private borrowers from 2011 through 2017. We focus on state corporate income tax cuts as there are only seven corporate income tax hikes during this time period, as compared to 62 tax cuts, so state tax increases affect too small a sample of firms for us to obtain reliable inferences. We show that corporate tax cuts are associated with significant increases in the leverage ratios of small private firms. For example, firms' outstanding debt increases by approximately 3% two years prior to the effective year of the tax cut and remains significantly elevated at between 1.3% and 2.0% up to three years after the effective year. While at a first glance the response of firms well before the effective year of tax changes may be indicative of anticipation effects and pre-trends, we show that these responses correspond to the enactment date of the tax changes, which typically precede the effective dates by one to two years. Conducting the same event study using the enactment date instead of the effective date of tax cuts indicates that firms first respond to the tax cuts in the enactment year and do not exhibit any anticipation effects in the years leading up to the tax change enactments.

We also show that the large increase in leverage ratios of small private firms is primarily driven by changes in long-term debt. Finally, our results show that large private firms also have leverage-increasing responses to corporate tax cuts, but that they are faster to respond than small private firms. For example, the bulk of the leverage response of large private firms is concentrated within a year of tax change enactment. In contrast, while small private firms also exhibit large leverage responses in the tax enactment year, the leverage effects appear to be longer-lived and persist for four or more years following tax cut enactment.

To provide economic intuition for these somewhat unusual results, we use our data to estimate a dynamic model of leverage and investment. In the model, firms receive an interest tax deduction. However, because their debt is not fully collateralized, they can default. Taxes make optimal debt lower by lowering a default threshold and by decreasing lender recovery in default. Ex ante, it is not clear which of these effects is quantitatively more important, but our estimation results indicate that the negative effects of taxes on leverage are an order of magnitude more important than the positive effects, but only in those states of the world in which debt is risky. Otherwise, the tax advantage is more important, although the effects are small, as in Li et al. (2016).

Consistent with this idea, we also document that net capital expenditures of small private firms increase significantly by approximately 2% within two years of tax cuts, lending further support for the idea that tax cuts spur productivity, making firms more profitable and less likely to default. In contrast, large private firms do not exhibit changes in investment. Finally, we show that pre-tax earnings increase (weakly) for both small and large private firms, showing that even large firms experience a modest increase in investment opportunities following tax cuts.

We next examine how tax cuts affect leverage ratios of larger, public firms using Compustat data that provides financial statement information on public companies in the United States. We show that the large public firms in this sample respond to tax cuts very similarly to the private firms in our earlier results. Specifically, public firms increase total debt by between 1.9% and 2.5% around tax cuts. Once again, these dynamics are driven by long-term debt and firms exhibit a large response in leverage ratios starting in the tax cut enactment year. These results show that even among large public companies, taxes and corporate leverage are negatively related. Unlike private firms, however, we do not find significant changes in investment or pre-tax income among public firms.

Our empirical setting is similar to Heider and Ljungqvist (2015), who also study the leverage responses of public firms to state tax changes, showing that corporate leverage increases within a year of state corporate income tax hikes becoming effective. Similar to Heider and Ljungqvist (2015), we also find that borrowing increases by approximately 2% within a year of tax hikes becoming effective. We extend their study by showing that this increase in corporate borrowing is preceded by large drops in corporate borrowing that begin at tax hike enactment. These leverage reductions occur likely occur because the tax changes are capitalized into default spreads, while leaving the current value of debt interest tax shields unchanged. Following the effective date of tax hikes, the value of debt interest tax shields is higher, leading to increases in leverage as documented by Heider and Ljungqvist (2015). This evidence suggests that while debt interest tax shields are an important consideration for capital structure decisions of public firms, default thresholds and spreads are also a highly relevant factor for shaping the relation between taxes and leverage among these firms.

The negative relation between taxes and corporate borrowing stands in stark contrast with the empirical relations documented in the prior literature (Graham 1996; Givoly et al. 1992; Titman and Wessels 1988; Gordon and Lee 2001; Faccio and Xu 2015; Fleckenstein et al. 2019). This difference comes in part from prior work focusing on samples of large, publicly-traded companies, which are much safer than our sample of private firms and for which debt interest tax shields may represent a first-order capital structure consideration. In comparison, the vast majority of firms in our samples are privately-held, for which the costs of debt are likely to be the main driving force of financing policy. Additionally, our tests consider the phenomenon that state tax policy typically becomes effective up to two years after enactment, and we examine firms' leverage responses in the interim. Consequently, our paper also contributes to this literature in that we examine firms' dynamic response to corporate income tax changes.

2. Data

2.1 Data on Corporate Borrowing

Our data on firm-level income statement and balance sheet information comes from Schedule H.1 of the Federal Reserve's Y-14Q data collection. The collection began in June of 2012 to support the Federal Reserve's stress tests and contains granular information on the loan portfolio of the 33 largest banks in the United States.[1] Specifically, banks provide loan-level data on their corporate loan portfolio whenever a loan exceeds $1 million in commitment amount together with the most recent financial statement information of the associated borrower, if available. These data are quarterly and the sample period runs from the third quarter of 2011 to present. Borrower financials are typically annual and provided to satisfy loan collateral and covenant requirements.[2] Given that only a minor fraction of firms report financials quarterly, we keep the financial statement information with a reporting date closest to the end of each calendar year, typically the financials from Q4 for the trailing twelve months. Finally, we restrict the sample to domestic private borrowers, excluding government entities, individual borrowers, utilities (two-digit NAICS code of "22"), financials (two-digit NAICS code of "52"), public administration entities (two-digit

[1] The panel has grown over time and included 37 institutions until 2018Q1. Regulatory changes increased the reporting threshold from $50 to $100 billion as of 2018Q2, thereby leading to the exclusion of four institutions with total assets below $100 billion. Loans in the Y-14 Collection account for approximately three-quarters of total U.S. commercial and industrial lending.

[2] The smallest companies in the Y-14 collection do not have financial statement data, likely because it is too costly for the smallest companies to prepare financials, so they submit tax returns to lenders that we do not observe.

NAICS code of "92"), and nonprofit organizations. We exclude public firms as we study those separately with Compustat data. See Appendix A in Brown et al. (2020) for a more detailed description of the data cleaning.

Even though we do not observe firm tax filing status, the small size of the companies in the Y-14 data suggests that a significant portion of firms are subject to individual taxation of pass-through income. For example, half of the firm-years with financial statements in Y-14 have less than $18 million in total assets and three quarters of firms have less than $70 million in total assets. Considering our focus on corporate income taxes, we remove pass-through entities such as sole proprietorships, partnerships, and S-corporations using the following restrictions. We exclude borrowing entities where the entity is classified as "Individual" or the guarantor of the debt is classified as "Individual". We further exclude companies that have less than $100 million in book total assets as of the previous year. We impose this restriction because larger companies are significantly more likely to benefit from choosing corporate taxation and organize as C-corporations.[3] This is also unlikely to affect the applicability of our results as the Joint Committee on Taxation reports that virtually all assets of C-corporations belong to those with total assets exceeding $100 million.[4]

For the purposes of our empirical tests we require the availability of the book value total assets, net income, net sales, ebitda, total liabilities, long-term debt, and total debt. We also require that the beginning period book value of total assets is available, which we use to scale all financial variables. The resulting sample has 33,488 firm-year non-singleton firm-year observations during the 2011-2017 time period. We winsorize credit commitments and all financial statement variables at the 1^{st} and 99^{th} percentiles to mitigate the effect of outliers. Variable definitions are in the Appendix.

We also study the effect of corporate taxes on borrowing using the Shared National

[3]For instance, the major tax benefits of organizing as a C-corporation include no restriction on the number of shareholders or types of ownership, retaining earnings for future expansion at a lower tax cost, and wider range of deductions than those available to pass-through entities. Despite the lower tax burden of pass-through entities relative to C-corporations when reporting labor income as profits, Smith et al. (2019) shows that these incentives disappear for large firms (those with more $100 million in sales).

[4]See, Table 3 in `https://www.jct.gov/publications.html?func=startdown&id=4765`.

Credit Data that spans 1992 through the present. The SNC Program covers all syndicated deals exceeding $20 million and held by three or more unaffiliated institutions supervised by the Federal Reserve System (FRS), Federal Deposit Insurance Corporation (FDIC), and the Office of the Comptroller of the Currency (OCC).[5] Deals participated by supervised institutions and meeting the above inclusion criteria account for nearly the entire syndicated loan market in the United States in terms of loan amounts. Given that we study the effect of taxes on firm borrowing, we aggregate loan commitment amounts to the borrower-level. While loan-level analysis is feasible, borrower-level analysis is more appropriate as lenders often renegotiate all loans to a given borrower during the renegotiation process. Total firm commitments therefore represent the combined amount of credit line sizes and term loan commitments. We restrict this sample to domestic firms and exclude government entities, utilities (two-digit NAICS code of "22"), financials (two-digit NAICS code of "52"), public administration entities (two-digit NAICS code of "92"), and firms that have defaulted on their debt and are either in non-accrual status or have "troubled-debt" restructurings.

Finally, our sample of public firms comes from the CRSP-Compustat Fundamentals Annual database. We limit the sample period to 2011 through 2017 because WRDS provides historical information on firms' location only starting in 2007 and because we need at least four years of past location data to identify the effect of past changes in corporate tax rates on corporate leverage. Similar to the private firms samples, we exclude utilities (2-digit SIC code of "49" or two-digit NAICS code of "22"), financials (1-digit SIC code of "6" or two-digit NAICS code of "52"), public administration entities (1-digit SIC code of "9" or two-digit NAICS code of "92"), foreign firms (where the firm's historical headquarters or incorporation location is outside of the US), firms with negative or missing total assets, and firms with missing pre-tax earnings.

[5] The SNC inclusion criteria also covered deals with two supervised unaffiliated lenders prior to 1999. Excluding these deals does not significantly affect our results. For more detail on the SNC rule change see Ivanov et al. (2019).

2.2 State Taxation and Economic Data

We use the data sets provided on Owen Zidar's website[6] on the top statutory state corporate income tax rates since 1987 to identify the effective dates of changes in state corporate taxes. For each of these tax changes we then collect the corresponding enactment date — or the date the tax change becomes law. We gather all enactment dates since 2012 from the legislature website of each state or the Tax Foundation website. We collect data on all enactment dates prior to 2012 from amendments to the states' tax statutes.[7] Specifically, we obtain electronic copies/scans of the tax statutes from each state's legislature/legal library. We read through the statutes to identify the relevant corporate income tax rate changes and record the respective enactment dates, typically the date the state's governor signs the legislation. We identify the tax enactments corresponding to 99 state corporate income tax changes in this manner.[8] For 6 of the tax changes, the state librarians directed us to online legislative archives, and we found and downloaded the relevant bills or statute texts ourselves. In 2 cases where the enactment or effective dates were unclear from the tax statute text, we found information from state legislature websites or online legal resources.

Following Suárez Serrato and Zidar (2018), we control for the structure of the corporate tax base using the fifteen measures listed below: an indicator of having throwback rules, an indicator of having combined reporting rules, investment tax credit rates, research and development (R&D) tax credit rates, an indicator for whether the R&D tax credit applies to an incremental base that is a moving average of past expenditures, an indicator for whether the R&D tax credit applies to an incremental base that is fixed on a level of past expenditures, the number of years for loss carryback, number of years for loss carryforward, an indicator for franchise taxes, an indicator for federal income tax deductibility, an indica-

[6]See `https://scholar.princeton.edu/zidar/publications/structure-state-corporate-taxation-and-its-impact-state-tax-revenues-and-economic`.

[7]We are grateful to Marc Lovell from the Legal Library at the Federal Reserve Board for preparing a database of legislature/legal library contact information for each state in our sample.

[8]In 11 cases where state librarians could not immediately locate the relevant tax legislation, we consulted a legal librarian from the Federal Reserve Board for legislative histories from LexisNexis to provide the state librarian with the statute or bill number.

tor for federal income tax base as the state tax base, an indicator for federal accelerated depreciation, an indicator for accelerated cost recovery system (MACRS) depreciation, an indicator for federal bonus depreciation, and corporate tax apportionment weights. We extend the fifteen tax base measures through 2017 by collecting information from the CCH tax handbooks and the websites of state governments. Additionally, we collect state corporate income tax rates since 2010 from the Tax Foundation website and obtain top statutory state individual income tax rates from Tax Foundation website since 2000. Finally, we obtain annual data on gross state product (GSP) and the unemployment rate for each state from the U.S. Bureau of Economic Analysis.

2.3 Descriptive Statistics

We describe the sample of private firm-years for which we have available financial statement information from 2012 through 2017 in Panel A of of Table 1. We do not include post-2017 firm financials data as to be able to identify the timing of firms' (early) responses to tax changes that become effective or enacted in 2018 and 2019. The typical company has $256 million in book assets, while a quarter of companies has between $100 and $151 million in book assets. In addition, sample firms are significantly more levered than the typical public firm with total debt-to-assets of approximately 35% and total liabilities-to-assets of 65%. Sample firms are also significantly more profitable and hold substantially less cash than their public counterparts (see, e.g. Kahle and Stulz 2017). Overall, the sample presented here provides a comprehensive account of small bank-dependent private firms.

Panel B of Table 1 describes the sample of firm-years reliant on syndicated loan financing from 1992 through 2013. As in the case of Panel A, we do not include post-2013 data as we are interested in examining the dynamics in corporate borrowing for up to 5 years prior to a tax event. The majority of the firms in the sample are private companies that are unlikely to have access to public debt and equity markets and consequently obtain most of their external financing through bank borrowing. Thus, our sample is better suited for a comprehensive examination of the relation between taxes and corporate borrowing. The typical (median) firm reliant on syndicated financing has approximately $143 million dollars in loan commitments, while a quarter of the sample has less than $65 million in commitments. Additionally, the median utilized amount, which is defined as the sum of credit line drawndowns and term loans, is approximately $50 million, while the average utilization ratio under all credit commitments is about 50%. This suggests that sample firms have significant amount of slack under their credit lines.

Panel C summarizes the state corporate income tax hikes and tax cuts that become effective between 1987 and 2019. State legislatures often introduce new tax packages in a staggered fashion. For example, the state of Indiana approved a tax package in 2011 that lowered corporate income taxes from 8.5% to 6.25% between 2013 and 2017 (a 0.5% reduction in years 2013, 2014, 2015, 2016 and a 0.25% reduction in 2017).[9] In this example, the Indiana tax package enters our estimation sample only once with 2013 as the tax cut effective year. We have a total of 36 tax hikes and 121 tax cuts. Tax hikes increase corporate income taxes by an average of 1.31%, while tax cuts reduce taxes by about 0.59%. Prior to the effective date of tax changes, state corporate income tax rates are lower in states with subsequent tax hikes than in states with tax cuts. For example, initial corporate income tax rates average 6.59% in tax hike states and 7.59% in tax cut states. The tax changes reverse this pattern, resulting in higher state corporate income taxes in states with tax hikes.

3. Empirical Approach

We use an event study methodology around corporate tax increases and corporate tax cuts:

$$y_{it} = \bar{\alpha_i} + \bar{\beta_{mt}} + \sum_{k=-5}^{k\geq+5} \bar{\lambda_k} \mathbf{1}\{K_{it} = k\} + \boldsymbol{\delta X} + \epsilon_{it} \tag{1}$$

[9] See `https://taxfoundation.org/indiana-approves-tax-changes-including-corporate-tax-rate-reduction`.

where i, m, t, and k denote firms, industries, years, and years relative to the event of interest, respectively. Specifically, $k < 0$ correspond to pre-trends and $k \geq 0$ correspond to dynamic effects relative to the event. Additionally, $t \geq +5$ represents five or more years after the event of interest. y_{it} represents the outcome of interest, such as the natural log of the firm's total loan commitments, $\bar{\alpha_i}$ + $\bar{\beta_{mt}}$ are firm and industry-year fixed effects, and X is a vector of state tax base rule and credits measures described in Section 2. Given the inclusion of firm fixed effects, $\bar{\alpha_i}$, the event study estimates represent deviations from the average level of the outcome of interest for a given firm.

In specifications relying on the small firm balance sheet data or public firm balance sheet data since 2011 we define the omitted category as years $t \leq -3$ relative to tax cut implementation due to the short time series of that sample. We do not choose the omitted categories to be in the two years prior to the tax changes becoming effective because state corporate tax changes are typically enacted one to two years prior to becoming effective. For example, out of the 88 enactments of tax legislation packages between 1987 and 2019, 38 become effective immediately or retroactively, 38 become effective in the next year and 12 become effective in more than one year. However, although a number of the tax legislation packages are effective immediately, they gradually increase/decrease rates for up to 4–5 years in the future. In these cases, our event studies based on tax effective dates estimate firm leverage responses relative to the first instance of a tax change becoming effective. The event studies based on tax enactments simply estimate leverage responses around the enactment dates of tax legislation packages.

In robustness specifications relying on corporate borrowing data from the syndicated loan market since 1992, in the spirit of Borusyak and Jaravel (2017), we choose the two omitted categories to be apart at years $t = -3$ and $t \leq -6$ relative to the tax change so that we are better able to detect non-linear pre-trends. In other words, the event study estimates in the two years leading up to tax change implementation represent tests of whether firms respond to tax changes immediately upon announcement of changes in tax policy.

Despite the lower efficiency of the estimator in Equation 1 (see Borusyak and Jaravel 2017), Equation 1 is still preferable to a canonical difference-in-differences specification, such as:

$$y_{it} = \bar{\alpha}_i + \bar{\beta}_t + \lambda D_{it} + \boldsymbol{\delta X} + \epsilon_{it} \quad (2)$$

Specifically, Equation 2 is only valid under the restrictive assumption that $\bar{\lambda}_k$'s in Equation 1 are all equal for $k > 0$. This means that the treatment leads to an immediate and permanent jump in the outcome variable and no further effects. If this assumption is violated, λ will be biased and difficult to interpret given λ is the weighted average of $\bar{\lambda}_k$'s in Equation 1 and not all the weights need to be positive (see Goodman-Bacon 2019). As Borusyak and Jaravel (2017) point out the bias in λ stems from using post-treatment periods to provide counterfactuals for earlier periods. Additionally, Equation 2 assumes the absence of pre-trends prior to the implementation of tax changes. This assumption may also be violated in our setting because state corporate income tax changes are typically announced one to two years prior to implementation.

4. Results

4.1 Private Firm Evidence

We first test how corporate leverage is related to state corporate income tax cuts, utilizing the sample of private firms since 2011 and data on state corporate income tax cuts since 2007. We do not conduct a similar analysis around corporate income tax hikes because there are only seven corporate income tax hikes during this time period, while there are 62 tax cuts. Additionally, five out of the seven tax hikes occur prior to the start of our sample period: Maryland in 2007, Michigan in 2007, Oregon in 2010, Illinois in 2011, and Michigan in 2011. Moreover, these tax changes affect only a small minority of firms in our sample. Given these limitations, we are unable to conduct reliable estimation of corporate leverage responses around state corporate income tax hikes.

The consensus view in the prior literature is that the main mechanism through which taxes affect borrowing is debt interest tax shields. Specifically, higher taxes increase the value of debt interest tax shields, thereby leading to greater incentives to borrow. However, higher taxes also decrease firms' after-tax cash flow, thereby making firms more likely to default on risky debt and reducing lender recovery rates given default. This is especially the case for small private companies that do not have access to external capital markets other than bank credit that is typically contingent on maintaining high cash flow (Sufi 2009). In other words, in addition to reducing the value of debt interest tax shields, tax cuts are also likely to increase firms' distance to default thresholds and increase their borrowing capacity. Conversely, corporate tax increases enhance the value of debt interest tax shields but also decrease firms' distance to default thresholds. Therefore, the relation between taxes and corporate borrowing is an empirical question.

Table 2 presents how tax cuts are related to firm balance sheet outcomes in event time. We define the base category in the event studies as years $t < -2$ relative to the tax cut effective year. We focus on three main outcomes: total debt, long-term debt, and total liabilities. Given that smaller private companies may be more financially constrained and exhibit differential responses to corporate tax changes, we also split the sample at the median value of lagged total assets ($256 million), so "small" firms are defined as those with below-median total assets and "large" firms are those with prior year assets exceeding that value.[10] Our results indicate that total debt, long-term debt, and total liabilities all increase for small private firms around corporate income tax cuts. The change first occurs two years prior to tax cuts becoming effective (at tax cut enactment), although the effects are initially not statistically significant. The effects persist for up to three years after tax cuts become effective, especially for the sample of small firms, where we see significant increases in event year $t + 2$ in the case of long-term debt. For the sample of small firms, total liabilities

[10]Our results are similar when we choose alternative cutoffs such as $300 million in prior year total assets or the 75^{th} percentile of prior year total assets.

increase in a very similar manner, indicating the change in total leverage is almost entirely driven by the dynamics in long-term debt. In contrast, large private firms do not appear to respond as strongly to tax cuts, with these effects being overall smaller and significant only in the enactment year.

One issue with our sample of mostly small private firms is that many are insufficiently profitable to owe taxes either in the current year or in many years into the future. Thus, it is not surprising that the tax effects we find are small and mostly insignificant. To investigate this issue, we replicate Table 2 excluding companies with bank internal ratings of "B" and lower. Consistent with the idea that financially distressed firms may not be affected by tax changes, in Table 3 we show that the response of small firms is even stronger when excluding financially distressed firms. For example, total debt once again increases two years prior to tax cuts becoming effective and is persistently 2–3% higher up to three years after tax cuts become effective. In comparison, the leverage response of large firms continues to be insignificant. In light of these results, for the remainder of the analysis, we focus on higher credit quality firms for which taxes are likely to affect borrowing capacity meaningfully.

Our next set of tests aims to shed light on whether firms' responses up to two years prior to the effective year of tax cuts is driven by pre-trends/anticipation effects or by firms responding to tax cuts upon the enactment of the tax changes. To do so in Table 4 we re-estimate our event study around the enactment of tax cuts. We show that firm leverage now increases in the enactment year as well as in some of the subsequent years, indicating that the leverage responses of firms up to two year prior to tax cuts effective dates is driven by firms reacting promptly to the enactment of tax legislation. We do not detect any significant pre-trends or anticipation effects for both small and large private firms. A notable difference from Tables 2 and 3 is that large private firms also exhibit positive leverage responses to tax cuts which is concentrated within a year of tax cut enactments. This difference is a byproduct of the significant gap between effective and enactment dates of tax changes. In contrast, leverage ratios (in terms of both total and long-term debt) of small firms continue to exhibit significant responses to tax cuts for up to four years following tax enactment.

One potential concern with our tests is that changes in state individual income taxes may spuriously drive corporate outcomes. For example, the documented leverage effects could be attributed to changes in consumer spending triggered by changes in personal taxation. Prior literature has demonstrated that reductions in state personal income taxes increase personal wages and employment, thereby leading to higher personal disposable income (Zidar 2019). Therefore, individual income tax cuts are likely to lead to higher consumer spending and consequently to higher firm investment opportunities and borrowing. Conversely, individual income tax hikes will lead to reductions in firm investment opportunities and lower leverage ratios.

To test whether changes in state personal income taxes affect the relation between corporate taxes and leverage, we replicate our specifications in Table 2 where we also include event study indicators associated with state individual income tax cuts and tax hikes. Specifically, we include the same set of event indicators, from $t = -2$ through $t \geq 4+$, as in the case of corporate income tax changes. Table 5 shows that the dynamics for total debt we have documented earlier do not change in a meaningful way after accounting for changes in individual income taxes. For example, the long-term debt, total debt, and total liabilities of small firms exhibit the dynamics nearly identical to those documented earlier. Given this evidence, it is unlikely that changes in individual income taxes drive our observed leverage effects. Finally, the stability of our results after flexibly controlling for individual income tax changes further alleviates concerns that some of the firms in our sample may be pass-through entities subject to individual income taxes.

Overall, we document that taxes are negatively related to corporate borrowing. These results stand in stark contrast with the empirical relations documented in the prior literature. For example, Titman and Wessels (1988), Heider and Ljungqvist (2015), and Faccio and Xu (2015), all document that taxes are positively related to corporate leverage. A notable difference between these studies and ours is that we rely on samples of smaller privately-held firms that are more likely to be financially constrained than public firms.[11] Specifically, prior work has focused primarily on samples of publicly-traded companies, likely with lower growth opportunities for which debt interest tax shields may well be the primary consideration for capital structure decisions. Additionally, in contrast with prior studies, our sample does not include firms with access to public bond and equity markets, making our sample a convenient empirical laboratory for studying the effect of taxes on corporate borrowing.

Nonetheless, to understand whether the difference between our results and prior work is attributable to differences between public and private firms, we next examine how tax cuts affect the leverage ratios of larger, public firms, which should be arguably less financially constrained. For this analysis, we use data from Compustat. Table 6 shows the evolution of three measures of corporate leverage around state corporate income tax cuts: the book values of total debt-to-total assets and long-term debt-to-total assets, as well as the market value of long-term debt-to-total assets. Columns (1)–(3) of Table 6 present event study results around the effective dates of tax cuts, while columns (4)–(6) show event study results around tax cut enactments. Columns (1)–(3) show that the leverage responses of Compustat firms are broadly similar to those documented in Section 4.1. The leverage of public firms increases significantly two years prior to tax cuts becoming effective. Although these results are statistically noisier than those from our sample of private firms, they are consistent across different measures of leverage. Leverage increases lie between 1.9 and 2.5 percentage points, which are economically large magnitudes. Further, these effects persist up to a year after the tax cuts become effective and fade to zero thereafter. Overall, the difference between our study and prior work is likely a byproduct of exploration of the

[11] For example, Hadlock and Pierce (2010) show firm size is one of the most informative predictors of financial constraints. This notion is corroborated by Erel et al. (2015), who show that small privately-held firms in their sample appear to face financial constraints, while large private firms do not.

dynamics of corporate tax rate changes. We further reconcile our results with prior work in Section 4.3.

4.2 Real Effects of Tax Cuts

While our results so far establish a robust negative relation between tax shocks and firms' equilibrium credit outcomes, it is also important to understand whether the changes in borrowing affect firms' real outcomes such as investment and profitability. Tax cuts may ultimately lead to higher investment and profitability to the extent that increasing the distance to default thresholds allows firms to undertake investment opportunities they were unable to pursue previously.

We test whether the asset growth effects are accompanied by increases in firm profitability as higher investment opportunities are also likely to be reflected in firms' profitability. The results in columns (1)–(3) of Table 7 confirm this notion, as we observe EBITDA increases for small firms following the enactment of corporate tax cuts, while larger companies do not experience significant changes in profitability following tax cut enactments.

Our data also provide information on net capital expenditures, or the difference between capital spending and proceeds from divestitures/assets sales, of each company. Because of the existence of time-to-build lags and because investment is lumpy (Doms and Dunne 1998; Whited 2006), the effect on assets may not be immediate and may materialize with significant delay following the implementation of tax cuts. Consistent with this idea Table 7 shows that net capital expenditures of small private firms increase by approximately 1% within two years of tax cut enactment (column 5). In contrast, the effects for large private companies are small and statistically insignificant (column 6). As a result, net investment also increases in the full sample by about 1% (column 4). This result is particularly interesting, as it suggests a separate channel for our results. Firms invest following tax cuts and borrow immediately to fund these outlays. However, because of time-to-build, these outlays materialize more slowly, so we see an initial rise in leverage. Overall, our results suggest that tax cuts have a significant impact on firms' investment opportunities as we document meaningful changes in firm investment and profitability.

4.3 Longer-Time Series Evidence from Corporate Borrowing Data

Next, we test how corporate credit is related to state corporate income tax changes, utilizing the sample of firms reliant on the syndicated loan market. We measure total firm commitments using the total syndicated commitments in a given firm-year. Total firm commitments are the combined amount of credit line sizes and term loan amounts. One advantage of using total commitments as opposed to the drawn (funded) portion of commitments is that we are able to better measure firms' demand for credit. For example, firms may increase their credit line commitments to fund investment projects either inter-year or in future years as in Martin and Santomero (1997), but these actions may not necessarily be reflected in year-end leverage if firms are simultaneously repaying credit lines. Finally, as described in Section 3 our specifications include firm fixed effects, so the event-study estimates should be interpreted as annual deviations from the average level of total credit commitments for a given firm.

Figure 1 presents how firm commitments are related to state corporate income tax cuts and corporate income tax hikes in event time. Specifically, the figure plots event study estimates from a Log(Commitments) regression on event time indicators. In addition, in some specifications we include time-varying borrower controls, as well as state economy and tax base controls. Panel A shows that state tax hikes have a large negative effect on the total commitments of the average firm. These negative effects first appear two years prior to tax hikes becoming effective, indicating that the average firm reduces credit commitments by about 5% immediately upon the announcement of state corporate income tax hikes. The decline in corporate borrowing intensifies to up to 7% after tax-hike implementation and persists until for three more years. Given total commitments are typically twice as large as funded debt, these effects correspond to a between 2.5 and 3.5 percentage points increase in leverage. Importantly, these effects are not permanent and fade to zero thereafter.

Panel A of Figure 1 also indicates that total firm commitments increase around corporate tax cuts but that the magnitude of such increases is substantially smaller than in the case of tax hikes. Specifically, the average firm increases borrowing by about 2% as tax cuts become effective. However, these results are not statistically significant. The significantly larger tax hike effects are likely to be a byproduct of tax hikes changing state corporate income taxes by a greater percent than tax cuts (see the statistics in Panel C of Table 1). Panel B of Figure 1 augments the analysis in Panel A by including time-varying firm, state economy, and state tax base controls, painting a very similar picture to the results in Panel A.

In Panels C and D Figure 1, we replicate the first two panels for the subsample of low-risk firms—those that are assigned a Shared National Credit (SNC) rating of "Pass" as of the previous year. Low credit quality firms are likely to face high costs of additional leverage and may exhibit muted response to tax changes as the reduction/increase in the distance to default thresholds may not be sufficient to lead to additional/less borrowing. In line with this intuition, we find that high credit quality firms exhibit a larger increase in borrowing of approximately 4–5% following tax cuts and that this effect is statistically significant in some specifications. Additionally, the effect of tax hikes on corporate borrowing is overall very similar for the subsample of high-credit quality firm.

These results also help reconcile our findings with Heider and Ljungqvist (2015) that also studies the leverage responses of public firms to state corporate income tax changes but finds that leverage ratios increase following tax increases. Our results complement theirs by showing that the increase in corporate leverage after the effective date of state corporate income tax hikes is preceded by large leverage reductions. These leverage reductions are driven by tax hikes reducing firms' expected future income, thereby increasing distance to default thresholds, while leaving the current value of debt interest tax shields unchanged. Following the effective date of tax hikes, the value of debt interest tax shields is higher, leading to increases in leverage as documented by Heider and Ljungqvist (2015). This suggests that while debt interest tax shields may be an important consideration for capital structure decisions of public firms, default thresholds are also a highly relevant factor for shaping the relation between taxes and leverage among these firms.

5. Model

While we have hinted at theoretical explanations for our results, we have not yet supplied a cohesive framework to understand the underlying economics behind the empirical patterns in our data. We now turn to this task. We use the environment of an equilibrium economy with a representative consumer and a unit continuum of firms. The economy also contains a government and a financial intermediary, but these players simply act as pass-through agents for the firms and consumer.

Each of the infinitely-lived firms uses capital and labor in a stochastic, decreasing returns technology to generate output, y, according to

$$y = z^{\nu} \left(k^{\alpha} n^{1-\alpha}\right)^{\theta}, \tag{3}$$

where k is the stock of capital, n is labor, z is a productivity shock, α is capital's share, θ governs the degree of returns to scale, and where we normalize the parameter ν to be $1-(1-\alpha)\theta$. In addition to this basic technology, we assume that the firm has a fixed component of operating costs, which we denote as f. The productivity shock, z, is lognormally distributed and follows a process given by:

$$\ln(z') = \rho \ln(z) + \sigma_z \varepsilon', \qquad \varepsilon' \sim \mathcal{N}(0,1), \tag{4}$$

where a prime indicates the subsequent period, and no prime indicates the current period.

Investment in capital, I, is defined by a standard capital stock accounting identity:

$$k' \equiv (1-\delta)k + I, \tag{5}$$

in which δ is the rate of capital depreciation. The price of the capital good has been normalized to one. Adjusting the capital stock incurs quadratic costs that take the form:

$$\psi(k, k') = \frac{\psi(k' - (1-\delta)k)^2}{2k} \tag{6}$$

where ψ is a parameter that governs the magnitude of adjustment costs.

Taxation in our model is simple, as there is only corporate taxation at a stochastic rate τ, which follows an autoregressive process given by

$$\tau' = \rho_\tau \tau + \sigma_\tau u', \qquad u' \sim \mathcal{N}(0,1). \tag{7}$$

This tax rate applies to profits and to financing activities, as described next.

The firm can finance its optimal investment program with retained earnings or external debt. We let p denote the stock of net debt, so $p > 0$ indicates that the firm has debt on the balance sheet, and $p < 0$ indicates that the firm has cash on the balance sheet. We assume that debt is raised through a zero-profit intermediary, which in turn raises the necessary funds from the representative consumer. Debt takes the form of a one-period discount bond, on which the firm can default. Let the interest rate on debt be $\tilde{r}(k', p', z)$, so debt proceeds are $p'/(1 + r(k', n', b', z, \tau)(1-\tau))$.[12] As we outline below, this interest rate is determined endogenously from the lender's zero-profit condition and is therefore a function of the model's state variables. If instead the firm opts to save, it earns the after-tax risk-free rate, r, with the interest taxed at a rate τ. Thus, the interest rate on debt can be expressed as:

$$r(k', b', z, \tau) = \begin{cases} \tilde{r}(k', b', z, \tau) & \text{if} \quad p > 0 \\ r & \text{if} \quad p \leq 0 \end{cases} \tag{8}$$

Cash flows to shareholders, $e(k, p, n, k', p', z, \tau)$, are then the firm's after-tax operating income plus net debt issuance, minus net expenditure on investment, and minus tax-

[12]Note that this formulation assumes that the firm takes the tax advantage in the period in which it issues the debt. While not in accord with real-world debt contracts, this assumption reduces the state space and simplifies the default condition (Strebulaev and Whited 2012).

deductible interest payments on debt, as follows:

$$
\begin{aligned}
e(k,p,n,k',p',z,\tau) &= (1-\tau)\left(z^{\nu}\left(k^{\alpha}n^{1-\alpha}\right)^{\theta} - wn - f\right) \\
&- (k'-(1-\delta)k) - \psi(k,k') + \frac{p'}{1+r(k',n',b',z,\tau)(1-\tau)} - p,
\end{aligned}
\tag{9}
$$

where w is the wage rate, which is determined in equilibrium.

While a positive firm cash flow is distributed to its stockholders, we assume that negative cash flows are not allowed, that is:

$$
e(k,p,n,k',p',z,\tau) \geq 0. \tag{10}
$$

This assumption is tantamount to eliminating external equity finance. Because much of our sample constitutes private firms, who have no access to public equity markets, this assumption is innocuous.[13]

The Bellman equation for the problem can then be expressed as:

$$
\pi(k,p,z,\tau) = \max_{k',n,p'} \left\{ e(k,p,n,k',p',z,\tau) + \frac{1}{1+r}\mathbb{E}\pi\left(k',p',z',\tau'\right) \right\}, \tag{11}
$$

subject to (5) and (10).

5.1 Loan contract

We assume that a perfectly competitive financial intermediary offers the firm a one-period loan contract, which need not be fully collateralized. As such, the firm can default. In contrast to the models in Hennessy and Whited (2007) or Gao et al. (2020), we do not assume that lenders can extend credit as long as the firm has positive present value. Instead, we follow Gilchrist et al. (2013) and Michaels et al. (2019), and assume that the firm defaults if it does not have sufficient resources on hand to repay its debt, that is, its future market value is not collateralizable. This assumption is particularly apt for our sample of smaller private firms.

[13] In addition, we will eventually show in an appendix that allowing for costly equity issuance has little effect on our quantitative results. (To be added . . ..)

Specifically, default is triggered when debt repayment exceeds the firm's current after-tax profit plus the fraction, ξ of its capital that can be recovered in default:

$$(1-\tau)\left(z^{\nu}\left(k^{\alpha}n^{1-\alpha}\right)^{\theta}-wn-f\right)+\xi(1-\delta)k<p \tag{12}$$

Note that we subtract the wage bill from output in (12) because labor is paid in full, even if the firm subsequently defaults. Note also that taxes get paid before the the lender can recover any payments. Both of these timing conventions are in accordance with absolute priority rules. Finally, note that because the tax deduction is taken when the firm issues debt, it is absent from this condition. For fixed levels of (k,n,p), (12) defines a region over the joint domain of (z,τ) in which default occurs. We denote this region Ω.

Given this default threshold, the contractual interest rate, $\tilde{r}(k',b',z,\tau)$, is determined by a zero-profit condition that must hold under free entry in the intermediation sector. The payoff to the lender outside of default is simply this contractual interest rate. Inside default, the lender recovers an amount equal to the left side of (12). Thus, under free entry and risk-neutrality, the face value of debt discounted at the risky rate $\tilde{r}(k',p',z,\tau)$ must equal the expected payoff discounted at the risk-free rate. Therefore, $\tilde{r}(k',p',z,\tau)$ satisfies:

$$\frac{1}{1+r}\left[\int_{\Omega}\left(z'k'^{\alpha}n'^{\beta}+\xi\left(1-\delta\right)k'\right)dG\left(z',\tau'\mid z,\tau\right)+\left(1-G\left(\Omega\mid z,\tau\right)\right)p'\right]=\frac{p'}{1+\tilde{r}(k',p',z,\tau)}. \tag{13}$$

For a given (p',k',z,τ), equations (12) and (13) pin down the loan contract.

5.2 Equilibrium

The economy also contains an infinitely lived representative consumer, who chooses consumption and labor each period to maximize the expected present value of her utility, discounted at the risk-free rate r. Her one-period utility function is given by $\ln(c)+\varphi(1-n_s)$, in which c is consumption, n_s is the supply of labor, and φ is a parameter that governs the utility of leisure. Her budget constraint is given by:

$$c + p'_d - p_d(1+r) = wn_s + e(\cdot) + T, \tag{14}$$

in which p_d is consumer wealth, and T is the net tax revenue generated from the firms, which we assume the government transfers to the consumer as a lump sum. Let ζ be the stationary distribution over the firm's states, (z, τ, k, p). We define equilibrium in this economy as follows.

Definition 1 *A competitive equilibrium consists of (i) optimal firm policies for capital, labor, and debt, $\{k', n, p'\}$, (ii) allocations to the consumer of consumption, c, and labor, n_s, and (iii) prices, (w, r), such that:*

1. *All firms solve the problem given by* (11).
2. *The consumer maximizes her utility, subject to* (14).
3. *The labor, bond, and output markets clear.*

$$n_s = \int n d\zeta \tag{15}$$

$$p_d = \int p' d\zeta \tag{16}$$

$$c = \int (y - I + T) d\zeta. \tag{17}$$

5.3 Solution

We solve the model using policy-function iteration and bisection, which yields an equilibrium wage rate, a value function, $\pi(k, p, z, \tau)$, and policy functions for capital and debt, given by $k'(k, p, z, \tau)$ and $p'(k, p, z, \tau)$.[14]

5.4 Estimation

We estimate the model parameters using our sample of small firms from the Y14 data.[15] To simplify computation, we set a subset of our parameters outside the model. First, we set

[14] We use 15 points for z, 3 for τ, 201 for k and 201 for b in our numerical approximation.
[15] Subsample analysis to be added later.

the risk-free interest rate, r, equal to 2%, which is close to the average five-year T-bill rate during our Compustat sample period. Second, following Bloom et al. (2018), we set $\varphi = 2$. Third, we set the standard deviation of the tax rate equal to the standard deviation of the taxes observed in our sample (0.013), and we set average level of the tax rate equal to 0.2, following Nikolov and Whited (2014). This rate is lower than the statutory national rate because it accounts for the presence of personal taxes, as in Graham (1996).

We estimate the remaining parameters (θ, σ, ρ, ρ_τ, δ, ψ, ξ, and f) jointly by minimizing the distance between a list of moments and functions of moments constructedfrom model-simulated data and those computed with actual data. In this estimation procedure, we use the optimal weight matrix, constructed as in Bazdresch et al. (2018), clustered by firm and year. Appendix B provides variable definitions for our actual data. In our simulated data, leverage, operating profits, and investment are given by p/k, $(z^\nu \left(k^\alpha n^{1-\alpha}\right)^\theta - wn - f)/k$, and $(k' - (1-\delta)k)/k$.

We choose the following 12 moments to match, the first six of which are the means and standard deviations of debt, investment, and operating income, all expressed as a ratio of assets. We also include the serial correlation of operating income, which we calculate using the method in Han and Phillips (2010) to account for firm fixed effects. The next four moments are regression coefficients motivated by the benchmarks in Bazdresch et al. (2018), which are estimates of the relations between optimal policies and the model state variables. In our model the state variables are capital, net debt, and the two shocks, z and τ. As suggested in Bazdresch et al. (2018), we transform these variables into measurable counterparts, in particular, the ratio of net debt to assets and after-tax operating income to assets. Our next four moments are then the coefficients from regressing the ratio of net debt issuance to assets and investment on these two variables. Our final moment is the difference-in-difference coefficient from regressing leverage on the enactment dates. We choose the enactment dates because there is no difference between enactment and effective dates in our model, and we want to capture the strong effects we find on enactment dates.

While all of the model parameters affect all of our moments, some of these moments are particularly useful for parameter identification. First, the mean and standard deviation of investment help identify the capital depreciation rate, δ, and the adjustment cost parameter, ψ, respectively. In this class of models, steady state investment rises with the depreciation rate, and the variance of investment naturally declines as quadratic adjustment costs induce more smoothing. The serial correlation, ρ, of the process for z is directly related to the estimated serial correlation of operating income, and all model variances increase with the standard deviation, σ, of the driving process. Mean operating income is mechanically decreasing in the profit function curvature, θ, and in the fixed cost of production, f. Nonetheless, we can separately identify these two parameters because the variance of operating profits is also mechanically decreasing in θ, while the fixed cost of production has little effect on this variance. In addition, leverage is decreasing in the fixed cost, as are all of the policy-function sensitivities, as the presence of the fixed cost breaks the scaling properties of the model and decreases the correlations among all of the model variables. Next, the average leverage ratio contains information about the default recovery rate, ξ,.

Finally, we identify the serial correlation of the tax process from our difference-in-difference coefficient. In our model, in contrast to our regressions, we normalize a tax change to be positive, so the sensitivity is negative. As shown in Figure 2, this coefficient drops with the serial correlation of the tax shock process, ρ_τ. When this parameter is low, the sensitivity is zero, as tax changes are not expected to last.

Table 8, panel A reports the model parameter estimates. All parameter estimates, except for the estimate of the quadratic capital adjustment cost parameter are significantly different from zero. The estimates of the profit function curvature and the standard deviation and serial correlation of the driving process are within ranges typically reported for this class of models (Bazdresch et al. 2018). The estimated quadratic capital adjustment cost, ψ, at a level of 0.17, is low. The annual capital depreciation rate, δ, is estimated precisely at a level of 0.10. The estimate of the default recovery rate is 0.113. Although this value is low, it makes sense for the mostly small firms in our sample, which tend to be more distressed when they default. Because lenders tend to be less accommodating toward small firms, they tend to continue to operate in distress. Finally, the fixed operating cost, f, is 0.015, which amounts to roughly 9$\%$ of steady-state operating profits.

Table 8, panel B reports the model and data moments used for estimation. In statistical terms, seven out of the twelve moment pairs are insignificantly different from one another. In economic terms, our model matches most of these moments well. For example, the simulated means of leverage, investment, and operating profits are all close to their real-data counterparts.

Although five out of the 11 t-statistics for these moment pairs indicate significance, this result is to be expected with a sample of our size, as most of the statistics we use as target moments can themselves be estimated extremely precisely. The only simulated moment that is economically different from its data counterpart is the standard deviation of the ratio of operating income to assets, which is about one-third of its value in the data.

Given this model parameterizations, we now explore the aspects of the model that produce a negative sensitivity of leverage to taxes. One particularly interesting feature of the solution is the behavior of optimal debt, which we depict in Figure 3. This figure is drawn given the parameter estimates in Table 8, and it represents a two-dimensional slice of a four dimensional policy function, where we have set k and p equal to their steady-state values. On the x-axis are various levels of the productivity shock, z, and on the y axis is p'/k'. Each line is drawn for one of the three levels of taxes in our model. As is standard in this class of models, leverage increases with z. As productivity increases, firms find it optimal to transfer resources through time via capital rather than via a storage technology, which in our model is $-p$. Put differently, when productivity rises, optimal investment outlays outpace internal resources, and the firm opts for debt finance. Interestingly, in this figure, we also see that leverage is lower when the tax rate is higher. The intuition can be understood as follows. While there is an interest tax deduction in the model, and while, ceteris paribus, this feature of the model makes debt more attractive when taxes are higher, taxes also make the firm less profitable and more likely to default, so it is optimal for the firm to choose lower levels of leverage. For our estimated set of parameters, the latter effect dominates the former.

The tradeoff between the tax advantage of debt and the deleterious effect of taxes on the default threshold can be seen in the optimal solution for the price of debt, that is $1/(1+\tilde{r}(k', p', z, \tau))$. We plot the price of debt in Figure 4 for the steady state level of capital and the median profitability shock. On the *x*-axis is leverage, and on the *y*-axis is the price of debt. Each of these price schedules is drawn for a different level of the tax rate. The effect of leverage on the contract is intuitive. For any (k', z, τ), The price of debt is decreasing in p', reflecting rising default risk.

The effect of taxes depends on the level of leverage. When leverage ranges between 0 and approximate 0.25, debt is safe, and the price of debt rises monotonically in the tax rate, reflecting the interest tax deduction. However, for higher levels of leverage, this relation between taxes and the price of debt changes in two ways. First, the price of debt falls monotonically in the tax rate, as a higher tax rate changes the default threshold. Second, the spread between the prices corresponding to high and low taxes widens, reflecting the stronger effect of taxes on the default threshold than the value of the tax deduction. The difference between the highest and lowest tax rates in our model is approximately 5%, resulting in tax savings of 0.1%. In contrast, at a debt-to-assets ratio of 0.27, Figure 4 shows that this tax raise raises the interest rate on debt by 1%.

6. Conclusion

Using comprehensive samples of both private and public companies and relying on event study techniques in the spirit of Borusyak and Jaravel (2017), we study the evolution of corporate borrowing around changes in state corporate income taxes since the 1980s. In stark contrast with the prior literature, we show that on average corporate taxes depress business borrowing and that companies adjust capital structure immediately upon the enactment of changes in state corporate tax policy. We show in a structural model that these dynamics are driven by tax hikes reducing firm profitability, as well as lender recovery in default. Both effects cause firms to decrease leverage.

Relying on detailed financial statement data for small and mid-sized private firms as well as large public companies from 2011 through 2017, we show that the large increases in corporate borrowing among small private firms are associated with significant real effects. Specifically, net capital expenditures and profitability of small private firms all increase significantly around corporate income tax cuts. While large private and public companies also increase borrowing in response to tax cuts, they do not experience changes in investment or profitability.

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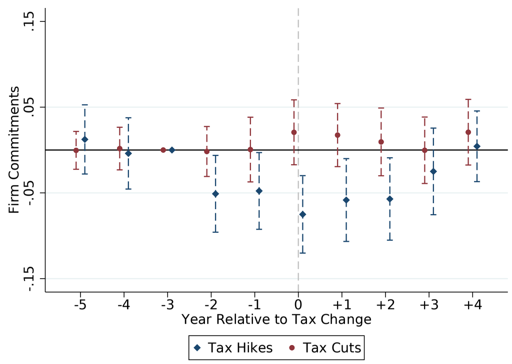
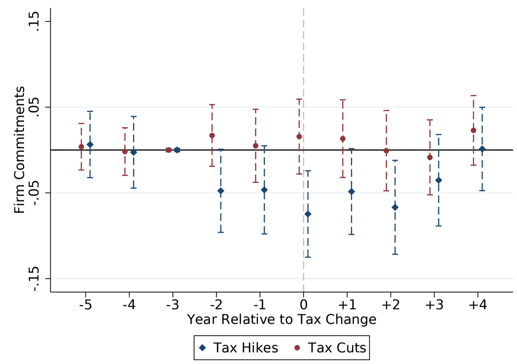
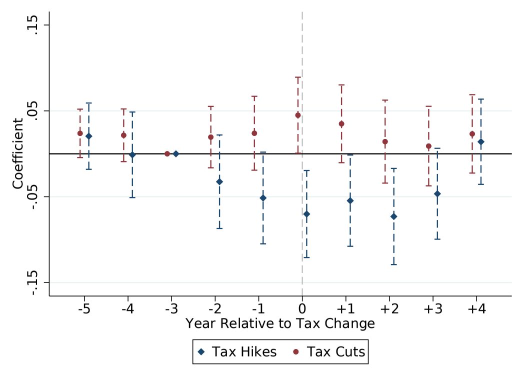


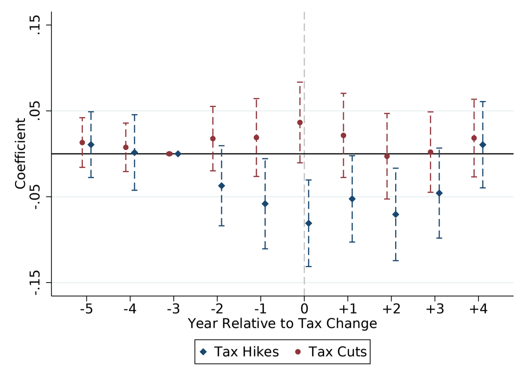
(a) *Full Sample (No Controls)*



(b) *Full Sample (Controls)*



(c) *Low Risk (No Controls)*



(d) *Low Risk (Controls)*

Figure 1: Corporate Taxes and Firm Borrowing. This figure presents event study coefficients from annual firm-level OLS regressions of the evolution of syndicated borrowing around state corporate income tax changes. The data come from the Shared National Credit Database and include all syndicated financing to a given borrower in a given year from 1992 through 2013. All specifications include firm, industry-year fixed effects defined at the four-digit NAICS level. Panels B and D also include the set of tax base and tax credit controls from Suárez Serrato and Zidar (2018), lagged borrower characteristics, as well as lagged changes and levels of the state GDP and the state unemployment rate. In Panels C and D the sample is restricted to borrowers with "pass"-rated commitments. The standard errors are double clustered at the borrower and state-year level.

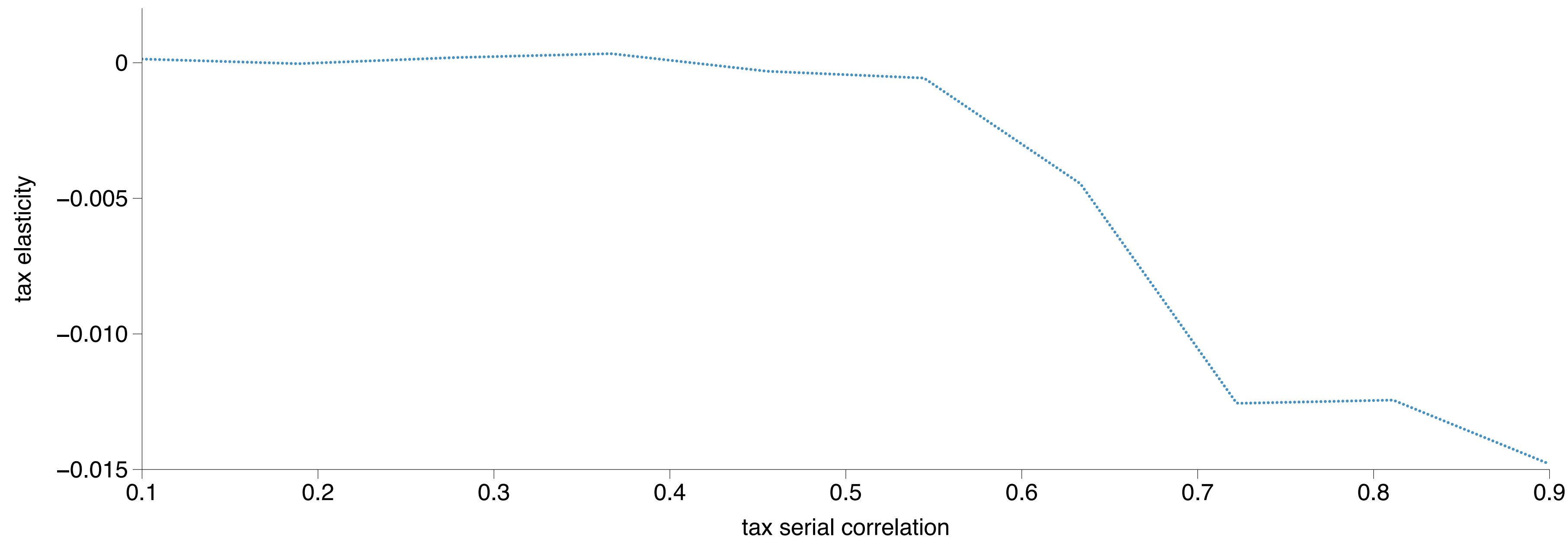


Figure 2: Tax Serial Correlation and the Tax Response This figure plots a comparative statics exercise, in which we allow the serial correlation of the tax process to take 20 different values. For each of these values we solve and simulate the model and plot the corresponding coefficient from regressing leverage on a dummy that equals 1 for a tax increase and -1 for a tax decrease.

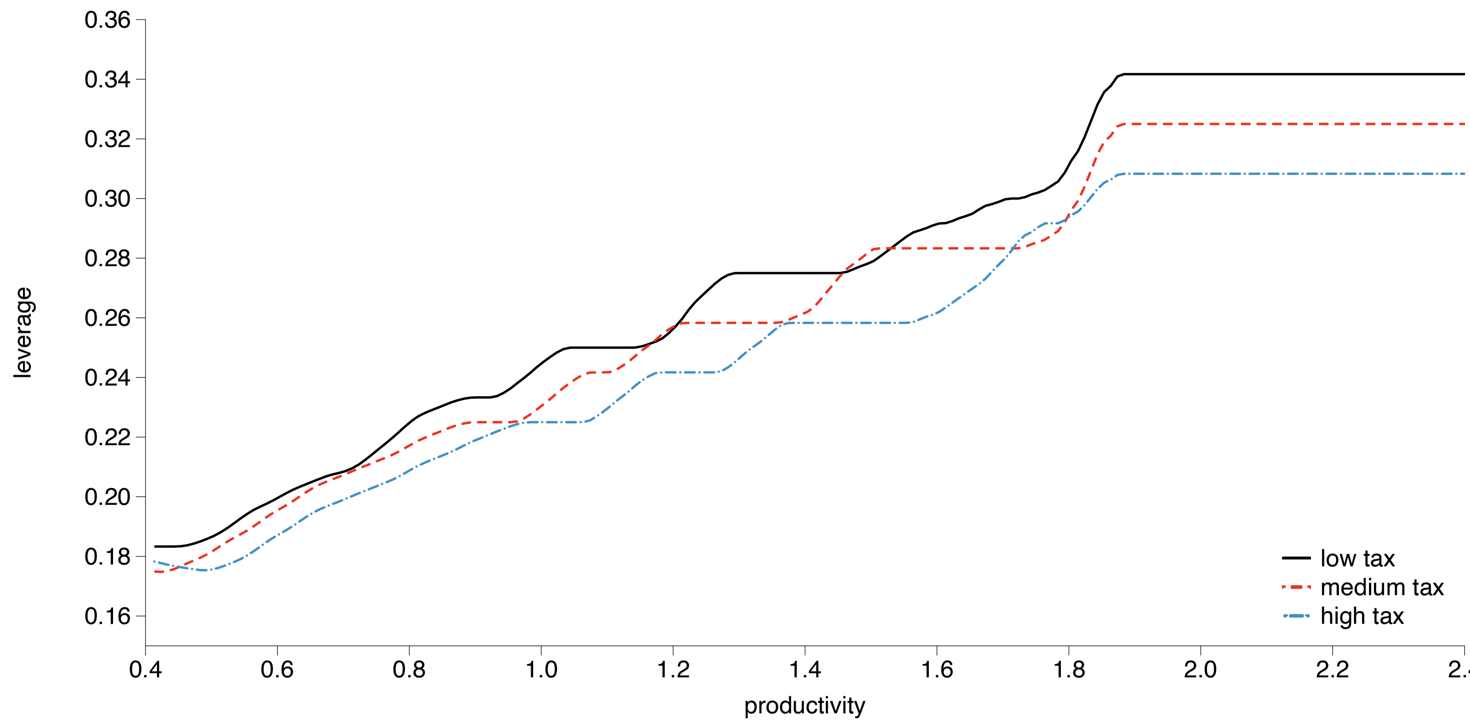


Figure 3: Optimal Debt and Taxes. This figure plots optimal next-period net debt/capital as a function of the profitability shock. Each line represents a different level of the tax rate: low, medium, and high.

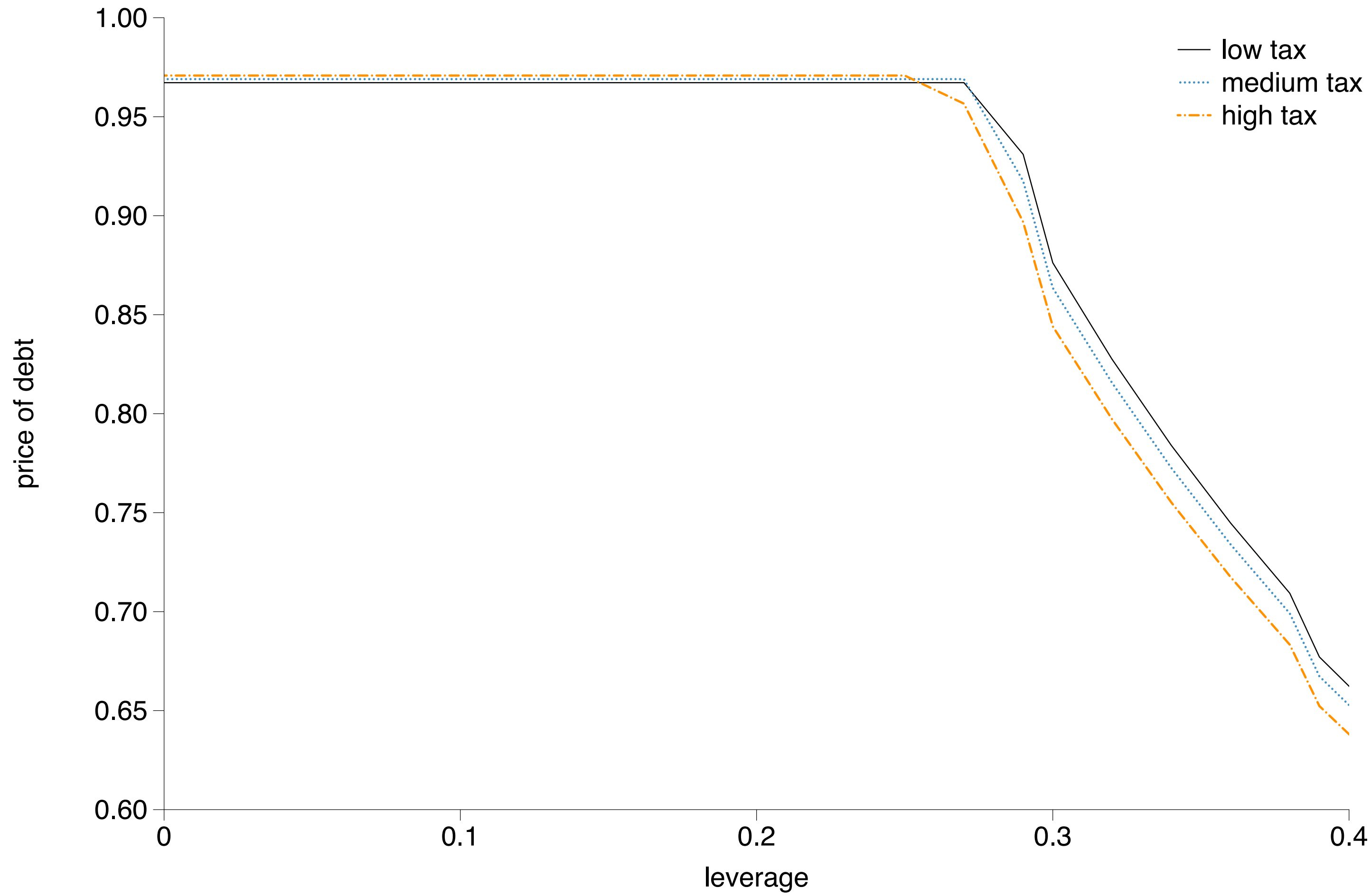


Figure 4: **The Price of Debt.** This plots the price of debt for different levels of the tax rate as a function of leverage, with each line corresponding to a different level of the tax rate: low, medium, and high.

Table 1: Summary Statistics. This table presents summary statistics for the firm-year detailing borrowing information (Panel A), the firm-year balance sheet sample (Panel B), and the tax changes (Panel C) used in our analyses. Commitment amount refers to the sum of credit line and term loan commitments, while utilized amount is the sum of term loans and the outstanding drawn amounts under credit lines. All firm financials variables in Panel B with the exception of $Book\ Assets$ are scaled by firm total assets as of the prior year.

	Mean	*St. Dev.*	*p10*	*p25*	*p50*	*p75*	*p90*
			Panel A: Firm-Year Financials Panel				
Book Assets, $m	2,299	22,202	118	151	256	596	1,759
Net Income	0.07	0.14	-0.02	0.02	0.05	0.09	0.16
Net Sales	1.88	1.58	0.39	0.81	1.50	2.52	3.67
EBITDA	0.14	0.15	0.03	0.07	0.11	0.17	0.25
Operating Income	0.09	0.15	-0.01	0.03	0.07	0.12	0.19
Cash	0.10	0.13	0.003	0.01	0.05	0.13	0.26
Debt	0.35	0.27	0.01	0.13	0.32	0.54	0.73
Total Liab.	0.65	0.28	0.29	0.46	0.65	0.82	0.96
Interest Expense	1.45	1.52	0.03	0.34	1.03	2.02	3.58
Fixed Assets	0.33	0.28	0.03	0.10	0.26	0.49	0.76
Total Assets	1.10	0.25	0.93	0.99	1.05	1.14	1.27
			Panel B: Firm-Year Borrowing Panel				
Commitment Amt, $m	380	815	37	65	143	350	865
Utilized Amt, $m	154	411	0	16	52	136	342
Utilization Ratio, $m	0.52	0.36	0	0.15	0.57	0.85	1
Contract Maturity, months	66	28	36.5	49	61	78	99
Remaining Maturity, months	36	21	10	19	34	50	61
			Panel C: Characteristics of Tax Changes				
Tax Cuts (N=121)							
Rate Change, %	0.59	0.58	0.10	0.25	0.50	0.75	1.04
Initial Rate, %	7.59	2.23	5.00	6.40	7.80	9.20	10.00
Resulting Rate, %	7.00	2.23	4.36	5.50	7.10	8.50	9.50
Tax Hikes (N=36)							
Rate Change, %	1.31	1.07	0.40	0.54	1.00	1.50	2.75
Initial Rate, %	6.59	1.84	4.00	5.00	7.00	7.88	9.00
Resulting Rate, %	7.90	1.84	6.00	6.50	7.95	9.25	9.98

Table 2: State Corporate Income Tax Cuts and Firm Leverage: Private Firms. This table presents results from firm-level annual OLS regressions of the evolution of firm leverage around state corporate income tax cuts. The sample is restricted to private companies with at least $100 million in total assets as of the previous year and runs from 2011 through 2017. All specifications include borrower, 4-digit NAICS industry-year fixed effects, the log of lagged firm sales, credit quality indicators, state tax hike indicators, a set of tax base and tax credit controls, as well as lagged changes and levels of the state GDP growth and unemployment rates. Column (1) presents results for the full sample, column (2) presents results for firms below the median in total assets, and column (3) presents results for firms above the median in total assets. The standard errors are double clustered at the borrower and state-year level.

Dependent variable:		*Long-Term Debt*			*Total Debt*			*Total Liabilities*	
Sample:	All	Small	Large	All	Small	Large	All	Small	Large
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Event Year $= -2$	0.005	0.015	-0.001	-0.008	-0.002	0.001	0.001	0.001	0.010
	(0.005)	(0.009)	(0.006)	(0.007)	(0.013)	(0.006)	(0.007)	(0.011)	(0.008)
Event Year $= -1$	0.010*	0.010	0.004	0.002	-0.001	0.009	0.016**	0.014	0.021*
	(0.006)	(0.009)	(0.010)	(0.007)	(0.011)	(0.009)	(0.008)	(0.012)	(0.012)
Event Year $= 0$	0.006	0.002	-0.001	-0.004	-0.011	0.003	0.004	0.001	0.005
	(0.007)	(0.010)	(0.010)	(0.008)	(0.013)	(0.010)	(0.009)	(0.012)	(0.013)
Event Year $= +1$	0.007	0.012	0.004	-0.004	-0.004	0.005	-0.005	-0.004	-0.003
	(0.007)	(0.010)	(0.010)	(0.008)	(0.012)	(0.010)	(0.009)	(0.012)	(0.013)
Event Year $= +2$	0.005	0.026**	-0.003	0.003	0.020	-0.003	0.002	0.022	-0.006
	(0.007)	(0.012)	(0.010)	(0.010)	(0.014)	(0.010)	(0.010)	(0.015)	(0.012)
Event Year $= +3$	0.010	0.018	0.003	0.001	0.016	-0.000	0.009	0.007	0.011
	(0.007)	(0.012)	(0.009)	(0.008)	(0.012)	(0.011)	(0.011)	(0.014)	(0.014)
Event Year $\geq +4$	0.006	0.006	0.003	-0.001	-0.003	0.004	0.003	0.004	0.002
	(0.005)	(0.008)	(0.009)	(0.007)	(0.011)	(0.009)	(0.007)	(0.011)	(0.010)
R^2	0.788	0.809	0.799	0.795	0.813	0.814	0.723	0.755	0.745
N	33488	15963	15969	33488	15963	15969	33488	15963	15969
State Economy Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Rating FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TB Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3: State Corporate Income Tax Cuts and Firm Leverage: Low-Risk Firms. This table presents results from firm-level annual OLS regressions of the evolution of firm leverage around state corporate income tax cuts. The sample runs from 2011 through 2017 and is restricted to private companies with at least $100 million in total assets as of the previous year that are rated above "B" by the lender. All specifications include borrower, 4-digit NAICS industry-year fixed effects, the log of lagged firm sales, credit quality indicators, state tax hike indicators, a set of tax base and tax credit controls, as well as lagged changes and levels of the state GDP growth and unemployment rates. Column (1) presents results for the full sample, column (2) presents results for firms below the median in total assets, and column (3) presents results for firms above the median in total assets. The standard errors are double clustered at the borrower and state-year level.

Dependent variable:	*Long-Term Debt*			*Total Debt*			*Total Liabilities*		
Sample:	All	Small	Large	All	Small	Large	All	Small	Large
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Event Year$= -2$	0.008	0.015*	0.003	-0.009	-0.007	0.005	0.002	-0.005	0.016*
	(0.005)	(0.009)	(0.007)	(0.007)	(0.014)	(0.007)	(0.007)	(0.011)	(0.009)
Event Year$= -1$	0.014**	0.020**	0.006	0.004	0.005	0.009	0.020**	0.017	0.025*
	(0.007)	(0.009)	(0.012)	(0.008)	(0.013)	(0.011)	(0.009)	(0.013)	(0.014)
Event Year$= 0$	0.006	0.016	-0.011	-0.011	-0.007	-0.013	-0.001	0.000	-0.006
	(0.007)	(0.011)	(0.010)	(0.008)	(0.014)	(0.011)	(0.009)	(0.014)	(0.013)
Event Year$= +1$	0.013*	0.022**	0.006	0.004	0.008	0.004	-0.001	0.002	-0.010
	(0.007)	(0.010)	(0.011)	(0.008)	(0.014)	(0.010)	(0.009)	(0.012)	(0.014)
Event Year$= +2$	0.007	0.029**	-0.011	0.003	0.027**	-0.013	0.007	0.022	-0.018
	(0.008)	(0.012)	(0.011)	(0.010)	(0.014)	(0.011)	(0.010)	(0.015)	(0.013)
Event Year$= +3$	0.009	0.013	0.001	0.001	0.023*	-0.004	0.010	0.002	0.009
	(0.007)	(0.011)	(0.010)	(0.008)	(0.012)	(0.011)	(0.012)	(0.015)	(0.015)
Event Year$\geq +4$	0.006	0.002	0.001	-0.002	-0.001	-0.003	0.006	-0.000	-0.002
	(0.006)	(0.009)	(0.010)	(0.007)	(0.012)	(0.009)	(0.008)	(0.012)	(0.011)
R^2	0.804	0.826	0.814	0.82	0.83	0.84	0.763	0.778	0.793
N	26612	12875	12392	26612	12875	12392	26612	12875	12392
State Economy Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Rating FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TB Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4: State Corporate Income Tax Cuts and Firm Leverage: Tax Enactments. This table presents results from firm-level annual OLS regressions of the evolution of firm leverage around the enactment of state corporate income tax cuts. The sample runs from 2011 through 2017 and is restricted to private companies with at least $100 million in total assets as of the previous year that are rated above "B" by the lender. All specifications include borrower, 4-digit NAICS industry-year fixed effects, the log of lagged firm sales, credit quality indicators, state tax hike indicators, a set of tax base and tax credit controls, as well as lagged changes and levels of the state GDP growth and unemployment rates. Column (1) presents results for the full sample, column (2) presents results for firms below the median in total assets, and column (3) presents results for firms above the median in total assets. The standard errors are double clustered at the borrower and state-year level.

Dependent variable:		*Total Debt*			*Long-Term Debt*	
Sample:	All	Small	Large	All	Small	Large
	(1)	(2)	(3)	(4)	(5)	(6)
Event Year= -2	0.004	0.003	0.005	-0.002	-0.007	0.010
	(0.005)	(0.008)	(0.007)	(0.007)	(0.013)	(0.008)
Event Year= -1	0.006	0.005	0.010	-0.001	-0.004	0.014
	(0.005)	(0.009)	(0.008)	(0.007)	(0.010)	(0.009)
Event Year= 0	0.016***	0.023**	0.014	0.013*	0.018	0.019**
	(0.005)	(0.010)	(0.008)	(0.007)	(0.012)	(0.008)
Event Year= $+1$	0.009	0.010	0.015	0.003	0.003	0.020*
	(0.008)	(0.011)	(0.012)	(0.010)	(0.012)	(0.011)
Event Year= $+2$	0.010	0.027**	-0.001	0.007	0.023	0.003
	(0.007)	(0.012)	(0.011)	(0.010)	(0.014)	(0.012)
Event Year= $+3$	0.005	0.022**	-0.009	0.002	0.009	0.001
	(0.007)	(0.011)	(0.010)	(0.008)	(0.012)	(0.011)
Event Year$\geq +4$	0.010*	0.011	0.011	0.005	0.029***	-0.002
	(0.006)	(0.010)	(0.007)	(0.007)	(0.010)	(0.008)
R^2	0.804	0.826	0.814	0.820	0.830	0.840
N	26612	12875	12392	26612	12875	12392
State Economy Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Rating FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes
TB Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: Corporate Tax Cuts and Leverage: Accounting for Individual Taxes. This table presents results from firm-level annual OLS regressions of the evolution of firm leverage around state corporate income tax cuts. The sample is restricted to private companies with at least $100 million in total assets as of the previous year and runs from 2011 through 2017 that are rated above "B" by the lender. All specifications include borrower, 4-digit NAICS industry-year fixed effects, the log of lagged firm sales, credit quality indicators, the set of state tax hike event indicators, the set of state individual income tax hikes and cuts event indicators, a set of tax base and tax credit controls, as well as lagged changes and levels of the state GDP growth and unemployment rates. The standard errors are double clustered at the borrower and state-year level.

Dependent variable:		*Long-Term Debt*			*Total Debt*			*Total Liabilities*	
Sample:	All	Small	Large	All	Small	Large	All	Small	Large
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Event Year$=-2$	0.008	0.011	0.007	-0.008	-0.011	0.011	0.001	-0.010	0.018*
	(0.005)	(0.009)	(0.007)	(0.007)	(0.015)	(0.007)	(0.007)	(0.010)	(0.010)
Event Year$=-1$	0.016**	0.023**	0.007	0.007	0.005	0.013	0.020**	0.015	0.034**
	(0.008)	(0.011)	(0.013)	(0.009)	(0.014)	(0.012)	(0.010)	(0.014)	(0.015)
Event Year$=0$	0.003	0.016	-0.014	-0.009	-0.000	-0.015	-0.006	0.006	-0.011
	(0.008)	(0.012)	(0.012)	(0.009)	(0.016)	(0.013)	(0.010)	(0.015)	(0.015)
Event Year$=+1$	0.013*	0.026**	0.002	0.005	0.011	0.001	-0.002	0.007	-0.013
	(0.008)	(0.011)	(0.012)	(0.008)	(0.014)	(0.011)	(0.010)	(0.013)	(0.014)
Event Year$=+2$	0.008	0.032**	-0.013	0.002	0.029*	-0.015	0.001	0.020	-0.022
	(0.009)	(0.013)	(0.011)	(0.011)	(0.015)	(0.012)	(0.010)	(0.014)	(0.015)
Event Year$=+3$	0.011	0.023*	-0.004	0.001	0.027*	-0.009	0.011	0.012	0.005
	(0.008)	(0.012)	(0.011)	(0.009)	(0.014)	(0.012)	(0.012)	(0.016)	(0.016)
Event Year$\geq +4$	0.009	0.008	-0.000	-0.002	-0.001	-0.007	0.005	0.004	-0.002
	(0.007)	(0.009)	(0.010)	(0.008)	(0.014)	(0.010)	(0.009)	(0.013)	(0.012)
R^2	0.804	0.826	0.814	0.82	0.83	0.84	0.763	0.779	0.793
N	26612	12875	12392	26612	12875	12392	26612	12875	12392
Ind. Income Tax Event Indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Economy Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Rating FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TB Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 6: State Corporate Income Tax Cuts and Leverage: Public Firms. This table presents results from firm-level annual OLS regressions of the evolution of leverage around state corporate income tax cuts. The sample runs from 2011 through 2017 and is restricted to public companies from the CRSP-Compustat database. All specifications include borrower and 4-digit SIC industry-year fixed effects, lagged levels and changes in: log firm assets, ROA, the market-to-book ratio, asset tangibility, state tax hike indicators, a set of tax base and tax credit controls, as well as lagged changes and levels of the state GDP growth and unemployment rates. Columns (1)-(4) present results from event studies around the effective dates of state income tax cuts, while columns (5) through (8) present results from event studies around tax cut enactments. The standard errors are double clustered at the borrower and state-year level.

Sample:		*Tax Effective Dates*			*Tax Enactments*	
Dependent variable:	*Tot Debt*	*LT Debt*	*LT Debt (mkt)*	*Tot Debt*	*LT Debt*	*LT Debt (mkt)*
	(1)	(2)	(3)	(4)	(5)	(6)
Event Year$= -2$	0.016*	0.018**	0.011*	-0.006	0.001	-0.000
	(0.009)	(0.008)	(0.006)	(0.008)	(0.007)	(0.006)
Event Year$= -1$	0.016	0.017	0.008	-0.007	-0.002	-0.002
	(0.011)	(0.011)	(0.008)	(0.009)	(0.008)	(0.007)
Event Year$= 0$	0.022*	0.014	0.007	0.015	0.022*	0.011
	(0.012)	(0.012)	(0.009)	(0.013)	(0.012)	(0.008)
Event Year$= +1$	0.025*	0.022*	0.007	0.017	0.015	0.003
	(0.013)	(0.012)	(0.008)	(0.015)	(0.014)	(0.009)
Event Year$= +2$	0.013	0.009	-0.006	0.019	0.020	-0.000
	(0.015)	(0.013)	(0.011)	(0.014)	(0.013)	(0.010)
Event Year$= +3$	0.021	0.020	0.007	0.024	0.027**	0.006
	(0.016)	(0.016)	(0.013)	(0.014)	(0.013)	(0.009)
Event Year$\geq +4$	0.017	0.020	0.016	0.018	0.019	0.012
	(0.017)	(0.016)	(0.012)	(0.016)	(0.015)	(0.011)
R^2	.691	.674	.769	.691	.674	.768
N	14207	14207	14207	14207	14207	14207
State Economy Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes
TB Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table 7: Real Effects of State Corporate Income Tax Cuts. This table presents results from firm-level annual OLS regressions of the evolution of firm investment and profitability around the enactment of state corporate income tax cuts. The sample runs from 2011 through 2017 and is restricted to private companies with at least $100 million in total assets as of the previous year that are rated above "B" by the lender. All specifications include borrower, 4-digit NAICS industry-year fixed effects, the log of lagged firm sales, credit quality indicators, state tax hike indicators, a set of tax base and tax credit controls, as well as lagged changes and levels of the state GDP growth and unemployment rates. Columns (1) and (4) present results for the full sample, columns (2) and (5) present results for firms below the median in total assets, and columns (3) and (6) present results for firms above the median in total assets. The standard errors are double clustered at the borrower and state-year level.

Dependent variable:		*EBITDA*			*Net Capital Expenditures*	
Sample:	All	Small	Large	All	Small	Large
	(1)	(2)	(3)	(4)	(5)	(6)
Event Year= -2	0.004	0.003	0.005	0.000	0.006	-0.004
	(0.005)	(0.008)	(0.007)	(0.003)	(0.005)	(0.004)
Event Year= -1	0.006	0.005	0.010	0.003	0.007	-0.002
	(0.005)	(0.009)	(0.008)	(0.003)	(0.005)	(0.005)
Event Year= 0	0.016***	0.023**	0.014	0.002	0.003	-0.000
	(0.005)	(0.010)	(0.008)	(0.004)	(0.006)	(0.007)
Event Year= $+1$	0.009	0.010	0.015	0.002	-0.002	0.003
	(0.008)	(0.011)	(0.012)	(0.004)	(0.007)	(0.007)
Event Year= $+2$	0.010	0.027**	-0.001	0.010**	0.009	0.001
	(0.007)	(0.012)	(0.011)	(0.005)	(0.007)	(0.006)
Event Year= $+3$	0.005	0.022**	-0.009	0.008	0.011	-0.006
	(0.007)	(0.011)	(0.010)	(0.006)	(0.009)	(0.006)
Event Year$\geq +4$	0.010*	0.011	0.011	0.002	0.002	-0.000
	(0.006)	(0.010)	(0.007)	(0.004)	(0.007)	(0.005)
R^2	0.804	0.826	0.814	0.445	0.46	0.476
N	26612	12875	12392	25617	12196	12080
State Economy Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Rating FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes
TB Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table 8: Model Estimation. This table reports the parameters and moments from the estimation of our model from Section 5. The parameter linear cost of equity issuance; θ is the curvature of the production function; ρ is the serial correlation of the shock process; σ is the standard deviation of the shock process; δ is the capital depreciation rate; cost; ψ is the quadratic capital adjustment cost; ξ is the recovery rate in default; and f is the fixed operating cost. 'debt-to-assets' is defined as long-term debt divided by lagged total assets; 'investment-to-assets' is defined as net capital expenditures divided by fixed assets; 'income-to-assets' is defined as ebitda divided by lagged total assets; 'debt issuance' is defined as the change in 'debt-to-assets'.

A. Parameter estimates

	θ	ρ	σ	ρ_τ	δ	ψ	ξ	f
	0.8757	0.5594	0.1161	0.7426	0.1005	0.1693	0.1126	0.0148
	(0.0112)	(0.1334)	(0.0305)	(0.0870)	(0.0259)	(2.1583)	(0.0065)	(0.0010)

B. Targeted moments

	Actual	Simulated	t-stat.
Mean debt-to-assets	0.2432	0.2329	1.1495
Standard deviation debt-to-assets	0.0867	0.0772	1.9403
Mean investment-to-assets	0.1089	0.1081	0.2477
Standard deviation investment-to-assets	0.1406	0.1236	1.8175
Mean income-to-assets	0.1400	0.1666	−2.3224
Standard deviation income-to-assets	0.0474	0.0241	9.2191
Serial correlation income-to-assets	0.5788	0.5296	0.4104
Coefficient of debt issuance on lagged debt	−0.9793	−0.9841	0.2902
Coefficient of debt issuance on income	0.0792	0.6833	−27.4918
Coefficient of investment on lagged debt	−0.0499	−0.8787	54.0749
Coefficient of investment on income	0.1972	0.7185	−8.0656
Tax coefficient	−0.0122	−0.0128	0.3425

Appendix: Variable Definitions

Below we present variable definitions for the financial statement data coming from the FR-Y-14Q Collection. The item numbers of data fields refer to Schedule H1 of the Y-14Q data on the Federal Reserve's website:
$https://www.federalreserve.gov/reportforms/forms/FR\_Y-14Q20191231\_i.pdf$:

Book Assets – is defined as the book value of total assets as of the end of the previous year 'Total Assets Prior Year' (item #71).

Net Income is defined as the net income of firm i for the trailing twelve month period ending in year t, 'Net Income Current Year' (item #59) divided by total assets of firm i in year $t-1$, 'Total Assets Prior Year' (item #71).

Net Sales is defined as the net sales of firm i for the trailing twelve month period ending in year t, 'Net Sales Current Year' (item #54) divided by total assets of firm i in year $t-1$, 'Total Assets Prior Year' (item #71).

EBITDA – is defiend as the Earnings Before Iterest, Taxes, Depreciation & Amortization of firm i for the trailing twelve month period ending in year t, divided by total assets of firm i in year $t-1$, 'Total Assets Prior Year' (item #71).

Operating Income is defined as operating income of firm i for the trailing twelve month period ending in year t, 'Operating Income' (item #56) divided by total assets of firm i in year $t-1$, 'Total Assets Prior Year' (item #71).

Cash is defined as the value of cash, depository accounts and marketable securities of firm i as of the end of year t, divided by total assets of firm i in year $t-1$, 'Total Assets Prior Year' (item #71).

Debt is defined as the book value of total debt of firm i as of the end of year t, 'Short-Term Debt' (item #74) + 'Long-Term Debt' (item #78) + 'Current Maturities of Long Term Debt' (item #75), divided by total assets of firm i in year $t-1$, 'Total Assets Prior Year' (item #71).

Long − Term Debt is defined as the book value of long-term debt of firm i as of the end of year t, 'Long-Term Debt' (item #78) + 'Current Maturities of Long Term Debt' (item #75), divided by total assets of firm i in year $t-1$, 'Total Assets Prior Year' (item #71).

Total Liabilities is defined as the book value of total liabilities of firm i as of the end of year t, 'Total Liabilities' (item #80), divided by total assets of firm i in year $t-1$, 'Total Assets Prior Year' (item #71).

Interest Expense is defined as the interest expense of firm i for the trailing twelve month period ending in year t, 'Interest Expense' (item #58), divided by total assets of firm i in year $t-1$, 'Total Assets Prior Year' (item #71).

Fixed Assets is defined as the book value of fixed assets of firm i as of the end of year t, 'Fixed Assets' (item #69), divided by total assets of firm i in year $t-1$, 'Total Assets Prior Year' (item #71).

Total Assets is defined as the book value of total assets of firm i as of the end of year t, 'Total Assets Current Year' (item #70), divided by total assets of firm i in year $t-1$, 'Total Assets Prior Year' (item #71).

Net Capital Expenditures is defined as the difference between capital expenditures and capital divestitures of firm i as of the end of year t, 'Capital Expenditures' (item

#82), divided by total assets of firm i in year $t-1$, 'Total Assets Prior Year' (item #71).

Below we present definitions for the variables relying on loan data from the Shared National Credit Database:

$\boldsymbol{Commitment\ Amt}$ is defined as the total value of syndicated loan commitments of firm i as of the end of year t, where total commitments include both the size of credit line commitments and outstanding term loans.

$\boldsymbol{Utilized\ Amt}$ is defined as the value of utilized amounts under total syndicated loan commitments of firm i as of the end of year t, where utilized commitments include both drawn amounts under credit line commitments and outstanding term loans.

$\boldsymbol{Utilization\ Ratio}$ is defined as the fraction of total syndicated commitments that has been drawn (utilized) by firm i as of the end of year t.

$\boldsymbol{Contract\ Maturity}$ is defined as the weighted average original contract maturity across all syndicated loan commitments of borrower i in year t.

$\boldsymbol{Remaining\ Maturity}$ is defined as the weighted average remaining contract maturity across all syndicated loan commitments of borrower i in year t.

Below we present definitions for the variables relying on financial statement data from the Compustat database:

$\boldsymbol{Tot\ Debt}$ is defined as the sum of long-term debt (item dltt) and short-term debt (item dlc) of firm i in year t, divided by the book value of total assets of firm i in year $t-1$ (item at).

$\boldsymbol{LT\ Debt}$ is defined as the value of long-term debt (item dltt) of firm i in year t, divided by the book value of total assets of firm i in year $t-1$ (item at).

$\boldsymbol{Tot\ Debt\ (mkt)}$ is defined as the sum of long-term debt (item dltt) and short-term debt (item dlc) of firm i in year t, divided by the market value of total assets of firm i in year $t-1$. The market value of total assets is defined as the sum of long-term debt (item dltt), short-term debt (item dlc), and the market value of equity (the product of items prcc_f and csho).

$\boldsymbol{LT\ Debt\ (mkt)}$ is defined as the value of long-term debt (item dltt) of firm i in year t, divided by the market value of total assets of firm i in year $t-1$. The market value of total assets is defined as the sum of long-term debt (item dltt), short-term debt (item dlc), and the market value of equity (the product of items prcc_f and csho).