Taxes Depress Corporate Borrowing: Evidence from Private Firms

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Title

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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 increases following 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.

1. Introduction

We revisit an old question that has been at the center of corporate finance at least since Modigliani and Miller (1963): the effect of corporate taxes on business borrowing. And we tackle this question in two new ways. First, we have new data on private firms and can thus confront the issue that nearly all empirical evidence on this topic is based on samples of large public companies (Titman and Wessels 1988; Graham 1996; Heider and Ljungqvist 2015; Faccio and Xu 2015). Yet, most 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, over half of new job creation in the United States occurs in privately held companies (Smith 2007).

Using both our new data on private firms and standard data on public firms, we study changes in state corporate income taxes since the 1980s. Interestingly, and in contrast to the positive associations between corporate taxes and leverage found in several previous studies, most of our results point to a negative relation between taxes and leverage, despite the deductibility of interest in the tax code during our sample period. Moreover, we uncover interesting anticipation effects, as companies adjust capital structure shortly after the enactment of these laws, which typically become effective one to two years later.

Second, we use the estimation of a dynamic model of firm leverage to rationalize this result. The model is tailored to understand private firms along one important dimension. In contrast to large public firms, informational frictions prevent private firms from borrowing against their future market value. Thus, while the tax deductibility of interest creates a standard advantage for debt, higher taxes also make leverage more costly by lowering profits and potential recovery in default. Because default thresholds then fall and credit spreads rise, firms have an incentive to decrease leverage. We show quantitatively that the effect of the interest tax shield is small, so the net effect on leverage is negative, especially when firms are small.

Turning to the details of our analysis, most of our data are from two supervisory data sets that cover private U.S. firms. Our primary data set comes from the Federal Reserve's Y-14 Collection, which 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 (SNC) database. This source spans a longer time period (1992–2013), and it covers the borrowing of private and public firms reliant on the syndicated loan market, which accounts for the vast majority of corporate borrowing. We also consider a sample of standard Compustat data on nonfinancial firms that spans the post-2011 period.

Using the event study techniques in Borusyak and Jaravel (2017), we first investigate how state corporate income tax cuts affect privately held firms, relying on the Y-14 data for small and mid-sized private borrowers from 2011 through 2017. We examine cuts because this time period contains only four corporate income tax hikes, as compared to 62 tax cuts. We find that firms' outstanding debt increases by approximately 3.6% in the one to two years preceding the effective year of the tax cut and remains significantly elevated at between 2.1% and 3.5% up to three years after the effective year.

While at first glance, the response of firms before the effective year of tax changes may indicate pre-trends, we show that these responses are more indicative of anticipation. 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 with no significant reaction before enactment. In addition, the event study coefficients around enactment dates are larger and more precisely estimated, ranging from approximately 4% in the enactment year to about 3% three years later. This result suggests that firms are more likely to respond to the tax enactment packages rather than to the usual multiple effective years associated with each tax package.

We also show that the large increase in leverage ratios of small private firms is primarily driven by changes in long-term debt. In contrast, we find that large private firms do not

change debt in response to corporate income tax cuts and only exhibit limited and short-lived increases in non-debt liabilities such as trade credit. Similarly, while we also find that leverage rises in response to tax cuts for our sample of public firms, the magnitudes are smaller, and the significance is marginal.

To provide economic intuition for these somewhat unusual results, we use our data to estimate a dynamic model of leverage and investment in the spirit of Hennessy and Whited (2005, 2007). In the model, firms face an exogenous stochastic tax rate, so they optimize their policies considering the possible future evolution of corporate taxes, as in Hennessy and Strebulaev (2020). They also receive an interest tax deduction. Because their debt need not be fully collateralized, they can default, which occurs when they have insufficient internal resources to repay their debt. A higher tax rate exerts downward pressure on optimal debt because credit spreads rise, as both default thresholds and lender recovery fall 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).

We also show that the relation between corporate tax rates and leverage is conditional on firm size, with small firms exhibiting a negative relation between taxes and leverage, and large firms exhibiting a positive relation. Intuitively, large firms are less productive, so they do not need to use debt to fund capital expenditures. Therefore, they keep their leverage in a region in which it is effectively fully collateralized, so the interest tax deduction is all that matters. In contrast, small firms are more productive and need to use debt to fund projects. They optimally operate with debt that is not fully collateralized, so the effect of taxes on default matters more.

This last feature of the model helps rationalize our empirical result of a negative relation between taxes and corporate borrowing with the positive relation documented in much of

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the prior literature (Givoly et al. 1992; Graham 1996; Titman and Wessels 1988; Gordon and Lee 2001; Faccio and Xu 2015; Fleckenstein et al. 2019). This work focuses on samples of large, publicly traded companies, which are much safer than our sample of private firms, so interest tax shields 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. A final contribution of our work to this literature is our collection of tax enactment dates, which allows us to examine the dynamics of firms' responses to corporate income tax changes.

The rest of the paper is organized as follows. Section 2 describes our data, Section 3 describes our empirical methodology, and Section 4 presents our results. In Section 5, we outline, estimate, and analyze our dynamic model. Section 6 concludes.

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] Because only a minor fraction of firms

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[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, so they substitute tax returns, which we do not observe.

report financials quarterly, we keep the financial statement information with a reporting date closest to the end of each calendar year, which is typically the information from Q4 for the trailing twelve months.

Finally, we restrict the sample to domestic private borrowers, excluding foreign and U.S. state and local government entities, individuals and private households, utilities (two-digit NAICS code of "22" or two-digit SIC code of "49"), financials (two-digit NAICS code of "52" or one-digit SIC code of "6"), public administration entities (two-digit NAICS code of "92" or one-digit SIC code of "9"), educational institutions (three-digit NAICS code of "611"), hospitals (three-digit NAICS code of "622"), religious institutions (three-digit NAICS code of "813"), and other nonprofit organizations. We also exclude firms that simultaneously are located in multiple states through subsidiaries. Finally, we exclude public firms, as well as firms with publicly traded securities as we study those separately with the CRSP-Compustat data. See Appendix A in Brown et al. (2020) for a more detailed description of the data set.

Although 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 the 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 firm-year observations in which book assets fall below $100 million in 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] Imposing this

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[3]The major tax benefits of organizing as a C-corporation relative to a pass-through entity include no restriction on the number of shareholders or types of ownership, retaining earnings for future expansion at a lower tax cost, and a wider range of deductions. Despite the lower tax burden on pass-through entities relative to C-corporations, Smith et al. (2019) show that these incentives disappear for large firms with more $100 mil-

restriction is likely conservative, as the Joint Committee on Taxation reports that virtually all assets of C-corporations belong to those companies whose total assets exceed $100 million.[4]

For the purposes of our empirical tests, we require the availability of the book value total assets, net income, net sales, operating income, total liabilities, long-term debt, and total debt. We also require that the beginning-of-period book value of total assets be available, as we use this variable to scale all financial variables. The resulting sample has 38,221 non-singleton firm-year observations during the 2011-2017 time period. We winsorize credit commitments and all financial statement variables at the 1st and 99th percentiles to mitigate the effect of extreme observations. Variable definitions are in Appendix A.

We also study the effect of corporate taxes on borrowing using the Shared National Credit (SNC) data, which spans 1992 through the present. The SNC Program covers all syndicated deals that exceed $20 million and that are held by three or more unaffiliated institutions supervised by the Federal Reserve System, Federal Deposit Insurance Corporation, or the Office of the Comptroller of the Currency (OCC).[5] The loan deals in this data collection comprise nearly the entire syndicated loan market in the United States in terms of loan amounts. Because we study the effect of taxes on firm borrowing, we aggregate loan commitment amounts to the borrower-level. 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.

Our sample of public firms comes from the CRSP-Compustat Fundamentals Annual

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lion in sales.

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

[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).

database. We limit the sample period to 2011 through 2017 to ensure comparability with the sample of private firms. Because a firm's headquarters location in Compustat is back-filled to its most recent headquarters location, we use a file provided by Standard & Poor's that contains the correct historical headquarters locations since 1994 ("CST_HIST"). As with our samples of private firms, we exclude utilities (2-digit SIC code of "49"), financials (1-digit SIC code of "6"), public administration entities (1-digit SIC code of "9"), foreign firms (where the firm's historical headquarters or incorporation location is outside of the United States), firms with missing headquarters location, firms with negative or missing total assets, and firms with missing pre-tax earnings.

Finally, to understand whether private firms adjust leverage through equity issuance we download Regulation D (private placements) data from the U.S. Securities and Exchange Commission (SEC) website. Specifically, we scrape the names and IRS tax identifiers (whenever available) of all firms with private placements on the SEC website since 2009, using the SEC-provided firm CIKs and index files.[6] We then merge these observations with the Y-14 sample of 38,221 firm-years to ascertain whether any sample firms have ever issued private placements. We find 754 firm-year matches, so it appears that few of our sample firm tap private equity markets.[7]

2.2 State Taxation and Economic Data

We use the data sets provided on Owen Zidar's website[8] 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

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[6]See `https://www.sec.gov/Archives/edgar/full-index/`.
[7]Additional detail on these firm-years is available in Appendix Table B2.
[8]See `https://scholar.princeton.edu/zidar/publications/structure-state-corporate-taxation-and-its-impact-state-tax-revenues-and-economic`.

all enactment dates prior to 2012 from amendments to the states' tax statutes.[9] 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.[10] 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.

Next, we obtain annual data on state and county GDP and the unemployment rate, as well as county population, GDP, employment, and per-capita income from the U.S. Bureau of Economic Analysis.[11]

Finally, in all of our regressions, 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 carrybacks, number of years for loss carryforwards, an indicator for franchise taxes, an indicator for federal income tax deductibility, an indicator for the 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

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[9]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.

[10]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.

[11]See https://apps.bea.gov/regional/downloadzip.cfm.

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.

2.3 Descriptive Statistics

We describe the sample of private firm-years for which we have available financial statement information from 2011 through 2017 in Panel A of of Table 1. The typical company has $258 million in book assets, while a quarter of companies has between $100 and $150 million in book assets. In addition, sample firms are significantly more levered than the typical public firm with total debt-to-assets of approximately 36% and total liabilities-to-assets of 69%. Sample firms are also significantly more profitable and hold substantially less cash than their public counterparts (see, e.g. Kahle and Stulz 2017).

As we study the response of corporate leverage to corporate income tax changes, we need to ensure our leverage measures vary sufficiently in order to detect the effects of tax changes. Because borrowers in our sample have access to bank financing (by construction), a significant fraction of which is in the form of credit lines, and that bank loan renegotiation is frequent (Roberts and Sufi 2009; Roberts 2015), leverage is also likely to exhibit frequent and significant variations. To this end, in Figure 1 we plot annual changes in our three leverage measures: long-term debt, total debt, and total liabilities. All three panels show significant variation in leverage among the private firms in our sample.

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. Most 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. 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 drawdowns 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 in 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).[12] 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:

$$y_{it} = \bar{\alpha}_i + \bar{\beta}_{mt} + \sum_{k=-5}^{k \geq +5} \bar{\lambda}_k \mathbf{1}\{K_{it} = k\} + \boldsymbol{\delta}\boldsymbol{X} + \epsilon_{it} \tag{1}$$

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

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where i, m, t, and k denote firms, industries, years, and years relative to the event of interest, respectively. Specifically, $k < 0$ corresponds to dates preceding the event, and $k \geq 0$ corresponds to dynamic effects relative to the event. Additionally, $t \geq +5$ represents five or more years after the event. y_{it} represents the outcome of interest, such as the natural log of the firm's total loan commitments, $\bar{\alpha}_i$ and $\bar{\beta}_{mt}$ are firm and industry-year fixed effects. 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. As noted in Borusyak and Jaravel (2017), this specification is valid under the assumption that treatment effects, represented by the $\bar{\lambda}_k$'s, are homogeneous across units and calendar time, depending only on k.

As noted in Borusyak and Jaravel (2017), the model in equation (1) is unidentified up to a linear trend. One solution is to specify a base year before which no pre-trends are present. In specifications relying on the small firm balance sheet data or public firm balance sheet data since 2011, we define this omitted category as years $t \leq -3$ relative to the event. We do not choose the omitted categories to be in the two years prior to the tax changes becoming effective because these 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 our robustness specifications relying on the SNC data, 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

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in the two years leading up to tax change implementation represent tests of whether firms respond to tax changes immediately upon the 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:

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

Specifically, equation 2 is only valid under the restrictive assumption that the $\bar{\lambda}_k$'s in equation 1 are all equal for $k > 0$. This requirement means that the treatment leads to an immediate and permanent jump in the outcome variable and no further effects. If this assumption is violated, the estimate of λ in equation (2) is bias difficult to interpret because λ is the weighted average of $\bar{\lambda}_k$'s in equation 1, and not all the weights need to be positive (Borusyak and Jaravel 2017; de Chaisemartin and D'Haultfoeuille 2020; Abraham and Sun 2020; Goodman-Bacon 2021). This work has pointed out that 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.

Finally, in equation (1), X is a vector of controls. For all three data sets, we include 4-digit NAICS industry-year and firm fixed effects. We also include the contemporaneous tax base controls described in Section 2.

The remaining controls differ for each of our three datasets because of data limitations. For the regressions using the Y-14 data, we include firm internal credit rating fixed effects, which range from AAA to D, and the log of lagged firm sales. We also include county-level log employment, per-capita income, log population, and lagged levels and changes in log GDP. For the regressions using the SNC data, we include the state unemployment rate and lagged levels and changes in state log GDP. Borrower controls include lagged

levels of average remaining maturities across all loans, utilization rates across all loans, the number of lending relationships, pass rating. Because the SNC data set does not contain any information from borrower financial statements, we can only include these lending-related controls. For our regressions using Compustat data, our firm controls are lagged levels and changes in log total assets, the ratio of net income to assets, the ratio of property, plant, and equipment to total assets, and the market-to-book ratio. We also include the state unemployment rate and lagged levels and changes in state log GDP.

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 spanning 2011–2017 and data on state corporate income tax cuts from 2007 through 2019. 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, three out of the seven tax hikes occur prior to the start of our sample period: Maryland in 2007, Michigan in 2007, and Oregon in 2010. 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. Nevertheless, we control for the incidence of tax hikes throughout our specifications.

One potential concern with our tests is that contemporaneous changes in state individual income taxes may drive corporate leverage rather than corporate income tax changes. 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 lead to reductions in firm investment opportunities and lower leverage ratios. To account for these possibilities, we also include event study indicators associated with state individual income tax cuts and tax hikes throughout our specifications. 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.[13]

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 the effects of tax cuts on balance sheet outcomes in event time. We define the base category in the event studies as years $t \leq -3$ relative to the tax cut effective year. We focus on three main outcomes: total debt, long-term debt, and total liabilities. Because smaller private companies may be more financially constrained and thus exhibit differential responses to corporate tax changes, we also split the sample at the median value of lagged total assets ($258 million). "Small" firms are defined as those with below median

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[13]Our results for long-term debt, total debt, and total liabilities are nearly identical if we do not include the event indicators for individual income tax changes.

total assets, with "large" firms constituting the rest of the sample.[14]

We find that total debt, long-term debt, and total liabilities all increase for small private firms around corporate income tax cuts. The change first occurs one to two years prior to the tax cuts becoming effective, although the effects only become statistically significant one year before the effective date. These leverage increases persist for up to two years after the effective date, especially for the sample of small firms, where leverage is persistently higher through event year $t+2$ for all measures of leverage. The dynamics of long-term and total debt appear nearly identical, suggesting that long-term borrowing drives total debt dynamics. Increases in total liabilities for small private firms exceed the increases in long-term and total debt, but the majority of the response in total liabilities is explained by the increases in debt. Thus, we find scant evidence for an important role for changes in trade credit around corporate income tax changes. Finally, large private firms do not appear to respond to tax cuts, with these effects being overall smaller and statistically insignificant.

While it is possible that firms also respond to corporate income tax cuts by adjusting equity issuance, this scenario is unlikely for the bank-dependent private firms in our sample. Specifically, as Appendix Table B2 indicates, only 754 out of the 38,221 firm-years in our sample raise money through private equity markets between 2009 and 2019. Replicating our results by excluding these firm-years results in event study estimates that are nearly identical (see Appendix Table B3).

Because distressed companies might not have taxable profits, we exclude companies with bank internal ratings of "CCC" and lower. As shown in Appendix Table B1, the results from including these companies are weaker both economically and statistically, consistent with the notion that firms without taxable profits do not react to tax changes.

Our next set of tests examines whether firms' responses up to two years prior to the effective date is driven by pre-trends, or whether these results reflect firm responses to the actual tax cut enactments. In Table 3, we present the results of reestimating our event stud-

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

ies around the enactment dates. We find that firm leverage increases in the enactment year, as well as in some of the subsequent years, indicating that the firm leverage changes prior to effective dates is driven by firms reacting promptly to the enactment of the tax legislation. We do not detect any significant pre-trends for either small or large private firms. Similar to the results in Table 2, large private firms do not exhibit a significant response to tax cuts, with the exception of a statistically noisy increase in total liabilities. In contrast, leverage ratios of small firms in terms of long-term and total debt as well as total liabilities continue to exhibit significant responses to tax cuts for up to three years following tax enactment.

The dynamics evident in our results speak to two important alternative interpretations of our results. First, one could imagine that the effects we see prior to enactment are simply the reactions of firms who want to take advantage of the interest deduction before the tax cut. However, this hypothesis is inconsistent with the persistent effects we see after the both the enactment and effective dates. Second, it is possible that our results are a product of credit supply effects, with banks shifting lending to low-tax states. However, this hypothesis is inconsistent with the effects we see before the effective dates, as banks would have no incentive to shift lending to states before the new tax code becomes relevant.

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 closer to financial distress than public firms.[15] In support of the notion that size and public status matter for the leverage-tax relation, our result of a negative relation between taxes and leverage is not without precedent, as Farre-

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[15]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 firms in their sample appear to face financial constraints, while large private firms do not.

Mensa and Ljungqvist (2015) also find a negative association between changes in book leverage and taxes in a sample of small private firms.

Finally, 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. For this analysis, we use data from Compustat. Table 4 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 4 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. Leverage increases significantly two years prior to tax cuts becoming effective, and these effects persist up to a year after the tax cuts become effective, fading to zero thereafter. However, the effects are smaller in magnitude, and the statistical significance is marginal.

4.2 Real Effects of Tax Cuts

While our results so far establish a robust negative relation between tax changes 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 via two channels: a direct positive effect on the marginal product of capital and a fall in the cost of capital resulting from changes in default thresholds as argued in Section 1. Because of the existence of time-to-build lags, and because investment is lumpy (Doms and Dunne 1998; Whited 2006), the effect on both assets and profitability may not be immediate and may materialize with significant delay following the implementation of tax cuts.

Our data also provide information on net capital expenditures, or the difference be-

tween capital spending and proceeds from divestitures/assets sales, of each company. Consistent with this idea, in Table 5 we show that net capital expenditures of small private firms increase by approximately 1.4% at tax enactment dates, contemporaneously with the leverage increases we observe in Table 3 (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 1.1% (column 4). This result is particularly interesting, as it suggests a separate channel for our results. Firms invest following tax cuts, and they borrow immediately to fund these outlays. 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.

We also test whether the higher investment documented in columns (1)-(3) is accompanied by increases in firm profitability. The results in columns (4)–(6) of Table 5 show that EBITDA does not change following tax enactments for either small or large firms, suggesting that tax cuts do not affect profitability or that positive changes in profitability may still materialize with a significant delay that is outside of our event time horizon.

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. 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 2 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 2 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 the magnitudes of tax hikes exceed the magnitudes of tax cuts, as shown in Panel C of Table 1. Panel B of Figure 2 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 2, we replicate the first two panels for the subsample of firms that are unlikely to be financially-distressed: those that are assigned a Shared National Credit (SNC) rating of "Pass" as of the previous year. Financially distressed firms are much less likely to have taxable income and therefore less likely to respond to taxes in any way. In line with this intuition, we find that "Pass"-rated 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.

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5. Model

To offer a cohesive framework to understand the underlying economics behind the empirical patterns in our data, we turn to a dynamic model 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 internal equity in the form of 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 competitive financial intermediary sector, 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 $p'/(1+r(k', n', b', z, \tau)(1-\tau))$.[16] 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:

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

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-deductible interest payments on debt, as follows:

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

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 nega-

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[16]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).

tive 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.[17]

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 sector 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) by assuming 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.

Specifically, default is triggered when debt repayment exceeds the firm's current after-tax profit plus the fraction, $1 - \xi$ of its capital that can be recovered in default:

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

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 lender can recover

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[17]When we allow external equity to exist but be costly, if we calibrate the cost so that the frequency of equity issuance is similar to that of public firms, we find qualitatively similar results.

any payments. Both of these timing conventions are in accordance with absolute priority rules. Finally, 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:

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

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, with a discount factor b. 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:

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

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 $p'(k, p, z, \tau)$.

5.4 Estimation

We estimate the model parameters using our sample of highly rated small firms from the Y14 data. To simplify computation, we set a subset of our parameters outside the model. First, we set the consumer's discount factor equal to 0.96. Second, following Bloom et al. (2018), we set $\varphi = 2$. This parameterization leaves us with a consumer that spends one-third of her hours working. 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 constructed from

model-simulated data and those computed with actual data. In this estimation procedure, we use the optimal weight matrix, 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, $(z^\nu (k^\alpha n^{1-\alpha})^\theta - wn - f)/k$, 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 a difference-in-difference coefficient from regressing leverage on the enactment dates with firm and industry-year fixed effects. We choose the enactment dates because there is no difference between enactment and effective dates in our model.

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_r.

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. 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 6, panel A reports the model parameter estimates. All parameter estimates are significantly different from zero. The estimates of the profit function curvature, the capital adjustment costs, 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 annual capital depreciation rate, δ, is estimated precisely at a level of 0.094. The estimate of the deadweight loss in default is 0.646. Although seemingly high, this estimate is in line with the average recovery rate found in Kermani and Ma (2020).This value also makes sense for the mostly small firms in our sample, which tend to be more distressed when they default. Finally, the fixed operating cost, f, is 0.017, which amounts to roughly 14% of steady-state operating profits.

Table 6, panel B reports the model and data moments used for estimation. In statistical terms, four 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 most 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 moments that are economically different from their data counterparts are two of the empirical policy function coefficients. However, these coefficients do have the right sign and are expected to be larger in absolute value in simulated data because there is much more noise in real data.

Given this model parameterization, 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 6, and it represents two two-dimensional slices of a four-dimensional policy function. On the x-axis of each panel 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.

In panel A, we have set k and p equal to their steady-state values. We observe hump shapes in some of these policy functions, which reflect income and substitution effects. 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. If productivity is sufficiently high, then an income effect becomes stronger, implying that the firm wants more of both capital and the storage technology, so debt falls with productivity. 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, and for a medium-sized firm in our simulated sample, the latter effect dominates the former.

In panel B, we set k equal to the largest value in our simulated sample. Here, we find that optimal leverage rises with the tax rate.

The intuition behind the difference between these two panels can be found in Figure 4, which depicts the endogenous risky interest rate on debt, $\tilde{r}(k', p', z, \tau)$, as a function of leverage. As in Panel A of figure 3, this figure is drawn for the steady state capital stock. It is also drawn for the mean of the z shock. 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 risky interest rate is increasing in leverage, reflecting rising default risk.

The effect of taxes depends on the level of leverage. When leverage ranges between 0 and approximate 0.22, 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 interest rate rises 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 0.24, Figure 4 shows that this tax raise raises the interest rate on debt by 1%.

In our model small and medium firms are productive, have strong investment opportunities, and need to use debt to expand, so they optimally position themselves near the point at which the interest rate schedules cross. In contrast, large firms are less productive, do not need as much debt and optimally position themselves on the flat part of the interest rate schedule, where debt is effectively risk-free, and the tax advantage of debt is all that matters.

This result in the model is consistent with our own empirical evidence that the negative relation between debt and taxes is negative for small firms. It is also consistent with the results in much of the rest of the literature that analyze large public firms and that find a

positive relation.[18]

6. Conclusion

Using comprehensive samples of both private and public companies and relying on simple 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 for private firms, corporate taxes on average depress business borrowing, and 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 lender recovery in default and thus widening credit spreads. 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 of small private firms increase with 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.

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[18]The qualitative shape of Figures 3 and 4 does not change when we allow the firm to issue costly equity and calibrate the issuance cost so that the frequency of issuance reflects large public U.S. firms.

References

Abraham, S., and L. Sun. 2020. Estimating Dynamic Treatment Effects in Event Studies with Heterogeneous Treatment Effects. *Journal of Econometrics*, forthcoming.

Bazdresch, S., R. J. Kahn, and T. M. Whited. 2018. Estimating and Testing Dynamic Corporate Finance Models. *Review of Financial Studies* 31:322–361.

Bloom, N., M. Floetotto, N. Jaimovich, I. Saporta-Eksten, and S. J. Terry. 2018. Really Uncertain Business Cycles. *Econometrica* 86:1031–1065.

Borusyak, K., and X. Jaravel. 2017. Revisiting Event Study Designs, with an Application to the Estimation of the Marginal Propensity to Consume. Manuscript, UCL.

Brown, J., M. Gustafson, and I. Ivanov. 2020. Weathering Cash Flow Shocks. *Journal of Finance*, forthcoming.

de Chaisemartin, C., and X. D'Haultfoeuille. 2020. Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects. *American Economic Review* 9:2964–2996.

Doms, M., and T. Dunne. 1998. Capital Adjustment Patterns in Manufacturing Plants. *Review of Economic Dynamics* 1:409–429.

Erel, I., Y. Jang, and M. S. Weisbach. 2015. Do Acquisitions Relieve Target Firms' Financial Constraints? *Journal of Finance* 70:289–328.

Faccio, M., and J. Xu. 2015. Taxes and Capital Structure. *Journal of Financial and Quantitative Analysis* 50:277–300.

Farre-Mensa, J., and A. Ljungqvist. 2015. Do Measures of Financial Constraints Measure Financial Constraints? *Review of Financial Studies* 29:271–308.

Fleckenstein, M., F. A. Longstaff, and I. A. Strebulaev. 2019. Corporate Taxes and Capital Structure: A Long-Term Historical Perspective. *Critical Finance Review* 8:1–28.

Gao, X., T. M. Whited, and N. Zhang. 2020. Corporate Money Demand. *Review of Financial Studies* 34:1834–1866.

Gilchrist, S., J. Sim, and E. Zakrajsek. 2013. Uncertainty, Financial Frictions and Investment Dynamics. Manuscript, Federal Reserve Board.

Givoly, D., C. Hayn, A. R. Ofer, and O. Sarig. 1992. Taxes and Capital Structure: Evidence from Firms' Response to the Tax Reform Act of 1986. *Review of Financial Studies* 5:331–355.

Goodman-Bacon, A. 2021. Difference-in-Differences with Variation in Treatment Timing. *Journal of Econometrics*, forthcoming.

Gordon, R. H., and Y. Lee. 2001. Do taxes affect corporate debt policy? Evidence from U.S. corporate tax return data. *Journal of Public Economics* 82:195–224.

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

Hadlock, C. J., and J. R. Pierce. 2010. New Evidence on Measuring Financial Constraints: Moving Beyond the KZ Index. *Review of Financial Studies* 23:1909–1940.

Han, C., and P. C. B. Phillips. 2010. GMM Estimation for Dynamic Panels with Fixed Effects and Strong Instruments at Unity. *Econometric Theory* 26:119–151.

Heider, F., and A. Ljungqvist. 2015. As certain as debt and taxes: Estimating the tax sensitivity of leverage from state tax changes. *Journal of Financial Economics* 118:684–712.

Hennessy, C. A., and I. A. Strebulaev. 2020. Beyond random assignment: Credible inference of causal effects in dynamic economies. *Journal of Finance* 75:825–856.

Hennessy, C. A., and T. M. Whited. 2005. Debt dynamics. *Journal of Finance* 60:1129–1165.

Hennessy, C. A., and T. M. Whited. 2007. How costly is external financing? Evidence from a structural estimation. *Journal of Finance* 62:1705–1745.

Ivanov, I., B. Ranish, and J. Wang. 2019. Bank Supervision and Syndicated Lending. Mauscript, Federal Reserve Board.

Kahle, K., and R. M. Stulz. 2017. Is the U.S. public corporation in trouble? *Journal of Economic Perspectives* 31:67–88.

Kermani, A., and Y. Ma. 2020. Asset Specificity of Non-Financial Firms. Manuscript, University of California, Berkeley.

Li, S., T. M. Whited, and Y. Wu. 2016. Collateral, Taxes, and Leverage. *Review of Financial Studies* 29:1453–1500.

Michaels, R., T. B. Page, and T. M. Whited. 2019. Labor and Capital Dynamics under Financing Frictions. *Review of Finance* 23:279–323.

Modigliani, F., and M. H. Miller. 1963. Corporate Income Taxes and the Cost of Capital: A Correction. *American Economic Review* 53:433–443.

Nikolov, B., and T. M. Whited. 2014. Agency conflicts and cash: Estimates from a dynamic model. *Journal of Finance* 69:1883–1921.

Roberts, M. R. 2015. The role of dynamic renegotiation and asymmetric information in financial contracting. *Journal of Financial Economics* 116:61–81.

Roberts, M. R., and A. Sufi. 2009. Renegotiation of financial contracts: Evidence from private credit agreements. *Journal of Financial Economics* 93:159–184.

Smith, C. W. 2007. On Governance and Agency Issues in Small Firms. *Journal of Small Business Management* 45:176–176.

Smith, M., D. Yagan, O. Zidar, and E. Zwick. 2019. The Rise of Pass-Throughs and the Decline of the Labor Share. Manuscript, Princeton University.

Strebulaev, I. A., and T. M. Whited. 2012. Dynamic Models and Structural Estimation in Corporate Finance. *Foundations and Trends in Finance* 6:1–163.

Suárez Serrato, J. C., and O. Zidar. 2018. The Structure of Corporate Taxation and Its Impact on State Tax Revenues and Economic Activity. *Journal of Public Economics* 167:158–176.

Sufi, A. 2009. The Real Effects of Debt Certification: Evidence from the Introduction of Bank Loan Ratings. *Review of Financial Studies* 22:1659–1691.

Titman, S., and R. Wessels. 1988. The Determinants of Capital Structure Choice. *Journal of Finance* pp. 1–19.

Whited, T. M. 2006. External finance constraints and the intertemporal pattern of intermittent investment. *Journal of Financial Economics* 81:467–502.

Zidar, O. 2019. Tax Cuts for Whom? Heterogeneous Effects of Tax Changes on Growth and Employment. *Journal of Political Economy* 127:1437–1472.
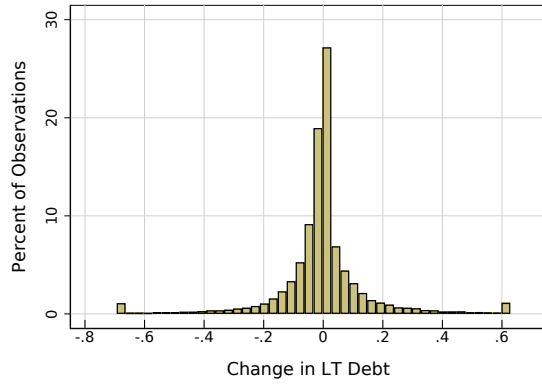
(a) Δ*Long-term Debt*
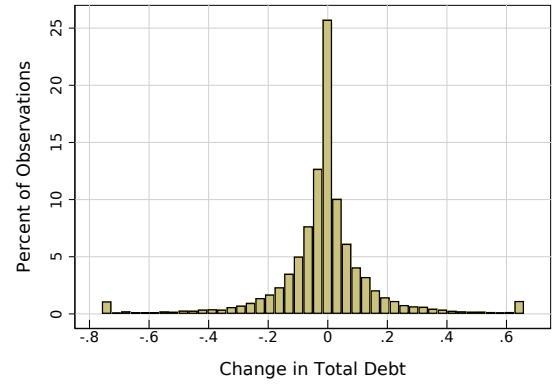
(b) Δ*Total Debt*
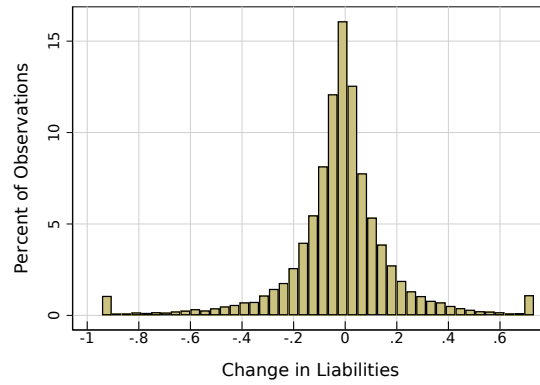
(c) Δ*Total Liabilities*

Figure 1: Empirical Distributions of Changes in Corporate Leverage. This figure presents distributions of changes in corporate leverage for each measure used in our study.
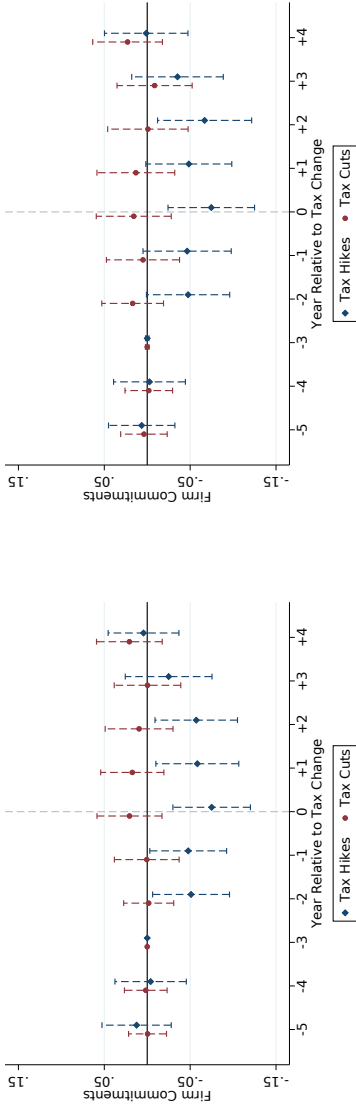
(a) *Full Sample (No Controls)*
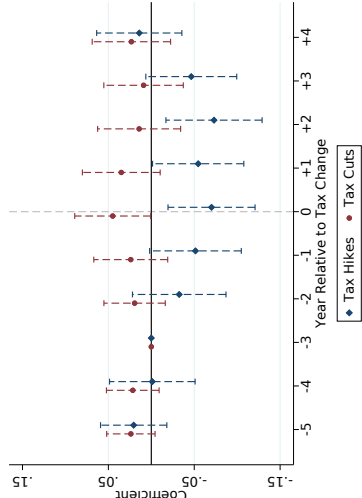
(b) *Full Sample (Controls)*

(c) *Pass-rated (No Controls)*
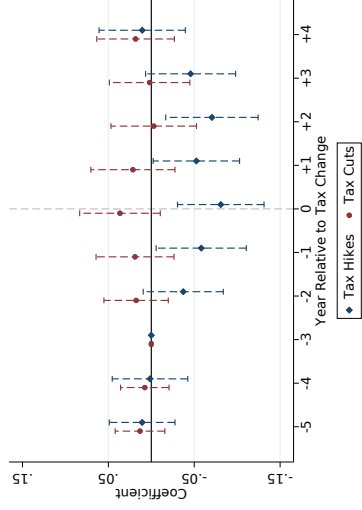
(d) *Pass-rated (Controls)*

Figure 2: 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 and 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.

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Panel A: Medium-sized firm
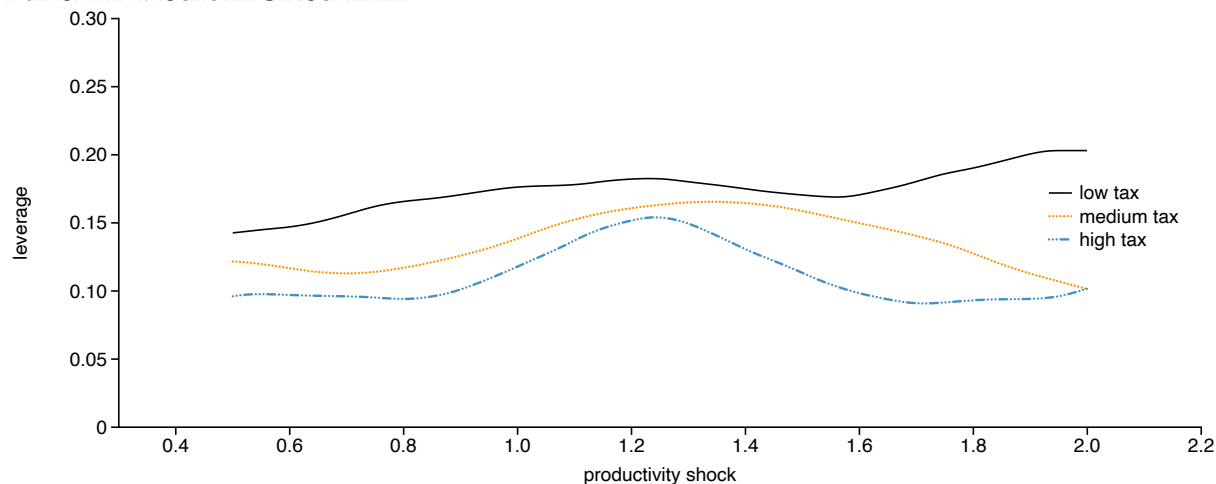
Panel B: Large firm
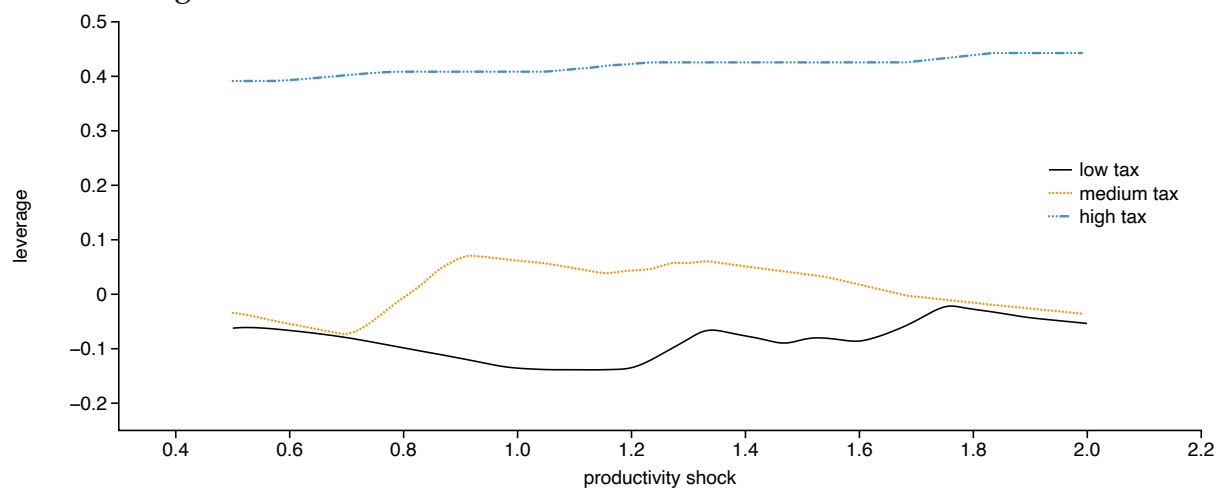
Figure 3: Optimal Debt and Taxes. This figure plots optimal next-period net debt/capital as a function of the profitability shock. Each line represents a different level of the tax rate: low, medium, and high. Panel A is drawn for a medium-sized firm, and Panel B is drawn for a large firm.
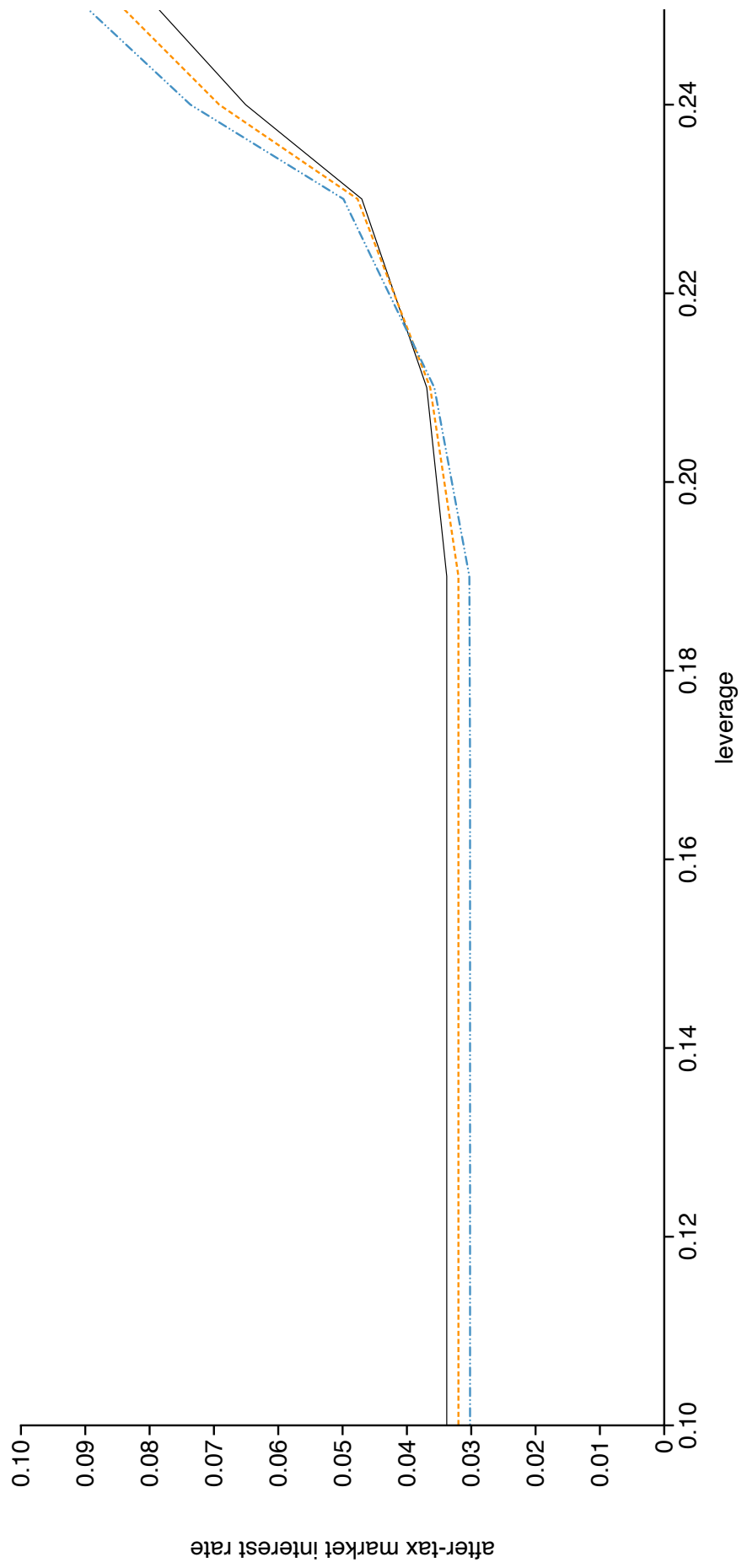
Figure 4: Market Interest Rate. This plots the risky market interest rate for different levels of the tax rate as a function of leverage, with each line corresponding to a different level of the tax rate: low, medium, and high.

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	2,482	23,654	117	150	258	627	2,092
Net Income	0.06	0.11	-0.03	0.01	0.05	0.09	0.16
Net Sales	1.86	1.50	0.37	0.58	1.50	2.57	3.75
EBITDA	0.13	0.13	0.02	0.06	0.11	0.17	0.25
Operating Income	0.09	0.12	-0.01	0.03	0.07	0.12	0.19
Cash	0.09	0.12	0.003	0.01	0.05	0.12	0.25
LT Debt	0.28	0.27	0	0.05	0.21	0.43	0.66
Debt	0.36	0.29	0.01	0.12	0.32	0.54	0.76
Total Liab.	0.69	0.31	0.30	0.48	0.68	0.86	1.05
Interest Expense	1.71	1.89	0.03	0.37	1.14	2.39	4.26
Fixed Assets	0.32	0.28	0.03	0.08	0.25	0.48	0.76
Total Assets	1.09	0.21	0.92	0.99	1.05	1.14	1.28
			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: Excluding Distressed Firms. This table presents results from firm-level annual OLS regressions of the evolution of firm leverage around the effective dates 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 "B" and above by the lender. All specifications include borrower, 4-digit NAICS industry-year fixed effects, the log of lagged firm sales, credit quality indicators, state corporate income tax hike indicators, state individual income tax cuts and hike indicators, a set of tax base and tax credit controls, as well as lagged changes and levels of county GDP, employment, per-capita income and population. Columns (1), (4), (7) present results for the full sample, columns (2), (5), (8) present results for firms below the median in total assets, and column (3), (6), (9) presents results for firms above the median in total assets. The standard errors are double clustered at the state and industry-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	-0.004	0.007	-0.014*	-0.009	0.004	-0.014	-0.005	0.011	-0.016
	(0.004)	(0.008)	(0.008)	(0.011)	(0.022)	(0.009)	(0.009)	(0.014)	(0.011)
Event Year= −1	0.011	0.022*	-0.007	0.016*	0.036*	-0.003	0.026**	0.059***	-0.004
	(0.007)	(0.012)	(0.013)	(0.009)	(0.020)	(0.014)	(0.010)	(0.017)	(0.015)
Event Year= 0	0.013*	0.022**	-0.005	0.014	0.036*	-0.008	0.018*	0.043**	-0.008
	(0.007)	(0.010)	(0.012)	(0.009)	(0.019)	(0.015)	(0.010)	(0.017)	(0.019)
Event Year= +1	0.006	0.017*	-0.008	0.006	0.021	-0.002	0.008	0.034*	-0.015
	(0.008)	(0.010)	(0.015)	(0.009)	(0.016)	(0.017)	(0.012)	(0.019)	(0.018)
Event Year= +2	0.007	0.039**	-0.006	0.017	0.035*	0.001	0.017	0.050**	-0.009
	(0.010)	(0.015)	(0.011)	(0.016)	(0.019)	(0.017)	(0.012)	(0.020)	(0.017)
Event Year= +3	0.010	0.025	0.010	0.012	0.023*	0.016	0.016	0.029	0.012
	(0.009)	(0.016)	(0.012)	(0.009)	(0.013)	(0.015)	(0.012)	(0.018)	(0.015)
Event Year≥ +4	0.005	0.006	0.009	0.006	-0.001	0.006	0.011	0.019	-0.005
	(0.006)	(0.010)	(0.010)	(0.010)	(0.015)	(0.011)	(0.010)	(0.018)	(0.013)
R^2	0.771	0.79	0.791	0.77	0.793	0.791	0.714	0.763	0.729
N	35936	17239	16958	35936	17239	16958	35936	17239	16958
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Rating FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TB Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Local Economy Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3: 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 "B" and above by the lender. All specifications include borrower, 4-digit NAICS industry-year fixed effects, the log of lagged firm sales, credit quality indicators, state corporate income tax hike indicators, state individual income tax cuts and hike indicators, a set of tax base and tax credit controls, as well as lagged changes and levels of county GDP, employment, per-capita income and population. Columns (1), (4), (7) present results for the full sample, columns (2), (5), (8) present results for firms below the median in total assets, and column (3), (6), (9) presents results for firms above the median in total assets. The standard errors are double clustered at the state and industry-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	0.009	−0.001	0.017*	0.005	−0.003	0.018	0.006	−0.003	0.020
	(0.007)	(0.008)	(0.010)	(0.009)	(0.015)	(0.011)	(0.010)	(0.013)	(0.012)
Event Year= −1	0.008	0.010	0.005	−0.002	0.013	0.005	0.010	0.007	0.028*
	(0.009)	(0.011)	(0.013)	(0.013)	(0.016)	(0.014)	(0.011)	(0.014)	(0.017)
Event Year= 0	0.007	0.036***	−0.011	0.004	0.042***	−0.002	0.019	0.049**	0.014
	(0.008)	(0.009)	(0.015)	(0.011)	(0.014)	(0.015)	(0.012)	(0.019)	(0.017)
Event Year= +1	0.012	0.024**	0.004	0.006	0.033**	0.008	0.031***	0.045***	0.034*
	(0.009)	(0.011)	(0.014)	(0.011)	(0.014)	(0.015)	(0.011)	(0.013)	(0.018)
Event Year= +2	0.022	0.041***	0.006	0.015	0.050***	0.007	0.037**	0.059***	0.024
	(0.013)	(0.012)	(0.015)	(0.011)	(0.015)	(0.017)	(0.014)	(0.016)	(0.020)
Event Year= +3	0.012	0.031***	0.001	0.007	0.025*	0.014	0.019	0.037**	0.027
	(0.011)	(0.011)	(0.016)	(0.008)	(0.014)	(0.016)	(0.012)	(0.017)	(0.017)
Event Year≥ +4	0.008	0.019	0.008	0.004	0.013	0.011	0.015**	0.023	0.017
	(0.007)	(0.011)	(0.010)	(0.009)	(0.012)	(0.012)	(0.007)	(0.015)	(0.013)
R^2	0.771	0.789	0.79	0.77	0.793	0.791	0.714	0.763	0.729
N	35936	17239	16958	35936	17239	16958	35936	17239	16958
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Rating FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TB Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Local Economy Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4: 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, state individual income tax cuts and 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 state and industry-year level.

Sample:	Tax Effective Dates			Tax Enactments		
Dependent variable:	LT Debt	LT Debt (mkt)	Tot Debt	LT Debt	LT Debt (mkt)	Tot Debt
	(1)	(2)	(3)	(4)	(5)	(6)
Event Year= -2	0.018**	0.012*	0.014*	-0.007	-0.004	-0.013
	(0.008)	(0.006)	(0.008)	(0.009)	(0.006)	(0.010)
Event Year= -1	0.014	0.014	0.012	-0.007	-0.004	-0.019
	(0.010)	(0.010)	(0.011)	(0.011)	(0.007)	(0.012)
Event Year= 0	0.008	0.016	0.008	0.011	0.010	-0.001
	(0.011)	(0.010)	(0.012)	(0.011)	(0.009)	(0.012)
Event Year= $+1$	0.016*	0.012	0.019*	0.017	0.012	0.012
	(0.008)	(0.007)	(0.010)	(0.013)	(0.009)	(0.013)
Event Year= $+2$	-0.000	0.003	0.002	0.017	0.013	0.007
	(0.011)	(0.010)	(0.012)	(0.011)	(0.009)	(0.014)
Event Year= $+3$	0.004	0.004	0.010	0.019*	0.013*	0.014
	(0.014)	(0.010)	(0.017)	(0.010)	(0.007)	(0.013)
Event Year$\geq +4$	0.002	0.002	0.003	0.008	0.005	0.003
	(0.008)	(0.006)	(0.008)	(0.010)	(0.008)	(0.010)
R^2	0.672	0.767	0.69	0.672	0.767	0.689
N	14157	14157	14157	14157	14157	14157
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Year FE	Yes	Yes	Yes	Yes	Yes	Yes
TB Controls	Yes	Yes	Yes	Yes	Yes	Yes
State Economy Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table 5: 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 "B" and above 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, state individual income tax cuts and hike indicators, a set of tax base and tax credit controls, as well as lagged changes and levels of county GDP, employment, per-capita income and population. 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 state and industry-year level.

Dependent variable:	Net Capital Expenditures			EBITDA		
Sample:	All	Small	Large	All	Small	Large
	(1)	(2)	(3)	(4)	(5)	(6)
Event Year$= -2$	-0.002	0.002	-0.007	0.000	0.002	-0.001
	(0.004)	(0.006)	(0.004)	(0.003)	(0.005)	(0.004)
Event Year$= -1$	-0.001	0.001	-0.007	0.005	0.002	0.006
	(0.005)	(0.007)	(0.007)	(0.003)	(0.005)	(0.006)
Event Year$= 0$	0.011*	0.014	0.004	0.003	-0.002	0.005
	(0.006)	(0.009)	(0.006)	(0.004)	(0.005)	(0.006)
Event Year$= +1$	0.008	-0.000	0.009	-0.000	-0.005	0.007
	(0.006)	(0.009)	(0.006)	(0.005)	(0.006)	(0.006)
Event Year$= +2$	0.011	0.014	0.003	-0.002	-0.003	-0.002
	(0.007)	(0.012)	(0.006)	(0.005)	(0.008)	(0.006)
Event Year$= +3$	0.010	0.013	-0.003	0.006	0.006	0.006
	(0.008)	(0.010)	(0.006)	(0.004)	(0.007)	(0.006)
Event Year$\geq +4$	-0.002	-0.013	0.000	0.004	0.002	0.007
	(0.004)	(0.009)	(0.005)	(0.003)	(0.005)	(0.004)
R^2	0.413	0.437	0.453	0.784	0.824	0.777
N	33871	16061	16153	35269	16886	16645
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Rating FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Year FE	Yes	Yes	Yes	Yes	Yes	Yes
TB Controls	Yes	Yes	Yes	Yes	Yes	Yes
Local Economy Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table 6: Model Estimation. This table reports the parameters and moments from the estimation of our model from Section 5. The parameter 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; ρ_τ is the serial correlation of the tax process; δ is the capital depreciation rate; 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 net of cash divided by lagged total assets; 'investment-to-assets' is defined as net capital expenditures divided by fixed assets; 'income-to-assets' is defined as operating income divided by lagged total assets; 'debt issuance' is defined as the change in net debt divided by total assets. Tax coefficient is a difference-in-difference coefficient from regressing leverage on the enactment dates with firm and industry-year fixed effects. Standard errors are clustered by firm and year.

A. Parameter estimates

	θ	ρ	σ	ρ_τ	δ	ψ	ξ	f
	0.9443	0.5232	0.1975	0.8575	0.0942	0.5269	0.6457	0.0273
	(0.0077)	(0.0088)	(0.0152)	(0.0104)	(0.0037)	(0.0322)	(0.0525)	(0.0085)

B. Targeted moments

	Actual	Simulated	t-stat.
Mean debt-to-assets	0.2364	0.2346	1.3915
Standard deviation debt-to-assets	0.0970	0.1087	-2.1455
Mean investment-to-assets	0.1076	0.0972	5.7808
Standard deviation investment-to-assets	0.1404	0.0776	11.3853
Mean operating income-to-assets	0.1452	0.1881	-8.1124
Standard deviation income-to-assets	0.0493	0.0459	1.7624
Serial correlation income-to-assets	0.4102	0.4816	-0.4007
Coefficient of debt issuance on net debt	-0.8588	-0.1990	-7.3038
Coefficient of debt issuance on income	0.0693	1.3432	-9.3461
Coefficient of debt issuance on net debt	-0.0106	-0.2004	7.9429
Coefficient of debt issuance on income	0.0953	0.8663	-22.7310
Tax coefficient	-0.0154	-0.0155	0.0102

Appendix A: 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:
$https://www.federalreserve.gov/reportforms/forms/FR\_Y-14Q20191231\_i.pdf$:

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

$\textbf{\textit{Net Income}}$ 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).

$\textbf{\textit{Net Sales}}$ 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).

$\textbf{\textit{EBITDA}}$ – 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).

$\textbf{\textit{Operating Income}}$ 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).

$\textbf{\textit{Cash}}$ 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).

$\textbf{\textit{Debt}}$ 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).

$\textbf{\textit{Long-Term Debt}}$ 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).

$\textbf{\textit{Total Liabilities}}$ 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).

$\textbf{\textit{Interest Expense}}$ 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).

$\textbf{\textit{Fixed Assets}}$ 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).

$\textbf{\textit{Total Assets}}$ 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).

$\textbf{\textit{Net Capital Expenditures}}$ 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:

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.

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.

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.

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

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:

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).

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).

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).

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).

Appendix B - Additional Analyses

Table B1: 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 the effective dates 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. All specifications include borrower, 4-digit NAICS industry-year fixed effects, the log of lagged firm sales, credit quality indicators, state corporate income tax hike indicators, state individual income tax cuts and hike indicators, a set of tax base and tax credit controls, as well as lagged changes and levels of county GDP, employment, per-capita income and population. Columns (1), (4), (7) present results for the full sample, columns (2), (5), (8) present results for firms below the median in total assets, and column (3), (6), (9) presents results for firms above the median in total assets. The standard errors are double clustered at the state and industry-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	0.008	-0.013	-0.010	0.004	-0.012	-0.006	0.013	-0.016
	(0.004)	(0.008)	(0.008)	(0.010)	(0.021)	(0.008)	(0.008)	(0.014)	(0.010)
Event Year= −1	0.008	0.013	-0.005	0.011	0.027	-0.002	0.022**	0.049***	-0.002
	(0.007)	(0.011)	(0.013)	(0.008)	(0.019)	(0.014)	(0.009)	(0.016)	(0.014)
Event Year= 0	0.012*	0.017*	-0.001	0.012	0.031*	-0.005	0.018*	0.039**	-0.002
	(0.007)	(0.010)	(0.013)	(0.008)	(0.017)	(0.016)	(0.010)	(0.016)	(0.020)
Event Year= +1	0.004	0.009	-0.004	0.002	0.013	-0.000	0.008	0.028	-0.007
	(0.008)	(0.010)	(0.014)	(0.008)	(0.016)	(0.015)	(0.010)	(0.018)	(0.017)
Event Year= +2	0.004	0.028*	0.000	0.012	0.022	0.004	0.014	0.043**	-0.006
	(0.009)	(0.014)	(0.011)	(0.015)	(0.017)	(0.017)	(0.011)	(0.019)	(0.018)
Event Year= +3	0.010	0.019	0.013	0.010	0.014	0.016	0.012	0.022	0.009
	(0.008)	(0.015)	(0.011)	(0.008)	(0.013)	(0.013)	(0.010)	(0.018)	(0.014)
Event Year≥ +4	0.005	0.004	0.012	0.005	-0.005	0.008	0.005	0.014	-0.008
	(0.006)	(0.011)	(0.010)	(0.010)	(0.017)	(0.009)	(0.010)	(0.019)	(0.013)
R^2	0.769	0.79	0.786	0.766	0.791	0.786	0.712	0.762	0.725
N	38221	18253	18224	38221	18253	18224	38221	18253	18224
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Rating FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TB Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Local Economy Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table B2: Summary Statistics. This table presents summary statistics for the 754 firm-years in our sample issuing private placements through Regulation D offerings since 2009. All firm financials variables the exception of *Book Assets* are scaled by firm total assets as of the prior year.

	Mean	St. Dev.	p10	p25	p50	p75	p90
	Firm-Year Financials for Firms with Private Placements						
Book Assets, $m	1,116	4,000	122	164	280	634	2,048
Net Income	0.02	0.10	-0.08	-0.02	0.02	0.06	0.11
Net Sales	1.39	1.38	0.14	0.40	0.97	1.82	3.39
EBITDA	0.12	0.13	0.003	0.05	0.10	0.16	0.22
Operating Income	0.06	0.13	-0.05	0.004	0.04	0.09	0.17
Cash	0.08	0.12	0.002	0.01	0.04	0.09	0.22
LT Debt	0.38	0.30	0.01	0.14	0.32	0.56	0.83
Debt	0.43	0.30	0.05	0.21	0.38	0.61	0.86
Total Liab.	0.75	0.33	0.37	0.53	0.71	0.93	1.17
Interest Expense	2.27	2.05	0.11	0.76	1.68	3.26	5.03
Fixed Assets	0.38	0.36	0.03	0.08	0.25	0.61	1.01
Total Assets	1.16	0.32	0.92	0.99	1.06	1.21	1.50

Table B3: Firm Leverage and Tax Enactments: Excluding Firms with Private Placements. 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 "B" and above by the lender. All specifications include borrower, 4-digit NAICS industry-year fixed effects, the log of lagged firm sales, credit quality indicators, state corporate income tax hike indicators, state individual income tax cuts and hike indicators, a set of tax base and tax credit controls, as well as lagged changes and levels of county GDP, employment, per-capita income and population. Columns (1), (4), (7) present results for the full sample, columns (2), (5), (8) present results for firms below the median in total assets, and column (3), (6), (9) presents results for firms above the median in total assets. The standard errors are double clustered at the state and industry-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	0.009	−0.001	0.014	0.004	−0.004	0.016	0.004	−0.003	0.017
	(0.006)	(0.008)	(0.009)	(0.008)	(0.015)	(0.010)	(0.009)	(0.012)	(0.012)
Event Year= −1	0.008	0.010	0.005	−0.002	0.014	0.006	0.011	0.009	0.027
	(0.009)	(0.012)	(0.012)	(0.013)	(0.016)	(0.015)	(0.011)	(0.014)	(0.017)
Event Year= 0	0.005	0.033***	−0.011	0.003	0.041***	−0.002	0.018	0.047**	0.015
	(0.008)	(0.009)	(0.015)	(0.011)	(0.014)	(0.015)	(0.012)	(0.018)	(0.017)
Event Year= +1	0.009	0.021*	0.004	0.005	0.032**	0.007	0.029***	0.043***	0.034*
	(0.010)	(0.011)	(0.013)	(0.011)	(0.013)	(0.014)	(0.011)	(0.012)	(0.018)
Event Year= +2	0.020	0.037***	0.005	0.014	0.049***	0.006	0.036**	0.059***	0.025
	(0.012)	(0.011)	(0.015)	(0.011)	(0.016)	(0.016)	(0.014)	(0.016)	(0.020)
Event Year= +3	0.008	0.029**	−0.001	0.005	0.026*	0.013	0.019	0.040**	0.027
	(0.010)	(0.011)	(0.016)	(0.008)	(0.015)	(0.016)	(0.011)	(0.017)	(0.018)
Event Year≥ +4	0.006	0.017	0.007	0.003	0.013	0.012	0.015**	0.022	0.018
	(0.007)	(0.012)	(0.010)	(0.009)	(0.012)	(0.012)	(0.007)	(0.014)	(0.013)
R^2	0.772	0.788	0.793	0.771	0.793	0.793	0.716	0.763	0.73
N	35255	16946	16607	35255	16946	16607	35255	16946	16607
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Rating FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TB Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Local Economy Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table B4: State Corporate Income Tax Cuts, Firm Leverage, and Investment: Credit Quality Split. 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 small private companies with at least $100 million in total assets as of the previous year that are rated "B" and above 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, state individual income tax cuts and hike indicators, a set of tax base and tax credit controls, as well as lagged changes and levels of county GDP, employment, per-capita income and population. Columns (1), (3), and (5) present results for non-investment grade firms, while columns (2), (4), and (6) present results for investment-grade firms. The standard errors are double clustered at the state and industry-year level.

Dependent variable:	*Long-Term Debt*		*Total Debt*		*Net Capex*	
Sample:	Non-IG	IG	Non-IG	IG	Non-IG	IG
	(1)	(2)	(3)	(4)	(5)	(6)
Event Year= -2	-0.000	0.010	-0.005	0.010	0.005	0.008
	(0.014)	(0.012)	(0.028)	(0.015)	(0.008)	(0.013)
Event Year= -1	0.005	0.017	0.011	0.014	0.001	0.011
	(0.017)	(0.016)	(0.028)	(0.018)	(0.009)	(0.012)
Event Year= 0	0.039*	0.020	0.051**	0.026	0.033**	0.010
	(0.021)	(0.021)	(0.025)	(0.024)	(0.013)	(0.016)
Event Year= $+1$	0.027	0.013	0.049*	0.029	0.008	0.005
	(0.020)	(0.020)	(0.025)	(0.022)	(0.013)	(0.020)
Event Year= $+2$	0.038*	0.014	0.068***	0.022	0.008	0.008
	(0.020)	(0.023)	(0.021)	(0.023)	(0.015)	(0.018)
Event Year= $+3$	0.028*	-0.009	0.039	0.002	0.023	-0.010
	(0.015)	(0.019)	(0.025)	(0.021)	(0.014)	(0.014)
Event Year$\geq +4$	0.022	-0.011	0.017	-0.006	-0.009	-0.025***
	(0.022)	(0.011)	(0.026)	(0.014)	(0.011)	(0.009)
R^2	0.772	0.843	0.736	0.905	0.438	0.596
N	9964	5428	9964	5428	9144	5115
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Rating FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Year FE	Yes	Yes	Yes	Yes	Yes	Yes
TB Controls	Yes	Yes	Yes	Yes	Yes	Yes
Local Economy Controls	Yes	Yes	Yes	Yes	Yes	Yes