Heterogeneous Responses to Corporate Tax Rates: Evidence from Small and Large Firms

Ruhollah Eskandari† and Morteza Zamanian‡

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Abstract

Do changes in the marginal tax rate of corporations affect their investment? Using unique data from US firms and a new measure of exogenous changes in marginal tax rate, we show that investment response of large firms to a marginal tax cut is almost twice the response of small firms. Consistent with small firms being more credit constrained, their new investment is financed almost entirely by debt whereas large firms use both internal cash and debt. Our findings are in line with the view that unconstrained firms are more responsive to marginal tax rate changes than to average tax changes. (JEL C32, C53, E62, G32, H32)

1 Introduction

The recent Tax Cuts and Jobs Act (TCJA) signed into law on 22 December 2017 have sparked renewed interest in the effect of tax policy on corporate decisions. The impact

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†Huddersfield Business School, Department of Accounting, Finance and Economics, ruholiah.eskandari@york.ac.uk

‡Amirkabir University of Technology, mo.zamanian@aut.ac.ir
of tax policy on corporate investment has garnered intense interest in public finance and macroeconomic research (Hall and Jorgenson (1967), Summers (1981), Auerbach and Hassett (1992), Cummins et al. (1994), Goolsbee (1998), Hassett and Hubbard (2002), Yagan (2015), Zwick and Mahon (2017), and House and Shapiro (2008)). In this paper, we examine how changes in the marginal tax rate (MTR) of corporations affect their investment. In particular, our main contribution is two-fold: (i) constructing a new narrative measure of exogenous variations in corporate MTRs for the US manufacturing firms; and (ii) analyzing real and financial responses of small versus large firms to these variations. In particular, we estimate the responses of investment, cash, and debt to a decline in the MTR. Our results show that the investment response of large firms to a marginal tax cut is almost twice the response of small firms. In addition, we show that small firms’ new investment is financed almost entirely by debt whereas large firms use both internal cash and debt.

Changes in MTRs, unlike other tax reforms, apply to every corporation with progressive income taxes. Therefore, allowing for heterogeneous responses, we examine whether a tax cut that goes to large firms stimulates more investment growth than a similarly-sized tax cut for small firms. Having private, smaller, bank-dependent firms in our sample enables us to estimate the heterogeneous responses of small versus large firms to MTRs. Calculating MTR changes for the panel of small and large firms is a novel contribution of this paper. Relying on publicly-listed firms (such as Compustat) indeed ignores private firms that are often treated as being more financially constrained. \(^1\) Zwick and Mahon (2017) and Yagan (2015) are two recent exceptions that analyze the effect of bonus depreciation policies on corporate investment and how it varies across public and private firms.\(^2\)

To estimate the heterogeneous responses of small versus large firms to MTRs, we construct the distinct series of changes in the MTR for small and large firms from 1956 to 2008. Calculating MTR changes for the panel of small and large firms is a novel contribution of this paper.\(^2\)

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\(^1\)Relying on publicly-listed firms (such as Compustat) indeed ignores private firms that are often treated as being more financially constrained.

\(^2\)Alstadsæter et al. (2017) study the effect of a dividend tax cut on corporate investment by unlisted firms in Sweden. Kari et al. (2009) evaluate the impact of dividend tax changes on investment of Finnish listed and unlisted corporations.
our study. Romer and Romer (2010) pioneered the use of narrative methods to identify tax changes that are exogenous to the state of the economy. We contribute to this literature by constructing a new narrative measure of exogenous variations in MTR rather than using the original Romer and Romer (2010) and Mertens and Ravn (2013) average tax rate series. We then examine how these variations affect the balance sheet of these two groups of firms. To achieve this task, we go through the following steps: (i) identify all instances where the statutory corporate tax rates have changed, (ii) restrict the sample to instances where these changes were exogenous to economic conditions using the narrative identification of Romer and Romer (2009), and (iii) compute exogenous changes in the marginal corporate tax rates for the group of small and large firms. This selection procedure yields a total of six exogenous declines in marginal tax rates at 1964Q2, 1965Q1, 1979Q1, 1982Q1, 1983Q1 and 1987Q3.3

For our empirical analysis, we make use of US Census Bureau’s Quarterly Financial Report (QFR) which is a large and unexplored dataset that includes a large proportion of small and private firms. QFR reports the balance sheet and income statement of US manufacturing firms in eight asset size classes since 1947. The QFR carry several advantages relative to other publicly released firm-level datasets which makes it appropriate for our research purposes. First, it provides information on both publicly and privately held firms. While a majority of datasets are restricted to public firms, using QFR helps us to improve the representativeness of our overall sample and is particularly relevant for studying the issue of financial constraints. In addition, QFR has a long period coverage which allows us to explore different episodes of exogenous tax shocks, mainly during the period from 1960s to 1980s when most of the exogenous tax changes were taken. This is particularly important since exogenous variations in tax rates are not very frequent over the recent decades in the US and after 1980 there are only two exogenous marginal corporate tax cuts (for large and publicly traded firms) that occur in 1987Q3 and 2018Q1. Finally, the data is reported at a

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3In the online appendix, we test the predictability of our constructed exogenous tax series and show that they are unforecastable on the basis of past observations on the vector of observables.
quarterly frequency thereby facilitating policy and business cycle analysis.\(^4\)

Our estimates show that both small and large firms respond to exogenous tax cuts by boosting investment. However, large firms increase investment nearly two times more than small firms at all horizons. In particular, a 1% cut in the MTR raises investment of small and large firms to a maximum of, respectively, 0.18 and 0.33 percentage points in the eighth quarter after the introduction of the tax reform.\(^5\) The behavior of total debt displays a pattern similar to investment in that the relative rise of the debt growth of large firms is much more pronounced than that of small firms. These results hold for the major components of short- and long-term debt, namely bank loans and commercial paper. The response of cash looks very different across firms. While the cash ratio of small firms exhibits a slightly negative response (largely insignificant) at all horizons, the cash ratio of large firms closely mimics small firms until quarter five and then it drops sharply. This switch in behavior is statistically significant.

We perform extensive robustness checks with respect to our measures of firm size, sample period, controlling various provisions of tax reform changes, measurement error in our narrative shocks, and finally a firm-level evidence and find little change in the estimates.\(^6\) Most importantly, we show that excluding the largest firms, especially those in the top 1%, from the other large firms has very little impact on our results. It is important because, recent empirical studies have provided evidence that the size of very large firms is so enormous that the behavior of the aggregate series is liable to be dominated by their behavior.\(^7\)

\(^4\)Note that QFR is an unexplored data since it was only available in hard copies prior to 1988 and there are some changes in its size brackets during the time. We extended it back to 1956 by collecting data from various issues of the QFR books and microfiches. We then transformed all the data into electronic versions and integrated them into unified forms.

\(^5\)While our estimates are based on 1% cut in the MTR, the average changes of the marginal tax rates during the sample of our study are 14% and 15%, respectively, for small and large firms. Consequently, using our estimates, one can project the near-term impact of the TCJA on investment of US small and large firms. The Act cut the top marginal federal corporate tax rate from 35 to 21 percent (by 40 percent). In the online appendix, we provide a back-of-the-envelope exercise to investigate the investment/cash/debt growth rates of small and large firms before and after the enactment of the TCJA.

\(^6\)In the online appendix, we perform further robustness checks with respect to tax increases vs. decreases, unanticipated vs. anticipated tax changes, and an alternative estimation framework (a VAR Model).

\(^7\)See, for example, Covas and Den Haan (2011), David et al. (2017b,a), and Van Reenen (2018), among
tion, we provide firm-level evidence on the effects of marginal tax rate changes. We estimate the relationship between changes in the corporate MTRs and investment, cash, and debt of public US companies. The general pattern of the firm-level responses to MTRs changes are remarkably similar to our semi-aggregate QFR-level responses.

On the theory side, we derive two testable implications about differential responses of small versus large firms following MTR changes. Cutting marginal corporate tax rates simultaneously changes incentives on multiple margins. First, there is an income effect. The reduction in tax rates reduces tax liability and acts as a retained earning windfall which alleviates firms’ financial constrain through an income effect that allows firms to optimally accumulate debt. This channel may do more to alleviate financial constraints for small firms since those firms are financially more constrained. It is therefore reasonable to expect that small firms issue more debt for financing incentives. Second, there is a substitution effect. Following marginal tax rate cuts, the after-tax rate of return on investment increases while the tax advantage of debt-financing falls relatively to cash-financing, as net interest is deductible and valued at the MTR. The latter substitution effect surely contribute to the greater cash financing of investment for larger firms following marginal rate cuts and therefore we expect large firms to rely more on cash than its small counterpart.

Changes in any one instrument affect firms on several decision margins and our primary finding that both group of firms increase their investment following marginal tax rate cuts reflects the intensive margins of tax cut.\(^8\) We contribute to this literature by providing new empirical evidences on the importance of financing constraints in the differential response of small versus large firms to corporate tax policy. Since size is a reasonable proxy for capital market access, small firms are more likely to be constrained in their ability to raise funds externally.\(^9\) Our finding that large firms benefit more from a tax reduction than small others.

\(^8\)As noted in Auerbach (2018), a corporate tax rate cut provides an incentive for corporations to increase investment from lower marginal effective tax rate (intensive margin) and lower average tax rate (extensive margin).

\(^9\)See, for example, Fazzari et al. (1988b), Gertler and Gilchrist (1994), Faulkender and Petersen (2006),
firms is consistent with the theoretical view that unconstrained firms’ investment is more responsive to changes in MTRs than constrained firms (Fazzari et al. (1988a), Holtz-Eakin et al. (1994), Hassett and Hubbard (2002), Devereux and Griffith (2003), and Djankov et al. (2010)). When cost of external finance is substantially larger than internal finance, firms’ investment rely largely on internal cash flow. Therefore, the amount of earning devoted to taxes plays the key role in the firms’ decision to invest. Variations in MTRs have then relatively small impact on corporate investment when firms are financially constrained.

The rest of this paper is organized as follows. Section 2 reviews the related empirical literature and explains our contributions. Section 3 describes the data and our measurement of small and large firms. Section 4 describes the identification of tax shocks. Sections 5 and 6 provide a descriptive analysis of the real and financial behavior of firms, and then lay out the basic specification of our econometric methodology, and finally report our empirical results. Section 7 discusses a number of robustness checks followed by a conclusion in Section 8.

2 Literature Review

Our paper is related to several strands of the literature. First, it is related to the recent empirical studies which has begun addressing the impact of marginal personal income tax rates on economic aggregates (Barro and Redlick (2011), Mertens and Montiel Olea (2018), and Zidar (2019)). In particular, Mertens and Montiel Olea (2018) construct a new measure of the marginal personal tax rates based on the Romer and Romer (2010) narrative account. They provide evidence that the aggregate economic responses are mainly due to marginal rather than average tax rates. In particular, Mertens and Montiel Olea (2018) construct a new narrative measure of exogenous variations in MTRs associated with postwar personal and Leary (2009), among others. Gertler and Gilchrist (1994) provide some justification for using size to proxy for capital market access, and they also discuss some of the limitations. The rationale for using size is the assumption that smaller firms are bank-dependent, risky, younger and informationally opaque and, therefore, they have restricted access to public debt markets and consequently face more severe supply constraints in their ability to issue debt (Erickson and Whited (2000), and Frank and Goyal (2015)).
tax reforms in the US. As they discuss, among the 15 plausible instances of unanticipated tax policy shocks that identified as exogenous by Romer and Romer (2010), a subset of 8 shocks correspond to tax reforms with a direct impact on MTRs. The other 7 instances impacted the ATRs but did not change the marginal rates. They show that policies with a direct impact on marginal personal tax rates are the key events generating the real economic effects with responses of GDP to marginal rather than average tax rates. They find no evidence for any effect on incomes when ATRs decline but marginal rates do not.

Second, our paper is also related to the literature exploring the heterogeneous responses of firms to tax reforms. The renewed interest in this topic, however, has been carried out on depreciation allowances, investment and dividend tax credits (Yagan (2015), Zwick and Mahon (2017)). Zwick and Mahon (2017) use a sample of more than 120,000 small and large firms to explore the effect of bonus depreciation policies on corporate investment and how it varies across firms. They analyze two bonus periods of 2001-2004 and 2008-2010 and find that small firms are substantially more responsive to bonus depreciation schedules. Yagan (2015) uses a sample of private C- and S-corporations and shows that investment did not respond to the 2003 dividend tax cut. Note that these laws included additional investment incentives targeted specifically at small businesses (House and Shapiro (2008)) or at least the limits on its use effectively tend to confine its benefits to such firms. See also Guenther (2018) and Kitchen and Knittel (2016) for more discussion.

In addition, our findings expands the literature regarding the sensitivity of small versus large firms to macroeconomic volatilities. In a seminal paper, Gertler and Gilchrist (1994) present evidence that small firms are more responsive to monetary policy shocks. They use the QFR data and show that small firms account for a significantly disproportionate share of the manufacturing decline that follows tightening of monetary policy. Using the same methodology and the QFR data, Kudlyak and Sanchez (2017) find that short-term debt and sales of large firms declined much more than that of small firms during the 2008 financial.
crisis and most recessions since 1969. Moscarini and Postel-Vinay (2012) show that the net job creation of large firms reacts more sensitively to the business cycle. More recently, Mehrotra and Crouzet (2020) use the QFR confidential microdata from 1977 to 2014 and find evidence of greater cyclical sensitivity among small firms. They also find that this greater sensitivity cannot easily be accounted for by financial factors.

Our paper is related to a well-developed body of fiscal policy literature about the real effect of taxation on economic activities. Mountford and Uhlig (2009) find that deficit-financed tax cuts improve GDP, with a maximal present value multiplier of five dollars of total additional GDP per each dollar of the total cut in government revenue 5 years after the shock. Romer and Romer (2010) use the narrative methods to identify exogenous tax changes and their impact on economic aggregates. Mertens and Ravn (2013) improve their measure by distinguishing between changes in personal and corporate income tax rates finding large short-run effects on output associated with unanticipated changes in either tax component. Mumtaz and Surico (2018) look at taxation through the lens of economic uncertainty. They argue that while the effect of spending and monetary policy uncertainty appears to be small, uncertainty about tax changes has detrimental consequences for real activity. We contribute to this literature by exploring how real and financial activities of firms over a long horizon are impacted by tax policies, using a new narrative measure of exogenous variations in MTR.

Finally, our paper complements the previous studies showing the heterogeneous impact of different tax measures on corporate activities. In particular, we provide evidence for the existence of a meaningful difference between corporate marginal and average tax rates in the US. Since our measure of MTR is defined as the rate imposed on taxable income within a given tax bracket, we use the statutory rates at which corporations are taxed. Our results support that there is a meaningful difference in the US between statutory and average tax rates which has been documented in the recent literature. An example is Dyreng et al. (2017) which investigates the issue in details. As the mention in this study: “the results point to an

10We also define ATR as the percentage of income actually paid after taking into account tax breaks.
increasing disconnect between statutory tax rates and effective tax rates over time among US firms. While the US statutory tax rate remained remarkably stable over the past 25 years, US firms’ effective tax rates have continued to decline. This notion is mention very clearly in other studies as well. As mentioned in Office (2013), “Effective tax rates (ETR) differ from statutory tax rates in that they attempt to measure taxes paid as a proportion of economic income, while statutory rates indicate the amount of tax liability (before any credits) relative to taxable income, which is defined by tax law and reflects tax benefits and subsidies built into the law.” In addition they indicate that “The average effective tax rates for profitable large corporations were well below the statutory rate and well below the effective rates for all large corporations in tax years 2008 through 2010”. Hungerford (2013) argues that “While the United States has one of the highest statutory corporate income-tax rates among advanced countries, the effective corporate income-tax rate (27.7%) is quite close to the average of rich countries (27.2%, weighted by GDP).”. Sullivan (2008) also provide evidence on differences between top statutory and effective tax rates.

3 Data and Measurement of Small and Large Firms

This section describes the data and the procedure of constructing the time series for small and large firms.

3.1 The Quarterly Financial Report

In this paper, we use the US Census Bureau, Quarterly Financial Report (QFR) of manufacturing firms. The QFR program has collected and released statistics of US firms at quarterly frequencies since 1947.\footnote{The QFR program is conducted under the authority of Title 13 of the United States Code, Section 91, which requires that financial statistics of business operations be collected and published quarterly. The law imposes a joint obligation on corporations to respond and on the US Census Bureau to maintain the confidentiality of information reported (http://www.census.gov/econ/qfr/historic.html).} Currently, this program covers manufacturing, mining, wholesale trade, retail trade, and some service industries. The QFR data is used by the Bureau of...
Economic Analysis as a primary source to estimate corporate profits for the National Income and Product Accounts (NIPAs). Based upon a sample survey, the QFR reports the income statements, balance sheets and related financial and operating ratios for US firms broken down by asset size and industry. At present, the QFR semi-aggregated statistics are released in 8 asset size brackets; under 5, 5-10, 10-25, 25-50, 50-100, 100-250, 250-1000, and over 1000 (all in million dollars). There were some changes in size brackets and reported data items in 1974, 1980 and 1988. All these data we integrated into unified forms and transformed into electronic versions for the purpose of this study. This data was only available in hard copies prior to 1988. We extended the data back to 1956 by collecting data from various issues of the QFR books and microfiches. An extensive robustness analysis was conducted to verify the accuracy of the collected data. We use this data to construct the aggregate time series of investment and other variables of interest. Previous studies employing QFR such as Gertler and Gilchrist (1994) restricted their analysis to very few data items such as sales and total debt, and variables such as investment, cash holdings, and short- and long-term debt are explored for the first time in our study.

We use QFR due to a number of advantages for our research purpose. One advantage is that it contains a wide range of historical data from 1947, allowing us to explore different episodes of exogenous tax shocks. It is particularly important because exogenous variations in taxation are not very frequent in the US over the last decades. This leads us to use QFR instead of, for example, Compustat alone since there is only one exogenous marginal corpo-

\[\text{\textsuperscript{12}}\text{Data collected by the QFR are also widely used by the Federal Reserve Board to assess industrial debt structure, liquidity, and profitability; the Treasury Department to estimate corporate tax liability; the Council of Economic Advisors and Congressional Committees utilize key indicators derived from QFR data as they design economic policies and draft legislation; the Federal Trade Commission (FTC) utilizes the series as a basic reference point in analyzing the financial performance of American industries; and banking institutions and financial analysts draw upon the series in making investment evaluations.}\]

\[\text{\textsuperscript{13}}\text{The main purpose of the QFR is to provide timely, accurate data on business financial conditions for use by Government and private-sector organizations and individuals. The primary public users are Bureau of Economic Analysis (BEA), Federal Reserve Board (FRB), Council of Economic Advisers, Small Business Administration, U.S. Treasury-Office of Tax Analysis, and Joint Committee on Taxation. Also, the QFR data has been used by Meltzer (1960), Nadiri (1969), Jorgenson et al. (1970), Gertler and Gilchrist (1994), Oliner and Rudebusch (1996), Leary (2009), Kudlyak and Sanchez (2017), and Mehrotra and Crouzet (2020), among others.}\]
rate tax cut related to large and publicly traded firms that occurs in 1987Q3. Another key advantage of QFR which makes it very appropriate for our research purpose is that QFR is an inclusive dataset in which the non-traded firms dominate the lower tier of the sample size distribution. Since small firms are almost never publicly traded, they are excluded in many datasets. Hence, the behavior of small firms is the missing aspect in the literature. Finally, the quarterly frequency of the reported QFR data makes it compatible with macroeconomic time series that are being reported in quarterly frequencies. Therefore, using this data permits us to include a large set of macroeconomic time series and their informational content in our econometric framework. Having all these advantages, QFR is appropriate and informative data to explore how tax policy impacts the performance of firms in different size classes.

The average loss ratio in the Compustat data rose from 0.02 to 0.25 between these periods, although this 1,300 percent increase can be attributed largely to the expansion of the Compustat sample to include more smaller firms. All publicly-traded firms must report the data items used in this paper on their accounting statements. Firms that appear in the data with missing items were typically not publicly traded in any years with incomplete data. Firms that do not appear at all were privately held or too small to be included by Compustat in its early years. It seems most likely that private firms would be more likely to face financing constraints than public firms, given their inability to raise funds for investment in the equity market. Small growing firms may also be more likely to face financing constraints than large firms. Thus by excluding small and private firms, results could understate the importance of cash flows in determining the impact of tax incentives for investment.

3.2 Measurement of Small and Large Firms

We construct our small and large group using a similar version of the procedure applied in Gertler and Gilchrist (1994). We introduce sales as our indicator of firm size and aggregate
all firm sizes into small and large groups. As the QFR brackets are classified based on asset size, we sort the classes from the smallest asset bracket to the largest. We then accumulate their sales beginning from the smallest asset class until we reach the 30\textsuperscript{th} percentile of the total sales in each period, our cutoff for small firms. Large firms are above the 30\textsuperscript{th} percentile of total sales.

More formally, using the quarterly data from 1956 through 2008, we follow the procedure below to construct our size groups. Let $S_{it}$ denote total sales of firms in size category $i$ in period $t$ (after deflating by the GDP deflator). We define $\overline{S}_{it}$ as the accumulated assets for categories less than or equal to category $i$ in period $t$ normalized by total sales in that period. Where $N = 8$ denotes the number of size categories.

$$\overline{S}_{it} = \frac{\sum_{j=1}^{i} S_{jt}}{\sum_{j=1}^{N} S_{jt}}, \quad i = 1, \ldots, N_t$$

Then we compute the threshold value or cutoff $i^*_t$ as,

$$i^*_t = \min_{i \in \{1, N_t\}} \{\overline{S}_{it} > 0.3\}$$

as well as the weights $\omega_t$ such that

$$\omega_t \overline{S}_{(i^*_t - 1)t} + (1 - \omega_t) \overline{S}_{i^*_t t} = 0.3$$

Small firms are those with sales below the 30\textsuperscript{th} percentile of aggregate sales. As discussed by Gertler and Gilchrist (1994) this procedure reasonably adjusts for biases arising from shifting firms across categories over time. This shift is mainly caused because the measure of size in the QFR is nominal assets implying inflation causes firms to drift from low nominal asset categories to high ones over time. Using this procedure, we have a consistent definition

\textsuperscript{14}All the results are robust when we divide the firms into large and small categories based on assets.
of small and large firms over the whole period. Figure 1 depicts the cutoff that straddle this 30th percentile over the period of analysis. The cutoff between small and large firms increases over time as the nominal assets of firms increases. When the cutoff falls inside the largest category (i.e., \( i_t^* = 8 \)), we set \( \omega_t \) equal to one in calculating the variables for small firms. As Gertler and Gilchrist (1994) show, this grouping of small and large firms provides a measure of the size as a reasonable proxy for access to capital markets.

To summarize, note that our cutoffs are built on asset classes. Therefore, for example, in 1964 where the cutoff is 25 million dollars, all firms with the asset value less than this threshold are categorized as small. Our classification of small firms for the year 1964 is then not necessarily matched with the $25K in revenue which is the threshold of surcharge exemption. Our choice of sales for sorting firms into small and large works as follows: we accumulate their sales beginning from the smallest asset class until we reach the 30th percentile of the total sales in each period, our cutoff for small firms. Therefore, our threshold of small/large firms are in asset size and not the sales.

**Figure 1: Percent of Manufacturing Sales by Cumulative Asset Size**

Cutoff: firms drift from low nominal asset categories to high categories.

**Notes:** This figure depicts the cutoff that straddle this 30th percentile over the period of analysis. The cutoff between small and large firms increases over time as the nominal assets of firms increases.

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15Note that the GDP deflator has no impact on the computation of the weights, \( \omega_t \).
After deriving the weights, we use the following procedures to compute the time series in levels and growth rates of variables for small and large firms. We first construct the time series trends (in levels) of variables for small and large firms as follows. Let \( G \) to be any variable of interest and \( G^S_t \) and \( G^L_t \) denote the corresponding trends of \( G \) for small and large firms,

\[
G^S_t = \sum_{j=1}^{i^*_t-1} G_{j,t} + (1 - \omega_t)G_{i^*_t,t}^*
\]

and

\[
G^L_t = \omega_t G_{i^*_t,t}^* + \sum_{j=i^*_t+1}^{N_t} G_{j,t}
\]

For the short-term analysis, we construct the times series of growth rates for variables of interest. Following Gertler and Gilchrist (1994), let \( G \) to be any variable of interest and \( g^S_t \) and \( g^L_t \) denote the growth rates of \( G \) for small and large firms.

\[
g^S_t = \frac{\sum_{j=1}^{i^*_t-1} G_{j,t} + (1 - \omega_{t-1})G_{i^*_t-1,t}^*}{\sum_{j=1}^{i^*_t-1} G_{j,t-1} + (1 - \omega_{t-1})G_{i^*_t-1,t-1}} - 1
\]

and

\[
g^L_t = \frac{\omega_{t-1} G_{i^*_t-1,t}^* + \sum_{j=i^*_t-1+1}^{N_t} G_{j,t}}{\omega_{t-1} G_{i^*_t-1,t-1} + \sum_{j=i^*_t-1+1}^{N_t} G_{j,t-1}} - 1
\]

We then seasonally adjust the series with a 4-quarter moving average and also linear detrending.\(^{16}\) Note that the size categories over which the growth rates are computed are the same for periods \( t \) and \( t - 1 \) (\( i^* \) and \( \omega \)). Splicing was done when the size categories in \( t - 1 \) are different than in \( t \).

For our analysis, we use growth rates instead of levels to make sure that our comparison between the responses of small and large firms are not impacted by the different scales of the

\(^{16}\)Since the QFR data is reported at a quarterly frequency and it is not seasonally adjusted, we therefore use smoothing to remove the seasonal component of the QFR time series.
variables in these two groups. In fact, the level of the 30% would show no variation for the relative growth of small versus large firms. The growth rates thus capture the difference in performance. To see relative performance over a number of quarters around specific events it is useful to cumulate these growth rates. The underlying average growth rates for small firms and large firms might differ however so one would want to adjust for that when seeking to understand the cyclical component. One could first take the mean out of the growth rates and then cumulate, or cumulate and detrend using a linear trend. This would be the same.

Table 1 presents summary statistics. For all variable definitions and details of their construction, see the Appendix A.

Table 1: Summary Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Small Firms</th>
<th></th>
<th></th>
<th></th>
<th>Large Firms</th>
<th></th>
<th></th>
<th></th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash/assets (%)</td>
<td>9.618</td>
<td>1.161</td>
<td>7.477</td>
<td>12.65</td>
<td>5.879</td>
<td>2.28</td>
<td>3.18</td>
<td>14.573</td>
<td>247</td>
</tr>
<tr>
<td>Cash flow volatility</td>
<td>0.004</td>
<td>0.002</td>
<td>0.001</td>
<td>0.009</td>
<td>0.003</td>
<td>0.002</td>
<td>0.001</td>
<td>0.009</td>
<td>244</td>
</tr>
<tr>
<td>Cash flow/assets</td>
<td>0.023</td>
<td>0.006</td>
<td>0.011</td>
<td>0.044</td>
<td>0.02</td>
<td>0.008</td>
<td>0.002</td>
<td>0.044</td>
<td>246</td>
</tr>
<tr>
<td>Sales/assets (%)</td>
<td>44.356</td>
<td>8.293</td>
<td>27.651</td>
<td>55.214</td>
<td>25.035</td>
<td>5.566</td>
<td>12.846</td>
<td>33.745</td>
<td>247</td>
</tr>
<tr>
<td>STD/assets (%)</td>
<td>5.887</td>
<td>1.293</td>
<td>3.28</td>
<td>8.668</td>
<td>2.939</td>
<td>0.794</td>
<td>1.571</td>
<td>4.673</td>
<td>247</td>
</tr>
<tr>
<td>Investment/assets (%)</td>
<td>42.035</td>
<td>7.721</td>
<td>33.813</td>
<td>59.112</td>
<td>63.513</td>
<td>9.950</td>
<td>45.434</td>
<td>79.639</td>
<td>246</td>
</tr>
<tr>
<td>NWC/assets (%)</td>
<td>28.675</td>
<td>5.56</td>
<td>17.839</td>
<td>37.182</td>
<td>14.019</td>
<td>10.501</td>
<td>1.565</td>
<td>33.042</td>
<td>247</td>
</tr>
</tbody>
</table>

Notes: The sample includes manufacturing firms drawn from the US Census Bureau, Quarterly Financial Report (QFR) from 1956 to 2008. For all variable definitions and details of their construction, see the Appendix A.

4 Identifying Tax Cuts

This section details the construction of the MTR measures for small and large firms using the narrative identification approach. Shocks identified by the narrative approach are model-independent and therefore are not affected by possible omitted variables as noted by Romer and Romer (2010). Since our study aims to compare the impact of taxes on small and large firms, we need to construct a measure that allows us to estimate the response of firms to a similarly-sized tax shock. Variations in the MTRs is a proper measure for this purposes.
4.1 Identifying the Dates

To construct our measure of changes in MTR, we select all shifts in the US federal statutory corporate income tax rates between 1956 and 2008. According to the Statistics of Income (SOI) Tax Stats Historical Table 24 there are twelve shifts in corporate statutory tax rates over this period. As shown in SOI Table 24 these shifts are dated 1965, 1968, 1970, 1971, 1975, 1979, 1982, 1983, 1985, 1987 and 1994. We restrict our attention to a subset of these dates that are exogenous to the state of economy. We therefore eliminate reforms arising endogenously from economic conditions. To do this, we rely on the narrative identification strategy of Romer and Romer (2009).

The selection procedure results a total of six exogenous marginal tax cuts at 1964Q2, 1965Q1, 1979Q1, 1982Q1, 1983Q1, and 1987Q3. We shall refer all of these points as “tax dates”. Note that, as mentioned earlier, relying on narrative approach to identify policy changes usually yields a small number of exogenous shocks. Too often, though, narrative methods that use historical documents identifies a small number of exogenous policy changes as compared to other identification methods (see, for example, Gertler and Gilchrist (1994), Ramey (2011), Romer and Romer (2010), Barro and Redlick (2011), and Favero and Giavazzi (2012)). In addition, we follow Mertens and Ravn (2012) to distinguish between anticipated and unanticipated reforms by introducing a timing convention. When the announcement date and the implementation date of a reform are no longer than 90 days apart, we classify the corresponding tax reform as unanticipated. The anticipated reforms are then those changes for which the two dates differ by more than 90 days. After scoring the tax reforms in this manner, two of the six selected reforms are defined as unanticipated (1964Q2 and 1987Q3) and the other four as anticipated (1965Q1, 1979Q1, 1982Q1 and 1983Q1). Appendix B provides our narrative analysis of all historical changes in federal corporate marginal tax rates and their sources in detail. Note that this identification strategy eliminates some exogenous tax reforms which are not implemented through changes in statutory rates. For example, most of the investment incentive reforms such as the 2002 and 2003 laws are excluded. The following section provides full details of measuring the size of MTRs for both groups of firms.

\[17\] While we concentrate on tax cuts, we identified two exogenous marginal tax rate increases in 1984Q3 and 1994Q2.

\[18\] Following Mertens and Ravn (2012) the announcement date is the date at which the policy has been legislated and the implementation date is the date at which the changes were to be implemented.
4.2 Measuring the Size

The aim of this step is to measure the size of the MTR changes for small and large firms at each tax date. Remind that our small and large groups are constructed by aggregating eight QFR categories into two groups (see Subsection 3.2). To measure the average size of an MTR cut for each group, we first measure the average size of tax cut for each QFR bracket. Then the size of tax cut for each small and large group is the average of MTR cuts over the brackets belonging to that group. Measuring the size of tax cuts for QFR brackets raises the difficulty that firms within each QFR bracket belong to multiple income tax brackets, and we don’t know the distribution of income in QFR brackets. To overcome this difficulty, we use US Compustat manufacturing firms and proceed through the following steps. For the sake of illustration, we execute the procedure for a sample of 16 hypothetical Compustat firms at a hypothetical tax date (these firms are denoted by f1 to f16 in Table 3 and their “total asset” and “pretax income” are reported in columns 2 and 3).

(i) We sort Compustat firms by total asset and then assign each firm to one QFR bracket based on its asset value. The result for the hypothetical sample appears in column 4 of Table 3.

(ii) Referring to the schedule of the tax reform at each tax date (Table 2 for the hypothetical date), we determine the size of marginal tax cut for each firm (columns 6 and 7). As shown in Table 2 the size of the marginal tax cut denoted by $mtr$ is the change in MTR divided by the initial level of MTR, i.e., $mtr_t = \frac{MTR_t - MTR_{t-1}}{MTR_{t-1}}$.

(iii) For each QFR bracket, we calculate the weighted average of $mtr$ for firms belonging to that bracket. The weights are total assets of the firms. In our example, f1 and f2 belong to the first QFR bracket. In addition, f1 belongs to the income class “25000$ and over” while f2 belongs to the class “less than or equal 25000$”, and the size of tax cut for them are 4 and 5 percent respectively. Therefore, the weighted average decline in MTR for the first QFR bracket at the tax date is $mtr_{1,t} = \frac{(4 \times 3.8) + (5 \times 4.61)}{3.8 + 4.61} = 4.55\%$.

Firms belonging to the second QFR bracket are f3 and f4 where the former has negative income. Since firms with negative income are exempted from taxation, we let such firms to receive zero tax cut after the reform. Therefore, the weighted average decline in MTR for this bracket is estimated as $mtr_{2,t} = \frac{(4 \times 9.4) + (0 \times 7.5)}{9.4 + 7.5} = 2.22\%$. We repeat this procedure to estimate the average $mtr_t$ for each QFR bracket at each tax dates.

(iv) Finally, we measure the average decline in MTRs for each group of small and large firms.
firms by an average over all $mtr_{i,t}$ belonging to that group weighted by total assets of the bracket. The tax cut for the cutoff category is partially considered in both small and large groups due to its weight in either group.\textsuperscript{20} The size of $mtr$ for small firms using our hypothetical sample is:

$$mtr_{S,t} = \sum_{i=1}^{8} (mtr_{i} \times \varpi_{S,i}) = 3.86\%$$

where $\varpi_{S,i}$ is the share of $i^{th}$ bracket in the total asset of small firms. Assuming the cut-off category to be 3 (see Figure 1), the small group includes the whole first 2 QFR brackets and part of the 3\textsuperscript{rd} (then all $\varpi_{S,4} = ... = \varpi_{S,8} = 0$). These weights are presented in columns 9 and 10 in B.2. Similarly, the corresponding $mtr$ for large firms at this tax date is:

$$mtr_{L,t} = \sum_{i=0}^{8} (mtr_{i} \times \varpi_{L,i}) = 3.73\%$$

The calculated $mtr$s for both small and large firms in this example (taking 16 Compustat firms) is reported in the last column of Table 3.

Using the whole Compustat manufacturing sample and proceeding through these steps at every tax date, we construct our narrative measure of declines in MTRs for small and large firms. The resulting series are presented in Table 4. In the online appendix, we test the predictability of the exogenous marginal tax rate changes and show that our constructed exogenous tax series are unforecastable on the basis of past observations on the vector of observables.

Table 2: Corporate Tax Schedule in the hypothetical year $t$

<table>
<thead>
<tr>
<th>Income Tax Brackets ($)</th>
<th>Tax Rate, $t-1$</th>
<th>Tax Rate, $t$</th>
<th>Size of Tax Cut</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;25000</td>
<td>22%</td>
<td>21%</td>
<td>5%</td>
</tr>
<tr>
<td>&gt;25000</td>
<td>52%</td>
<td>50%</td>
<td>4%</td>
</tr>
</tbody>
</table>

\textsuperscript{20}The cutoff category straddles the threshold of small and large groups as in Subsection 3.2.
Table 3: Measuring the Size of Tax Cut for Small and Large Firms in 1965

<table>
<thead>
<tr>
<th>Firm’s Index</th>
<th>Total Asset ($mm)</th>
<th>Pretax Income ($mm)</th>
<th>Corresp. QFR Bracket</th>
<th>Size Class</th>
<th>Corresp. Tax Bracket ($)</th>
<th>Size of Tax Cut in tax bracket (%)</th>
<th>Asset Weighted Average Tax Cut for QFR Bracket</th>
<th>Weight of the Bracket in Small Group (%)</th>
<th>Weight of the Bracket in Large Group (%)</th>
<th>Size of Tax Cut for Small and Large Groups (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>f1</td>
<td>3.8</td>
<td>0.61</td>
<td>1 Small</td>
<td>&gt; 25000</td>
<td>4</td>
<td>4.55</td>
<td>0.78</td>
<td>0</td>
<td>3.86</td>
<td>(small firms)</td>
</tr>
<tr>
<td>f2</td>
<td>4.61</td>
<td>0.005</td>
<td>1 Small</td>
<td>≤ 25000</td>
<td>5</td>
<td>2.22</td>
<td>0.14</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f3</td>
<td>7.5</td>
<td>-0.57</td>
<td>2 Small Exempted</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f4</td>
<td>9.4</td>
<td>3.56</td>
<td>2 Small</td>
<td>&gt; 25000</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f5</td>
<td>16.72</td>
<td>-0.91</td>
<td>3 Small Exempted</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f6</td>
<td>20.17</td>
<td>1.85</td>
<td>3 Small</td>
<td>&gt; 25000</td>
<td>4</td>
<td>4.00</td>
<td>0</td>
<td>0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f7</td>
<td>32.17</td>
<td>0.02</td>
<td>4 Small</td>
<td>≤ 25000</td>
<td>5</td>
<td>4.42</td>
<td>0</td>
<td>0.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f8</td>
<td>45.1</td>
<td>1.1</td>
<td>4 Small</td>
<td>&gt; 25000</td>
<td>4</td>
<td>2.50</td>
<td>0</td>
<td>0.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f9</td>
<td>51.6</td>
<td>-4</td>
<td>5 Small Exempted</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f10</td>
<td>86.2</td>
<td>20</td>
<td>5 Small</td>
<td>&gt; 25000</td>
<td>4</td>
<td>2.89</td>
<td>0</td>
<td>0.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f11</td>
<td>112.8</td>
<td>-15.6</td>
<td>6 Small Exempted</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f12</td>
<td>294.3</td>
<td>65.7</td>
<td>6 Small</td>
<td>&gt; 25000</td>
<td>4</td>
<td>4.00</td>
<td>0</td>
<td>0.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f13</td>
<td>705.5</td>
<td>8.3</td>
<td>7 Small</td>
<td>&gt; 25000</td>
<td>4</td>
<td>4.00</td>
<td>0</td>
<td>0.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f14</td>
<td>912.1</td>
<td>140.5</td>
<td>7 Large</td>
<td>&gt; 25000</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f15</td>
<td>1497.8</td>
<td>104.9</td>
<td>8 Large</td>
<td>&gt; 25000</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f16</td>
<td>12611.3</td>
<td>133.9</td>
<td>8 Large</td>
<td>&gt; 25000</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: For the sake of illustration, we execute the procedure for a sample of 16 hypothetical Compustat firms...
Table 4: Marginal Tax Rates (MTR)

<table>
<thead>
<tr>
<th>Name</th>
<th>Signed</th>
<th>Effective</th>
<th>Type</th>
<th>Persistence</th>
<th>Size (mtr) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Revenue Act of 1964)</td>
<td>1964</td>
<td></td>
<td></td>
<td></td>
<td>-3.89</td>
</tr>
<tr>
<td>2. Marginal Tax Cut of 1965</td>
<td>February</td>
<td>1965Q1</td>
<td>Anticipated</td>
<td>Permanent</td>
<td>-3.62</td>
</tr>
<tr>
<td>(Revenue Act of 1964)</td>
<td>1964</td>
<td></td>
<td></td>
<td></td>
<td>-3.98</td>
</tr>
<tr>
<td>(Revenue Act of 1978)</td>
<td>1978</td>
<td></td>
<td></td>
<td></td>
<td>-4.09</td>
</tr>
<tr>
<td>4. Marginal Tax Cut of 1982</td>
<td>August</td>
<td>1982Q1</td>
<td>Anticipated</td>
<td>Permanent</td>
<td>-0.12</td>
</tr>
<tr>
<td>(Economic Recovery Tax Act of 1981)</td>
<td>1981</td>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>5. Marginal Tax Cut of 1983</td>
<td>August</td>
<td>1983Q1</td>
<td>Anticipated</td>
<td>Permanent</td>
<td>-0.14</td>
</tr>
<tr>
<td>(Economic Recovery Tax Act of 1981)</td>
<td>1981</td>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>(Tax Reform Act of 1986 )</td>
<td>1986</td>
<td></td>
<td></td>
<td></td>
<td>-25.4</td>
</tr>
</tbody>
</table>

Notes: This table reports our constructed new narrative measures of exogenous variations in corporate marginal tax rates for postwar legislated tax changes in the US for small and large firms. Appendix B provides our narrative analysis of all historical changes in federal corporate marginal tax rates and their sources in detail.

Our empirical analysis explores the changes in the growth rates of the real and financial series around tax dates for small and large firms. We study two sets of variables, capital investment as an indicator of real activity and cash holdings as well as total debt as two main indicators of financial decisions. In the online appendix, we also carry out an extensive analysis with respect to additional variables including sales, inventories, dividend payout, and stockholder equity. Our empirical work proceeds in two main stages. First, in the next section, we present an informal descriptive analysis, designed to illustrate the basic properties of the data. Second, in the Section 6, we quantify the relative responses of small and large firms to tax policy with a linear local projection technique.

5 Descriptive Analysis

We apply a simple statistical and graphical procedure for the descriptive analysis of the raw time series around episodes of tax dates. In the previous section, we identified six tax dates for small firms (1964Q2; 1965Q1; 1979Q1; 1982Q1; 1983Q1; 1987Q3) and four dates for large firms (1964Q2; 1965Q1; 1979Q1; 1987Q3). Figure 2 shows a spaghetti chart displaying the
behavior of the growth rates around each of the tax dates for small firms (column 1) and for large firms (column 2) normalized to zero at the calendar quarter of the tax episode. It plots the smoothed (deseasonalized) linearly detrended growth rates of investment, cash holdings, and total debt for 8 quarters before and 16 quarters after each tax date. The raw pictures indicate that after all the episodes of tax dates, investment rises smoothly for both small and large firms four years after the tax date - although the increases are slightly larger after 1964Q2 and 1965Q1 (the Revenue Act of 1964) than after other tax dates. Column 3 compares the averages of the individual curves across all tax dates for small and large firms, illustrating that large firms on average raise investment substantially more. In particular, the average increase in the growth rate of investment by large firms four years after a tax cut is about six percentage points greater than for small firms. Total debt growth exhibits a similar pattern as the lowest panel suggests. Cash holdings of large firms drops substantially more on average than for small firms.

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21 We follow Gertler and Gilchrist (1994) to detrend and smooth the time series for small and large firm. This procedure captures both trend and seasonality. However, all the results are robust to HP filter as an alternative to the linear detrending strategy.
Notes: This figure shows a spaghetti chart displaying the behavior of the growth rates around each of the tax date for small and large firms. It plots the smoothed (deseasonalized) linearly detrended growth rates of investment, cash holdings, and total debt for 8 quarters before and 16 quarters after each tax shock. The first and second columns present the deviations of small and large firms cumulative growth rates from their respective values at the tax dates. The cumulative growth rates in the tax cut quarter is normalized to 0. Starred lines in column three illustrate the average of the individual curves.

Since the Economic Recovery Tax Act of 1981 was taken largely for ideological or long-term reasons, and not to return economic growth to normal (see Romer and Romer (2010) for details), we consider it as an exogenous policy in our analysis. Therefore, our measures of MTRs do not contain changes correlated with other factors affecting output, and our estimated model should yield unbiased estimates of the effects of changes in MTRs. But chance correlation and hidden motivations are always possibilities.22 In addition, while the

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22 As mentioned in Romer and Romer (2010): “One worry is that even though policymakers may say they
largest exogenous tax cut in 1987Q3 is surely a reasonable observation to consider, it is natural to ask whether it is driving the average results. To address these possibilities, we repeat our spaghetti procedure and local projections framework for small and large firms by dropping these tax changes.

In Figure 3, we first exclude the 1982Q1 and 1983Q1 tax cuts (lines denoted “Apples 4 Shocks”) to get an apples-to-apples comparison of small and large firms and then we exclude the largest exogenous tax cut in 1987Q3 (lines denoted “Apples 3 Shocks”). For comparison, the figure also repeats the results from the baseline specification. The result suggests excluding the extreme observations has little impact on the averages.

Figure 3: Analysis in the Neighborhood of Exogenous Tax Policy Dates: Excluding Largest Shock (1987Q3) and Smallest Shocks (1982Q1 and 1983Q1)

Notes: This figure illustrate the average of the individual curves that present the deviations of small and large firms cumulative growth rates from their respective values at the tax dates. The cumulative growth rates in the tax cut quarter is normalized to 0.

Figure 4 also illustrates the outcome of the same exercise for the debt structure across small and large firms. For parsimony, we report only the average deviation of each variable over all tax dates. Short-term debt is defined as debt with a maturity of one year or less, are changing taxes for reasons unrelated to current and prospective macroeconomic conditions, perhaps the democratic process causes such changes to be correlated with economic performance.”
and long-term debt as debt with longer maturity, both at issuance date. For small firms (left panel), short- and long-term debt closely mimic the behavior of total debt while each of the major components of debt, bank loans, and commercial paper behave differently. As shown, bank loans seems to have the major contribution in the average response of small firms consistent with the large part of their external financing obtained from banks as in Gertler and Gilchrist (1994). The right panel illustrates that the short- and long-term debt of large firms closely follow the patterns of bank loans and market debt. This implies that a vast majority of the short-term financing for large firms is obtained from banks, in contrast to long-term debt mainly obtained from the market.

Figure 4: Debt-Structure in the Neighborhood of Exogenous Tax Policy Dates

Notes: This figure illustrates the behavior of the growth rates around each of the tax date for the debt structure across small and large firms. For parsimony, we report only the average deviation of each variable over all tax dates. Short-term debt is defined as debt with a maturity of one year or less, and long-term debt as debt with longer maturity, both at issuance date.

We now present some additional information suggesting that our descriptive analysis is reasonable from the standpoint of capital and debt structures of small and large firms. Table 5 presents statistical information in level and percentage terms on the internal and external financing decisions and the composition of debt finance across size classes around episodes of our tax dates. We compare the average value of investment, cash, equity and the debt structure four years after each tax date with the average values two years before. As seen from this table, while investment raises roughly the same across small and large firms, on
average by 19%, different responses in capital and debt structure are apparent. For example, after the tax cut of 1964Q2, small firms increase their investment by $241mm or 6% of their average assets, and large firms increase investment by $1430mm or 9% of their assets. Small firms increase cash reserves at 11% of investment changes and rely mainly on debt for 81.8% of rising investment, while large firms use a combination of cash at 5% of investment changes and debt at 53% of investment changes. In addition, while small firms rely proportionately more on long-term debt and the majority of their financing is obtained from banks, large firms rely heavily on the paper market. Therefore, this table reflects the same intuition as our spaghetti plots.
Table 5: Composition of Capital and Debt Structure around 4 Large Episodes of Tax Dates

<table>
<thead>
<tr>
<th>Marginal Tax Cut of 1964Q2</th>
<th>Investment</th>
<th>Cash</th>
<th>Total Debt</th>
<th>Short-Term Debt</th>
<th>Long-Term Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Firms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average of 4 quarters before shock ($mm)</td>
<td>1102</td>
<td>350</td>
<td>602</td>
<td>184</td>
<td>-</td>
</tr>
<tr>
<td>Average of 8 quarters after shock ($mm)</td>
<td>1343</td>
<td>377</td>
<td>800</td>
<td>241</td>
<td>-</td>
</tr>
<tr>
<td>Changes ($mm)</td>
<td>241</td>
<td>27</td>
<td>197</td>
<td>-</td>
<td>57</td>
</tr>
<tr>
<td>Changes (%)</td>
<td>22</td>
<td>7.6</td>
<td>32.8</td>
<td>30.8</td>
<td>-</td>
</tr>
<tr>
<td>Percentage Share of Investment (%)</td>
<td>-</td>
<td>-11</td>
<td>81.8</td>
<td>23.5</td>
<td>-</td>
</tr>
<tr>
<td>Large Firms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average of 4 quarters before shock ($mm)</td>
<td>6497</td>
<td>1207</td>
<td>2034</td>
<td>270</td>
<td>-</td>
</tr>
<tr>
<td>Average of 8 quarters after shock ($mm)</td>
<td>7927</td>
<td>1134</td>
<td>2785</td>
<td>455</td>
<td>-</td>
</tr>
<tr>
<td>Changes ($mm)</td>
<td>1430</td>
<td>-73</td>
<td>751</td>
<td>185</td>
<td>-</td>
</tr>
<tr>
<td>Changes (%)</td>
<td>22</td>
<td>-6</td>
<td>37</td>
<td>68</td>
<td>-</td>
</tr>
<tr>
<td>Percentage Share of Investment (%)</td>
<td>-</td>
<td>5</td>
<td>53</td>
<td>13</td>
<td>-</td>
</tr>
<tr>
<td>Marginal Tax Cut of 1965Q1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Firms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average of 4 quarters before shock ($mm)</td>
<td>1114</td>
<td>357</td>
<td>638</td>
<td>191</td>
<td>-</td>
</tr>
<tr>
<td>Average of 8 quarters after shock ($mm)</td>
<td>1426</td>
<td>386</td>
<td>858</td>
<td>258</td>
<td>-</td>
</tr>
<tr>
<td>Changes ($mm)</td>
<td>285</td>
<td>29</td>
<td>220</td>
<td>67</td>
<td>-</td>
</tr>
<tr>
<td>Changes (%)</td>
<td>25</td>
<td>8</td>
<td>35</td>
<td>35</td>
<td>-</td>
</tr>
<tr>
<td>Percentage Share of Investment (%)</td>
<td>-</td>
<td>-10</td>
<td>77</td>
<td>24</td>
<td>-</td>
</tr>
<tr>
<td>Large Firms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average of 4 quarters before shock ($mm)</td>
<td>6667</td>
<td>1253</td>
<td>2075</td>
<td>271</td>
<td>-</td>
</tr>
<tr>
<td>Average of 8 quarters after shock ($mm)</td>
<td>8422</td>
<td>1094</td>
<td>3111</td>
<td>518</td>
<td>-</td>
</tr>
<tr>
<td>Changes ($mm)</td>
<td>1755</td>
<td>-159</td>
<td>1036</td>
<td>247</td>
<td>-</td>
</tr>
<tr>
<td>Changes (%)</td>
<td>26</td>
<td>-13</td>
<td>50</td>
<td>91</td>
<td>-</td>
</tr>
<tr>
<td>Percentage Share of Investment (%)</td>
<td>-</td>
<td>9</td>
<td>59</td>
<td>14</td>
<td>-</td>
</tr>
<tr>
<td>Marginal Tax Cut of 1979Q1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Firms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average of 4 quarters before shock ($mm)</td>
<td>1915</td>
<td>466</td>
<td>1432</td>
<td>347</td>
<td>58</td>
</tr>
<tr>
<td>Average of 8 quarters after shock ($mm)</td>
<td>2275</td>
<td>545</td>
<td>1703</td>
<td>390</td>
<td>73</td>
</tr>
<tr>
<td>Changes ($mm)</td>
<td>361</td>
<td>79</td>
<td>271</td>
<td>43</td>
<td>15</td>
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<tr>
<td>Changes (%)</td>
<td>19</td>
<td>17</td>
<td>19</td>
<td>12</td>
<td>26</td>
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<tr>
<td>Percentage Share of Investment (%)</td>
<td>-</td>
<td>-22</td>
<td>75</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>Large Firms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average of 4 quarters before shock ($mm)</td>
<td>12379</td>
<td>1340</td>
<td>4378</td>
<td>222</td>
<td>240</td>
</tr>
<tr>
<td>Average of 8 quarters after shock ($mm)</td>
<td>14573</td>
<td>1024</td>
<td>5014</td>
<td>291</td>
<td>480</td>
</tr>
<tr>
<td>Changes ($mm)</td>
<td>2194</td>
<td>-316</td>
<td>635</td>
<td>70</td>
<td>240</td>
</tr>
<tr>
<td>Changes (%)</td>
<td>18</td>
<td>-24</td>
<td>15</td>
<td>32</td>
<td>100</td>
</tr>
<tr>
<td>Percentage Share of Investment (%)</td>
<td>-</td>
<td>14</td>
<td>29</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Marginal Tax Cut of 1987Q3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Firms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before shock ($mm)</td>
<td>2431</td>
<td>667</td>
<td>1856</td>
<td>368</td>
<td>68</td>
</tr>
<tr>
<td>Average of 8 quarters after shock ($mm)</td>
<td>2757</td>
<td>614</td>
<td>2174</td>
<td>410</td>
<td>72</td>
</tr>
<tr>
<td>Changes ($mm)</td>
<td>325</td>
<td>-53</td>
<td>318</td>
<td>42</td>
<td>3</td>
</tr>
<tr>
<td>Changes (%)</td>
<td>13</td>
<td>-8</td>
<td>17</td>
<td>11</td>
<td>5</td>
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<tr>
<td>Percentage Share of Investment (%)</td>
<td>-</td>
<td>16</td>
<td>98</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Large Firms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before shock ($mm)</td>
<td>17699</td>
<td>1375</td>
<td>6721</td>
<td>290</td>
<td>570</td>
</tr>
<tr>
<td>Average of 8 quarters after shock ($mm)</td>
<td>20528</td>
<td>1211</td>
<td>8765</td>
<td>337</td>
<td>770</td>
</tr>
<tr>
<td>Changes ($mm)</td>
<td>2828</td>
<td>-164</td>
<td>2044</td>
<td>47</td>
<td>200</td>
</tr>
<tr>
<td>Changes (%)</td>
<td>16</td>
<td>-12</td>
<td>30</td>
<td>16</td>
<td>35</td>
</tr>
<tr>
<td>Percentage Share of Investment (%)</td>
<td>-</td>
<td>5.8</td>
<td>72</td>
<td>2</td>
<td>7</td>
</tr>
</tbody>
</table>

Notes: This table presents statistical information in level and percentage terms on the internal and external financing decisions and the composition of debt finance across size classes around episodes of our tax dates. We compare the average value of investment, cash, equity and the term structure of debt four years after each tax date with the average values two years before.
Overall, the main impression from the descriptive analysis is that the response to a tax cut by large firms is stronger than for small firms. Moreover, while the increase of investment and total debt after a tax cut have almost the same pattern across small and large firms, cash holdings drops considerably faster and greater for large firms. Small firms rely mainly on debt and also more on bank finance following a tax cut. Large firms in contrast use a combination of internal and external financing sources and issue more commercial paper.

6 The Response of Firms to Marginal Tax Rates Cut

This section first presents our econometric framework, a local projection technique. We use this method to estimate the effect of reduction in MTRs on the real and financial decisions of firms. We do it separately for each variable of interest across small and large firms. Estimated specifications and results are discussed afterward.

6.1 Econometric Methodology

To estimate the responses of small and large firms, we use the local projection model of Jordà (2005) with data from 1956 to 2008. The Jordà model is based on sequential regressions by simple regression techniques for each horizon \( h \) for each variable to construct impulse response functions (IRFs). The model is as follows for each size class of firms \((i = S, L)\) and horizon \((h=0,1,2,...,16)\):

\[
\Delta g_{i,t+h} = \alpha_{i,h} + A_{i,h}(L)X_{i,t-1} + B_{i,h}mtr_{i,t} + \epsilon_{i,t+h} \tag{1}
\]

where \( g_i \) is the growth rates of variables of interest for small and large firms, i.e., \( \Delta g_{i,t+h} = g_{i,t+h} - g_{i,t-1} \). We estimate the series of regressions using quarterly data, where \( A_{i,h}(L) \) is a polynomial of order four. We include two groups of control variables: size-specific variables and macroeconomic conditions in the vector of controls \( X_{i,t-1} \). The coefficient \( B_{i,h} \) gives the response of \( \Delta g_i \) at time \( t + h \) to the shock \( (mtr_{i,t}) \) at time \( t \), for each variable of interest and each size class of firms. The Newey and West (1987) corrected standard errors control serial correlation in the error terms induced by the successive leading of the dependent variable.

\[\text{As noted by Jordà (2005), Stock and Watson (2007), Auerbach and Gorodnichenko (2013), Ramey and Zubairy (2018), and Zidar (2019), using direct projections of tax shocks on outcomes is attractive because it does not impose dynamic restrictions on the estimates at different horizons.}\]

\[\text{This definition of dependent variables allows us to compare the behavior of firms one quarter before a tax cut and } h \text{ horizon after that. This transformation is the one used by Hall (2009), Barro and Redlick (2011), and Ramey and Zubairy (2018). Also, note that all the variables in this analysis are the growth rates as we defined earlier.}\]
We include four lagged values of each of the dependent variables in the regression to capture any additional short-run dynamics. In particular, well-documented evidence from the empirical investment literature suggests the lagged investment as an economically important determinant of current investment spending (see Gilchrist and Himmelberg (1995) and Eberly et al. (2012)). We also include the lagged values of cash holdings, cash flows, and the average corporate income tax rate. We also consider lagged values of investment and cash flow volatility for the regression of cash holding (see Graham and Leary (2018) for a detailed discussion).

In addition, we investigate the role of size-specific variables and macroeconomic conditions in determining the real and financial decisions of firms as they can induce time-series and cross-sectional heterogeneity across small and large firms. The choice of firm-specific variables in determining firm’s financial policy have been widely discussed in the literature (see, for example, Titman and Wessels (1988)). Moreover, recent studies emphasize that macroeconomic conditions have a profound impact on corporate decisions (see Hackbarth et al. (2006) and Hackbarth et al. (2006)). We therefore control for macroeconomic conditions by including four lags of the growth rates of real GDP, real T-bill rate, Economic Policy Uncertainty (EPU) index constructed by Baker et al. (2016) and two measures of the risk spread; Moody’s Seasoned BAA Corporate Bond minus Federal Funds Rate (BAAFFM) and Moody’s Seasoned AAA Corporate Bond Minus Federal Funds Rate (AAAFFM), respectively, for small and large firms. See Appendix A for the variable definitions and details of their construction.

Note that in our projection method, we use growth rates instead of levels to make sure that our comparison between the responses of small and large firms are not impacted by the different scales of the variables in theses two groups. In fact, the growth rates capture the difference in performance. To see relative performance over a number of quarters around specific events it is useful to cumulate these growth rates. The underlying average growth rates for small firms and large firms might differ however so one would want to adjust for that when seeking to understand the cyclical component. One could first take the mean out of the growth rates and then cumulate, or cumulate and detrend using a linear trend. This would be the same.

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25This specification is consistent with studies showing the effect of taxation on investment depends strongly on cash flows and overall economic conditions (e.g., Abel and Blanchard (1986); Fazzari et al. (1988a); and Oliner et al. (1995); among others.).
6.2 Results

Figure 5 shows the IRFs for model (1) for small and large firms from 1956 to 2008. It shows the effect of a 1% decline in the MTR on the path of investment, cash holdings, and total debt. This figure makes clear that the impact of a tax cut on corporate activity is size dependent. In this figure and all subsequent figures, the light and dark shaded bands around the IRFs are 90% and 68% confidence intervals. The first and second columns plot the corresponding IRFs with associated error bands for small and large firms. The top panel of Figure 5, shows the response of investment to a decline in MTRs. The second and third panels present IRFs for cash holdings and total debt across small and large firms.

Our estimates show that both small and large firms respond to exogenous tax cuts by boosting investment. A 1% cut in MTRs stimulates a large and persistent increase in investment, which is significant at every horizon for large firms, but significant for small firms six quarters after the tax changes. Large firms increase investment nearly two times more than small firms at all horizons. A 1% cut in the MTR raises investment of large firms to a maximum of 0.33 percentage points ($t = 4.11$) and small firms to a maximum of 0.18 percentage points ($t = 2.10$) 8 quarters after the shock. The cumulative differences across size classes become slightly significant at all horizons and reach a maximum of 0.17 percentage points in quarters 6 and 13. The figure shows that during the quarter of the tax change and the next three quarters, the effect on cash holdings is small and not significant. It then steadily and rapidly decreases for large firms for the next three years before rebounding slightly in the final year. The maximum effect is a fall in the growth rate of cash holdings of large firms of 2.3 percentage points ($t = -6.37$) after three years. The response is much smaller and smoother for small firms and not significantly different from zero at a 90% confidence band four quarters after the shock. The relative patterns of total debt mirror the relative patterns of investment for both size groups. The growth rate of debt for large and small firms raises by 0.58 percentage points ($t = 2.62$) and 0.37 percentage points ($t = 2.87$) two years after the shock.
Notes: This figure shows the IRFs for model (1) for small and large firms from 1956 to 2008. It shows the effect of a 1% decline in the MTR on the path of investment, cash holdings, and total debt. This figure makes clear that the impact of a tax cut on corporate activity is size dependent. Large firms increase investment nearly two times more than small firms at all horizons. The first and second columns plot the corresponding IRFs with associated error bands for small and large firms. The top panel shows the response of investment to a decline in MTRs. The second and third panels present IRFs for cash holdings and total debt across small and large firms. The red and starred blue lines indicate responses of small and large firms. Light and dark shaded areas represent 90% and 68% confidence intervals. The first and second columns illustrate confidence intervals for small and large firms.

These findings suggest that a tax cut that goes to large firms generates more investment growth than a similarly-sized tax cut for small firms. This is the intensive margin of tax cut which is related to the incentive effect of MTR. Since MTR is one component of the cost of capital, firms boosts investment when the marginal rate falls (Auerbach (2018)).
discuss the heterogeneous responses of small and large firms, we distinguish two income and substitution effects corresponding the role played by average as opposed to marginal tax rates. Since the amount of tax liability is a determinant of corporate investment, declines in tax rates acts as a retained earning and increases firms’ resources for investment. This is the income effect of tax cut which corresponds to the role of ATR and may do more to alleviate financial constraints of small firms. On the other hand, cutting tax rates increases after-tax rate of return on investment and increases the incentive of firms to invest. This is the substitution effect of tax cut which is related to changes in MTR. Therefore, firms that must pay a larger premium to raise external funds are less likely to benefit from changes in MTR. In the other words, unconstrained firms which are typically larger in size, are more likely being impacted by the substitution effect. We then expect large firms to benefit more from cuts in marginal rates. Here we shed more light on this channel exploring the cash holdings and debt behavior of firms. As the net interest is deductible and valued at MTR, the tax advantage of debt-financing falls relatively to cash-financing following MTR cut. The advantage of cash-financing motivates firms to burn their cash to finance investment. This channel is stronger for large firms considering their larger reliance on debt market. This substitution effect contributes to the larger cash financing (cash decline) of large firms.

Therefore, at the one end of the spectrum we have the income effect which is supposed to impact mainly the small firms and at the other end is the substitution effect which is more likely to affect the large firms. On the one hand, reforms that reduce tax liabilities without affecting marginal rates, will primarily act as a retained earnings windfall without altering marginal investment or financing incentives. Additionally, changes in MTR without any effect on earnings affect the incentive margin of firms. However, teasing apart these two effects is considerably difficult since changes in STR stimulate both effects. While the effect of changes in ATR on corporate activities has been studied before (see Mertens and Ravn (2013)), our contribution in this study is isolating the distinct effect of changes in MTR. For this purpose, we control for other measures of tax reforms that potentially affect the tax liability of firms including the narrative measure of ATR proposed by Mertens and Ravn (2013) and changes in the top statutory capital gains tax rate.

How important is the behavior of small firms for manufacturing as a whole? Here we estimate the investment/debt/cash responses of all firms in the QFR sample along with the small and large firms. Figure 6 shows that the relative patterns of investment/debt/cash of all firms mirror the relative patterns of large firms. Even though (by our definition) small firms’ share of sales each period is 30% on average, large businesses relatively contribute higher share of aggregate changes of business investment/debt/cash. Hence, total response
can be well approximated by that of large firms because of their dominant market share. Therefore, as small firms are almost never publicly traded, previous studies rely on publicly traded firms biasing their findings towards large and medium sized firms and are not very informative about the role of size.

Figure 6: Responses to a 1% Decline in MTR: Small, Large and Total Firms

Notes: This figure shows the IRFs of small firms and large firms, and the total after the tax dates.

Figure 7 shows the path of growth rates of debt-structure after a tax cut. The top panel illustrates the relative growth rates of short-term debt. For the most part, it appears large firms increase sharply relative to small firms. On the other hand, the relative patterns of long-term debt mirror total debt and investment. The growth rate of long-term debt for large firms (small firms) raises by 0.6 (0.4) percentage points about 1.4 (0.8) quarters after the shock. While large firms rely heavily on cash and also increase short-term and long-term debt after an MTR cut, small firms do not use their cash-reserves and also do not increase short-term debt. Supporting this interpretation is the findings of Harford et al. (2014) that small firms mitigate refinancing risk with increased cash holdings. As discussed in this study, since the maturity of short-term debt is one year or less, small firms do not raise short-term debt to increase investment and rely heavily on long-term debt with more
than one-year maturity. In fact, short-term debt mirrors cash-holding behavior. Considering size is a proxy for access to capital markets, one explanation for the differential response of firms could be their relative degree of credit constraint.  

Figure 7: Responses to a 1% Decline in MTR

Notes: This figure shows the path of growth rates of debt-structure after a tax cut. The top panel illustrates the relative growth rates of short-term debt. For the most part, it appears large firms increase sharply relative to small firms. On the other hand, the relative patterns of long-term debt mirror total debt and investment. The red and starred blue lines indicate responses of small and large firms. Light and dark shaded areas represent 90% and 68% confidence intervals. The first and second columns illustrate confidence intervals for small and large firms.

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26Practical considerations dictate using firm size to proxy for capital market access - see Gertler and Gilchrist (1994), Rajan and Zingales (1995), Almeida et al. (2004), Whited and Wu (2006), and Hadlock and Pierce (2010), among others.
6.3 Comparison with Broader Measures

The main aim of this paper is to explore the impact of variations in marginal tax rates on corporate activities. Our interest in marginal rates rather than other measures of tax changes is motivated by recent studies suggesting that aggregate responses are mainly due to variations in marginal tax rates. In addition, this measure allows us to estimate the response of firms to a similarly-sized tax shock. Our identification strategy excludes variations in corporate taxes that do not contain the changes in marginal rates.

To estimate the heterogeneous impact of tax policy on corporate investment, we use the constructed series of marginal tax changes for small and large firms. It is, therefore, useful to compare the results using our series of MTR changes with those existing conventional measures to see if any potential differences is indeed present. We consider two broader measures: Mertens and Ravn (2013) exogenously identified average corporate income tax rates (ATRs), and the marginal tax rate in the top tax bracket (TMTR), as the most common indicator used in the literature of corporate finance.

Figure 8 shows the implied impact of a tax change on balance sheets from the model (1) using the Mertens and Ravn (2013) exogenously identified ATRs. Figure 9 shows the implied impact using all changes in the TMTR. Results show that the estimates based on the broader measures (ATRs and TMTRs) are quite different than MTRs for both groups of firms. In particular, the implied impact of a change in ATR on investment of small firms is initially positive and larger than those found using MTR and then falls slowly. For large firms, it is not significantly different from zero. In addition, while the responses of investment and total debt are quite different from our results (Figure 5), the response of cash is similar. The implied impact of a decline in TMTR of 1% is again zero for the investment of both groups of firms. However, the impact on total debt and cash holdings are similar in size and timing to our baseline results. As pointed out by you, the ATR series is going to pick up a larger change in tax liability than our MTR series, and that should yield a differential effect on financial constraints and incentives for investment and the tax deductibility of debt. Overall, our findings on the effects of MTRs on large firms’ investment (as a good approximate of total) are statistically significant and larger than those found using ATRs and TMTRs.

Our findings are in line with the notion that financially unconstrained firms are more responsive to changes in MTR than those which are more constrained. As discussed in Fazzari et al. (1988a), when the cost of external finance differs significantly from internal finance, firms’ investment depends on the internal resources or the cash flow of firms. Therefore, variations in ATR play a more prominent role in corporate investment due to the key role
of average rates in the cash flow of firms. This view suggests that marginal rates have a more pronounced role in corporate investment when the cost advantage of internal finance is low. On the other hand, when firms must pay a large premium to raise external finance, marginal rates are less important. It is needless to say that being categorized as large does not necessarily mean that firms fall in top tax bracket. For example, based on the Compustat manufacturing sample at the tax date of 1987, only 310 out of 1408 firms in the large group (based on the QFR small/large threshold) fall in the top tax bracket.

Figure 8: ATR vs. MTR

Notes: This figure shows the IRFs of small and large firms to average v.s. marginal tax rate changes.
Figure 9: TMTR vs. MTR

Notes: This figure shows the IRFs of small and large firms to top bracket v.s. marginal tax rate changes.

7 Robustness

Our baseline results are potentially sensitive to the numerous specification choices not guided by theory. In this section, we explore the sensitivity of our findings to these choices. We perform extensive robustness checks with respect to our measures of firm size (different thresholds and excluding those firms in the bottom and top asset brackets in the QFR sample), outliers (excluding the largest exogenous tax cut and apples-to-apples comparison), sample period, controlling various provisions of tax reform changes (personal income tax changes, capital gains taxes, and changes in effective tax rate), measurement error in our
narrative shocks, and finally provide a firm-level evidence.\textsuperscript{27}

### 7.1 Different Measures of Firm Size

We begin by conducting robustness checks by changing the measure of firm size. Our analysis so far was based on the 30\textsuperscript{th} percentile of total sales as a measure of firm size at each period, i.e., small firms are those with sales below the 30\textsuperscript{th} percentile of sales. We first allow for different thresholds for the cutoff at the 25\textsuperscript{th} and 35\textsuperscript{th} percentiles of total sales.\textsuperscript{28} Figure 10 plots our baseline responses of investment, cash holdings, and debt to a 1\% cut in the MTR along with two different thresholds. For brevity and parsimony, however, we report only the impulse responses across small and large firms without confidence intervals.

Similar results suggest that our findings are robust to different cutoff thresholds. Interestingly, as the size threshold increases from 25\% to 35\% the investment response of large firms becomes stronger. This is consistent with our baseline results that large firms are more sensitive to tax cuts. Moreover, the decline in cash holdings of small firms becomes not significantly different from zero as intermediate size firms move into the large group. This result confirms that the results are not driven by medium size firms.

In sum, using different thresholds we find results in line with our baseline findings. Large firms increase investment twice as much small ones. Small firms rely heavily on debt following the investment boom while large firms use a combination of cash and debt. We also consider assets instead of sales as an alternative indicator of firm sizes, though we do not report the results here, we found results robust to this modification.

\textsuperscript{27}In the online appendix, we perform further robustness checks with respect to tax increases vs. decreases, unanticipated vs. anticipated tax changes, and an alternative estimation framework (a VAR Model).

\textsuperscript{28}We do not go below the 25\textsuperscript{th} percentile because at the beginning of our sample period the first nominal asset class contains more than 25\% of total sales (see Figure 1). In addition, we do not go above 35\textsuperscript{th} percentile because with time, the cutoff for small firms moves towards higher nominal asset class so that after 1999 the seven lower nominal asset classes contain 35\% of the firm distribution and the eighth class contains the rest.
Notes: This figure plots our baseline responses of investment, cash holdings, and debt to a 1% cut in the MTR along with two different thresholds. For brevity and parsimony, however, we report only the impulse responses across small and large firms without confidence intervals. Similar results suggest that our findings are robust to different cutoff thresholds.

Recent empirical studies have provided evidence that the different behavior of firms in the top 10% and in particular by firms in the top 1% is remarkable. Although small in number, the size of very large firms is so enormous that the behavior of the aggregate series is liable to be dominated by their behavior. For example, Covas and Den Haan (2011), conditioning on firm size, show that the use of aggregate data gives a misleading picture of the cyclicality of debt and equity issuance at the firm level. It is because the amounts of funds raised by a small subset of very large firms are so big that they have a large impact on the results for the aggregate series. In their sample, the top 1% contains on average only 32 firms. Mehrotra and Crouzet (2020) also find that the top 1% of firms dominate the behavior of aggregate sales and investment fluctuations. Therefore, it is natural to ask whether a small subset of very large firms driving our results for large firms.

The QFR data provides a quarterly balance sheet and income statement for the manufacturing sector as a whole and for eight size classes defined by the value of firm assets. The reported size classes consist of corporations with total assets (at book value) of less than 5, 5-10, 10-25, 25-50, 50-100, 100-250, 250-1000, and more than 1000 (all in million dollars).

29David et al. (2017b,a) and Van Reenen (2018) emphasize the role of firm heterogeneity in the dynamics of the aggregate labor share and document empirical patterns to assess the fall of labor’s share of GDP in recent decades based on the rise of “superstar firms”.

38
The coverage of the QFR sample relative to the population of firms varies across time. For example, in 1996q1 the QFR number of active corporations in the sample is 6895 which is drawn from a universe of approximately 166200 manufacturing firms. Of these surveyed firms, 3034 had less than $10 million in assets, 3398 had between $10 and $1000 million in assets, and only 463 had more than $1000 million in assets which is the top 6.7% of firms but account for about 72% of the total assets.\footnote{See Table J for the number of firms by industry and asset size class in 1996Q1, available at https://www2.census.gov/econ/qfr/pubs/qfr96q1.pdf.}

So far, we have condensed the eight asset size classes into one aggregate of small firms and another of large firms (see Subsection 3.2). We now exclude the top asset size class (firms with more than $1 billion total assets) from our definition of large firms and reestimate model (1) for small and new large firms. Figure 11 plots responses of investment, cash holdings, and debt to a 1% cut in the MTR and compares the responses of large firms including and excluding top asset size class.\footnote{As shown in Figure 1, the cutoff for small firms moves towards higher nominal asset class so that after 2000 the seven lower nominal asset classes contain less than 30% of the firm distribution and therefore we cannot exclude the 8\textsuperscript{th} asset size class, so that we shorten the sample to 1957Q2–2000Q3. However, as we discuss in the next subsection, shortening the sample period does not substantially alter the results.} Note that small group remains unchanged. The results suggest that the estimates are quite durable. For investment and cash, excluding the largest firms from the other large firms has very little impact. Only the response of total debt is substantially higher than our baseline results.
Notes: This figure plots responses of investment, cash holdings, and debt to a 1% cut in the MTR and compares the responses of large firms including and excluding top asset size class. Small group remains unchanged. The results suggest that the estimates are quite durable. For investment and cash, excluding the largest firms from the other large firms has very little impact. Only the response of total debt is substantially higher than our baseline results.

One limitation of the QFR data is that we do not observe S- and C-corporations in the QFR sample. Though, since S-corporations are typically small in size, the minimum we can do is providing a robustness check by excluding the QFR smallest bracket from our sample. Since S-corporations are likely to dominate the lower tier of the QFR sample size distribution, if the concern of personal taxation is serious, we expect the results to change when we drop firms in the bottom asset bracket. However, as shown in Figure 12, the results are very robust to this reclassification.
Notes: This figure shows the IRFs for the model (1) with the excluded QFR smallest asset bracket. The first and second columns plot the corresponding IRFs with associated error bands for small and large firms. The top panel shows the response of investment to a decline in MTRs. The second and third panels present IRFs for cash holdings and total debt across small and large firms. The red and starred blue lines indicate responses of small and large firms. Light and dark shaded areas represent 90% and 68% confidence intervals. The first and second columns illustrate confidence intervals for small and large firms.

7.2 Outliers and Sample Period

As discussed in the descriptive analysis, while the largest exogenous tax cut in 1987Q3 (-22.62% for small and -25.4% for large firms) is surely a reasonable observation to consider, it is natural to ask whether it is driving the average results. We reestimate model (1) dropping the 1987Q3 tax date (the Tax Reform Act of 1986). Another way to address the possible
importance of this extreme observation is to end the sample in 1986Q1.\textsuperscript{32}

Figure 13 suggests that our baseline result on the heterogeneous responses of small and large firms to a tax cut are durable.\textsuperscript{33} For both actions, excluding the extreme observation substantially increases the impact of a tax cut on investment. In addition, while it has the similar effect on the debt response of large firms, the impact on the response of small firms is small. The maximum investment effect of a tax cut of 1% excluding the 1987Q3 tax cut is 0.77 percentage points ($t = 1.50$) for small firms and 1.1 percentage points ($t = 2.11$) for large firms. Recall that for the full sample, the maximum effects are 0.18 percentage points ($t = 2.10$) for small and 0.33 percentage points ($t = 4.11$) for large firms. However, while the investment response is significant at every horizon for large firms, it is significant for small firms only in eight quarters after a tax cut. As shown in Figure 13, the results for the shorter sample are very similar to the action of excluding the largest shock.

Figure 13: Sensitivity of the Baseline Results to Outliers and Sample Period

Notes: This figure suggests that our baseline result on the heterogeneous responses of small and large firms to a tax cut are durable. For both actions, excluding the extreme observation substantially increases the impact of a tax cut on investment. In addition, our results for the shorter sample are very similar to the action of excluding the largest shock.

In addition, we also report results for the model (1) with excluded 1982Q1 and 1983Q1

\textsuperscript{32}Shortening the sample period also allows us to deal with changes in tax provisions other than the corporate tax rates. In fact, there are episodes where the corporate tax rates and depreciation provisions changes at the same time, as in 1986.

\textsuperscript{33}Again, for parsimony, we report the impulse responses across small and large firms without confidence intervals.
tax cuts. Therefore, the impulse responses for small firms are exactly an apples-to-apples comparison with that of large firms. The results presented in Figure 14 suggest that the estimates are quite durable.

Figure 14: Responses to a 1% Decline in MTR: Apples-to-Apples Comparison of Small and Large Firms

**Investment**

![Graph of Investment](image)

**Cash Holding**

![Graph of Cash Holding](image)

**Total Debt**

![Graph of Total Debt](image)

**Notes:** This figure shows the IRFs for the model (1) with excluded 1982Q1 and 1983Q1 tax cuts. The impulse responses for small firms are exactly an apples-to-apples comparison with that of large firms. It shows the effect of a 1% decline in the MTR on the path of investment, cash holdings, and total debt. The first and second columns plot the corresponding IRFs with associated error bands for small and large firms. The top panel shows the response of investment to a decline in MTRs. The second and third panels present IRFs for cash holdings and total debt across small and large firms. The red and starred blue lines indicate responses of small and large firms. Light and dark shaded areas represent 90% and 68% confidence intervals. The first and second columns illustrate confidence intervals for small and large firms.
7.3 Controlling Various Provisions of Tax Reform Changes

We consider three possible sources of omitted variable bias by controlling capital gains taxes (CGT), personal income taxes, and average corporate income taxes. CGT is the first potential omitted variable to consider. Since changes in capital gains taxation affect the average tax rates, controlling for their changes isolates the pure impact of MTRs on corporate activity. Therefore, we include changes in the top statutory CGT rate as an alternative control to deal with this potential bias. Figure 15 shows that our baseline results are robust to this modification.

Personal income tax policy is perhaps the most important omitted variable to consider. Mertens and Ravn (2013) show that both personal and corporate income taxes are adjusted simultaneously and the correlation between them is 0.42. Previous studies have addressed the effect of personal taxation on firms via its impact on the corporate bond spread. As Elton et al. (2001) argue, personal income taxation has a significant effect on the spread between rates on corporate and government bonds. They suggest that state tax on corporations accounts for a substantial portion of the premium in corporate rates over Treasuries. This premium exists since interest income from corporate bonds is taxed whereas interest income from Treasury and municipal bonds are not, motivating investors to demand a higher spread on corporate bonds.

Ideally, we would like to estimate the effect of MTR changes across firms, but there are potential contemporaneous changes in corporate and personal tax rates. To deal with this possible measurement error, we include the exogenous personal income tax shocks (APITR) constructed by Mertens and Ravn (2013) along with our measure of MTR changes in (1). As Figure 15 makes clear, different identification of the model with respect to two different tax policies do not affect our baseline results. Including personal income tax shocks in the model has very small effects on the responses of both small and large firms. This indicates that potential measurement error due to the correlation between two tax policies is not a serious concern in our analysis.

In addition, as the referee correctly pointed out, controlling for changes in the average corporate income tax rates would help isolate the effect of marginal rate cuts by controlling for changes in effective tax rate. Therefore, as suggested by the referee, we include changes in the exogenous corporate income tax shocks (ACITR) constructed by Mertens and Ravn

---

34 Among all changes in CGT rates, reforms in 1979, 1982, and 1987 are contemporaneous with our identified shifts in corporate MTRs.

35 Corporations can switch from C- to S-corporations and back again if they meet the legal requirements, but as documented in Yagan (2015) switching is rare empirically because consecutively switching back and forth is restricted by law.
(2013) along with our measure of MTR changes in (1) to deal with this potential measurement error. Figure 15 shows that our findings are robust to this specification.

Finally, while the correlation between various provisions of tax reform changes and their interaction effects is potentially a problem, we include all of the three provisions of tax reform changes (CGT, APITR, and ACITR) along with our measure of MTR changes in (1). Controlling for changes in these various provisions that are correlated with the narrative tax measure would help isolating the effect of marginal corporate tax rate changes. A comparison between the results of our baseline model and this identification strategy has shown in Figure 15. This graph makes clear that the estimated responses to changes in the corporate MTRs are robust to controlling for the various provisions of tax reform changes and their interaction effects. Additionally, Table 6 presents simple pairwise correlation coefficients among the four tax reform changes and confirms that correlation between various provisions of tax reform changes does not concern us here.

Figure 15: Sensitivity of the Baseline Results to Other Types of Tax Shocks

Notes: This figure shows the results when we include three provisions of tax reform changes (CGT, APITR, and ACITR) along with our measure of MTR changes in (1). Including changes of these tax reforms in the model has very small effects on the responses of both small and large firms. This indicates that potential measurement error due to the correlation between these tax policies is not a serious concern in our analysis.
Table 6: Pairwise Correlation Coefficients

<table>
<thead>
<tr>
<th>Variable</th>
<th>MTR (small firms)</th>
<th>MTR (large firms)</th>
<th>CGT</th>
<th>APITR</th>
<th>ACITR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTR (small firms)</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTR (large firms)</td>
<td>0.9997*</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGT</td>
<td>0.0943</td>
<td>0.0821</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APITR</td>
<td>0.1405</td>
<td>0.1312</td>
<td>0.1689</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>ACITR</td>
<td>0.0565</td>
<td>0.0518</td>
<td>0.0735</td>
<td>0.3837*</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Notes: This table reports the pairwise correlation coefficients between various provisions of tax reform changes: MTRs, CGT, APITR, and ACITR.

7.4 Measurement Error in MTRs

A potential measurement problem is error in the size of tax changes. To investigate the sensitivity of our baseline estimates with respect to this issue, we perform simulation experiments similar to Ramey (2011). We simulate the following process for \( i = S, L \).

\[
\tilde{mtr}_{i,t} = \phi_{i,t} mtr_{i,t}
\]

with \( \phi_{i,t} \sim U(0.8, 1.2) \)

In this equation, \( mtr \) is our marginal tax changes for small and large firms. Measurement error is added as follows. We allow the value of the \( mtr \) to be over-estimated or under-estimated by up to 20% for both groups of firms so that \( \phi \) is uniformly distributed over the interval of 0.8 to 1.2.

We then reestimate the model (1) with \( \tilde{mtr} \). Figure 16 shows the mean as well as 95% percentiles of the distribution of the estimated responses generated from 10,000 samples. The resulting error bands are very tight. The estimated output responses remain fairly stable when we draw a randomly over-estimated/under-estimated MTR series that leaves timing unchanged. Our approach is therefore robust to this type of measurement error.
Figure 16: Responses to a 1% Decline in MTR: Measurement Error

Notes: This figure shows the mean as well as 95% percentiles of the distribution of the estimated responses generated from 10,000 samples, when we reestimate the model (1) with $\tilde{mtr}$. The resulting error bands are very tight. The estimated output responses remain fairly stable when we draw a randomly over-estimated/under-estimated MTR series.

7.5 Firm-Level Evidence

In this section, we provide firm-level effects of marginal tax rate changes. We use a sample of all Compustat firm-year observations, except financial firms (SIC codes 6000-6999) and utilities (SIC codes 4900-4999) in order to eliminate the possible effects of regulation. We exclude firm-year with nonpositive values for total book assets, or sales, or cash holdings, or negative values for capital expenditures. We also do a separate analysis for manufacturing firms (SIC codes 2000-3999). Following the existing literature (Bates et al. (2009)), we winsorize the outliers in control variables as follows. Leverage is winsorized to fall between zero and one. R&D/sales, acquisitions/assets, cash flow volatility, and capital expenditures/assets are winsorized at the 1% level. The bottom tails of net working capital/assets and cash flow/assets are winsorized at the 1% level, and the top tail of the market-to-book ratio is winsorized at the 1% level. These sample selection criteria result in 265,859 (139,067) firm-year (manufacturing) observations corresponding to 20,973 (9,802) unique firms (manufacturing). Table 7 shows summary statistics for nonfinancial and nonutility public US companies.
Table 7: Summary Statistics for Firm-level Variables

This table reports summary statistics for variables used in our analysis. We use a sample of all Compustat firm-year observations, except financial firms (SIC codes 6000-6999) and utilities (SIC codes 4900-4999) in order to eliminate the possible effects of regulation. We exclude firm-years with nonpositive values for total book assets, or sales, or cash holdings, or negative values for capital expenditures. We also do a separate analysis for manufacturing firms (SIC codes 2000-3999). These sample selection criteria result in 265,859 (139,067) firm-year (manufacturing) observations corresponding to 20,973 (9,802) unique firms (manufacturing). For variable definitions and details of their construction, see Appendix A.

<table>
<thead>
<tr>
<th>variables</th>
<th>All Firms</th>
<th>Manufacturing Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition activity</td>
<td>Mean 0.0176</td>
<td>Mean 0.0156</td>
</tr>
<tr>
<td></td>
<td>SD 0.0567</td>
<td>SD 0.0529</td>
</tr>
<tr>
<td>Industry sigma</td>
<td>Mean 0.2528</td>
<td>Mean 0.2466</td>
</tr>
<tr>
<td></td>
<td>SD 0.6594</td>
<td>SD 0.7961</td>
</tr>
<tr>
<td>Cash/assets</td>
<td>Mean 0.1599</td>
<td>Mean 0.1675</td>
</tr>
<tr>
<td></td>
<td>SD 0.2052</td>
<td>SD 0.2100</td>
</tr>
<tr>
<td>Sales/assets</td>
<td>Mean 1.4347</td>
<td>Mean 1.3853</td>
</tr>
<tr>
<td></td>
<td>SD 27.8790</td>
<td>SD 35.4894</td>
</tr>
<tr>
<td>Cash flow/assets</td>
<td>Mean -0.0573</td>
<td>Mean -0.0543</td>
</tr>
<tr>
<td></td>
<td>SD 2.9097</td>
<td>SD 3.6535</td>
</tr>
<tr>
<td>TTD/assets</td>
<td>Mean 0.5000</td>
<td>Mean 0.4523</td>
</tr>
<tr>
<td></td>
<td>SD 15.9007</td>
<td>SD 15.9291</td>
</tr>
<tr>
<td>Capex/assets</td>
<td>Mean 0.0715</td>
<td>Mean 0.0579</td>
</tr>
<tr>
<td></td>
<td>SD 0.1219</td>
<td>SD 0.0622</td>
</tr>
<tr>
<td>R&amp;D/sales</td>
<td>Mean 0.3431</td>
<td>Mean 0.5641</td>
</tr>
<tr>
<td></td>
<td>SD 3.0903</td>
<td>SD 4.1062</td>
</tr>
<tr>
<td>Market to book</td>
<td>Mean 1.8356</td>
<td>Mean 1.8077</td>
</tr>
<tr>
<td></td>
<td>SD 5.0384</td>
<td>SD 4.4725</td>
</tr>
<tr>
<td>NWC/assets</td>
<td>Mean 0.0156</td>
<td>Mean 0.0915</td>
</tr>
<tr>
<td></td>
<td>SD 0.8362</td>
<td>SD 0.7744</td>
</tr>
<tr>
<td>Ln(real book assets)</td>
<td>Mean 0.1906</td>
<td>Mean 0.1861</td>
</tr>
<tr>
<td></td>
<td>SD 2.3233</td>
<td>SD 2.2507</td>
</tr>
<tr>
<td>No. of firm-years</td>
<td>265,859</td>
<td>139,067</td>
</tr>
<tr>
<td>No. of unique firms</td>
<td>20,973</td>
<td>9,802</td>
</tr>
</tbody>
</table>

We estimate the relationship between changes in the corporate MTRs and investment, cash, and debt of public US companies. To examine how the path of firm-level activity evolves before and after MTR shocks, we follow Zidar (2019) and run a series of direct projection regressions for different horizons \((h = -4, -3, ..., 5)\) as follows:

\[
y_{i,t+h} - y_{i,t-1} = \beta_h mtr_{i,t}^f + X'_{i,t} \Lambda_h + \mu_{i,h} + \delta_{t,h} + \epsilon_{i,t,h} \tag{1.1}
\]
where \( y \) is the logarithm of variable of interest and then \( y_{i,t+h} - y_{i,t-1} \) is the growth rates of variables of interest, \( i \) and \( t \) index firm and year, \( \epsilon_{i,t,h} \) is a residual component, and \( \mu_{i,h} \) and \( \delta_{i,h} \) are horizon-specific firm and year fixed effects. We estimate the series of regressions using yearly data. We include two groups of control variables: firm-specific variables and macroeconomic conditions in the vector of controls \( X_{i,t} \).\(^{36} \) \( mtr^f_{i,t} \) is the exogenous changes in the statutory corporate income tax rates faced by each firm in our sample. The coefficient \( \beta_h \) gives the response of \( y \) at time \( t+h \) to the shock at time \( t \), for each variable of interest. We use this direct projection approach to estimate average outcomes three years before and four years after tax shocks.

Figure 17 shows the IRFs three years before and four years after the tax shocks. It shows the evolution of investment/cash/debt of all firms along with manufacturing firms. The general pattern of the firm-level responses are remarkably similar to our previous semi-aggregate QFR-level responses. Panel A shows that firm’s investment exhibits little trend prior to the tax change and then gradually increased and reached a peak at 1.5% after one year and falls to 1% two years after the change. All significant at the 5% level for both manufacturing and all firms. Panel C shows similar patterns for firm’s total debt. Panel B shows the evolution of cash relative to the year before the tax change. Firm’s cash tends to be 2% lower two years after the tax change and then slightly increased somewhat to be roughly 1.8% lower two years after the tax change.

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\(^{36}\)Firm-specific explanatory variables are acquisitions, cash flow volatility, cash flows, R&D, market-to-book ratio, net working capital, and log of real assets. Macroeconomic factors are real GDP growth, federal funds rate, unemployment rate, VXO, inflation, and economic policy uncertainty (EPU). See Appendix A for the variable definitions and details of their construction.
Figure 17: Firm-level Effects of Tax Changes

Notes: This figure shows the effect of a 1% decline in the MTRs on the path of average corporate investment/cash/debt. The red and starred blue lines indicate responses of all and manufacturing Compustat firms. Standard errors are robust and clustered by firms; 95% confidence intervals are shown as dashed lines.

8 Conclusion

This paper explores the impact of corporate income tax cuts on small and large manufacturing firms in the US. Using a unique dataset on balance sheet and income of firms and constructing a new measure of variations in marginal tax rates, this study finds significant effects on corporate investment. A measure of marginal rates rather than other measures of tax changes is motivated by recent macroeconomic studies detecting substantial effect of variations in marginal tax rate on real economic variables. In addition, to estimate the impact of tax policy on small and large firms, we require a measure that allows us to estimate the response of firms to a similarly-sized tax shock. The narratively identified exogenous changes in marginal tax rate is a proper measure for this purpose.

Restricting our attention to the subset of exogenous marginal tax changes in the US
between 1956 and 2008, we identify a total of six exogenous marginal tax cuts at 1964Q2, 1965Q1, 1979Q1, 1982Q1, 1983Q1, and 1987Q3. We then use a local projection model to quantify the responses of investment, cash, and total debt to a decline in marginal tax rate (MTR) for both small and large firms. In all three variables, the responses of large firms are more pronounced. We find that the investment response of large firms to a marginal tax cut is almost twice the response of small firms. In addition, we show that small firms new investment is financed almost entirely by the issuance of new debt whereas large firms use both their internal cash as well as the issuance of new debt to finance their investments. This finding is supporting the view that financing constraints play a key role in the response of firms to tax policy.

Heterogeneous responses to changes in the marginal tax rates are much different from those using broader measures of exogenous tax changes. For instance, we first show that unconstrained firms are more responsive to changes in marginal tax rates. We then find evidence consistent with the view that constrained firms’ investment is significantly more responsive to average tax changes than to marginal tax rate changes.

We also investigate responses of net sales and inventories as well as dividend and stockholder equity. The results for both real decisions look quite similar to the investment response with large firms responding more than small ones. Moreover, while both firms pay more dividend for the first year, large firms then decrease paying a dividend while small firms continue paying a higher dividend. The response of stockholder equity never differs significantly from zero for all firms. Results are robust to many alternative specifications. Our results suggest that large firms benefit more from a tax reduction than small firms. This finding is consistent with the the fact that small firms have limited access to financial markets and stronger precautionary motives.

There are different avenues for future research. It would be interesting to extend the methodology in this research to other countries. Narratively identified tax changes are available for a broad set of countries (e.g., Cloyne (2013), Hayo and Uhl (2013), Gil et al. (2018), Pescatori et al. (2014) and Riera-Crichton et al. (2016)), allowing replication and comparison of our results across countries. Moreover, considering the current state of the US economy and applying our estimates, one can project the near-term impact of the TCJA on corporate real and financial activities. The Act cut the top marginal federal corporate tax rate from 35 to 21 percent (by 40 percent) beginning in 2018. The corporate tax cuts are permanent and it is the biggest corporate tax cut in US history. A back-of-the-envelope calculation suggests that the growth rate of investment for large firms to be 12.5 (7.6) percentage points higher by 2020 (2021). Finally, our empirical results should motivate
theoretical work on a model of precautionary cash-holding with endogenous firm access to credit markets. This would allow for a deeper understanding of how large firms optimize their capital structure towards a more diversified credit portfolio. Portfolio diversification lowers precautionary concerns and allows large firms to use cash reserves to increase investment.

Appendices

A Variable Definitions

All variables in brackets are QFR data items.

- **AAA-FFM**: Moody’s Seasoned AAA Corporate Bond Minus Federal Funds Rate (Source: FRED).
- **BAA-AAA spread**: Difference between the Moody’s seasoned BAA corporate bond yield and Moody’s seasoned AAA corporate bond yield (Source: FRED).
- **BAA-FFM**: Moody’s Seasoned BAA Corporate Bond minus Federal Funds Rate (Source: FRED).
- **Cash/assets**: Sum of total cash, U.S. Government and other securities \([TOCASHSEC]\) over total assets \([TOTASSET]\).
- **Cash/net assets**: Sum of total cash, U.S. Government and other securities \([TOCASHSEC]\) over net assets, where net assets equal total assets \([TOTASSET]\) minus cash holdings \([TOCASHSEC]\).
- **CFL volatility**: For each group of QFR firms, aggregate cash flow volatility is defined as the variance of cash flow/assets over the previous four years.
- **Cash flow/assets**: For each group of QFR firms, operating cash flows is measured by: \((NIAT_t - \Delta TOCRASET_t - \Delta TOCASHSEC_t + \Delta TOCRIAB_t)\) over total assets \([TOTASSET]\), where \([NIAT]\), \([TOCRASET]\), \([TOCASHSEC]\), and \([TOCRIAB]\) indicate, respectively, net income after tax, total current asset, cash-holding, and total current liabilities.
- **Econ policy uncertainty (EPU)**: Economic Policy Uncertainty index of Baker et al. (2016).
- **Investment/assets**: Quarterly change in fixed assets \([TOTASSET - TOCRASET]\) over total assets \([TOTASSET]\).
- **Long-term leverage (LTD/assets)**: Sum of long-term loans from banks due in more than 1 year \([STBANK]\), long-term bonds and debentures due in more than 1 year
[LTBNDEBT], other long-term loans due in more than 1 year [LTOOTHDEBT], current portion of long-term loans from banks due in 1 year or less [INSTBANKS], current portion of long-term bonds and debentures due in 1 year or less [INSTBONDS], current portion of other long-term loans due in 1 year or less [INSTOTHER] over total assets [TOTASSET].

- **Real GDP growth**: Real GDP, percent change from year ago, quarterly, seasonally adjusted annual rate (chained 2012 $) (Source: FRED).
- **Real Treasury bill rate**: End-of-year secondary market rate on 3-month Treasury bills, minus inflation (Source: FRED).
- **Sales/assets**: Net sales, receipts, and operating revenues [SALES] over total assets [TOTASSET].
- **Short-term leverage (STD/assets)**: Sum of short-term loans from banks with original maturity 1 year or less [STBANK], short-term commercial paper with original maturity 1 year or less [COMPAPER], other short-term loans with original maturity 1 year or less [STDEBTOTH] over total assets [TOTASSET].
- **Total leverage**: Sum of short-term debt (STD) and long-term debt (LTD) over total assets [TOTASSET].
- **T-bill**: 3-month Treasury-bill rate (Source: FRED).

All variables in brackets are Compustat data items.

- **Acquisition activity**: Acquisitions [aqc] scaled by total book assets [at].
- **Cash/assets**: Sum of cash and short-term investments [che] over total book assets [at].
- **Cash/net assets**: Sum of cash and short-term investments [che] over net assets, where net assets equal total book assets [at] minus cash holdings [che].
- **Cash flow/assets**: Operating income before depreciation [oibdp], after interest [xint], dividends [dvc], and taxes [txt] over total book assets [at].
- **Industry sigma**: For each firm-year and two-digit SIC group, we calculate the standard deviation of cash flow/assets over the past 10 years. If fewer than 3 years of lagged data are available, the standard deviation is set to missing. Industry sigma for a two-digit SIC group is calculate as the average standard deviation of cash flow/assets across all firms in the group.
- **LTD maturity**: Long-term debt due in next three years [dd1+dd2+dd3] over total long-term debt [dlc + dltt].
- **Long-term leverage (LTD/assets)**: Long-term debt [dltt] over total book assets [at].
- **Market to book**: The market value of assets [at + prce.f × csho − ceq] over total book assets [at].
- **NWC/assets**: Net working capital [wcap-che] over total book assets [at].
• **Real assets**: The book value of assets \([at]\) in year 2012 real dollars.

• **R&D/sales**: R&D expenditures \([xrd]\) over sales \([sale]\). R&D is set equal to zero when missing from Compustat.

• **Short-term leverage (STD/assets)**: Short-term debt \([dlc]\) over total book assets \([at]\).

• **Total leverage**: Sum of short-term debt \([dlc]\) and long-term debt \([dltt]\) over total book assets \([at]\).

### B Narrative Tax Changes

This appendix provides a narrative analysis of all historical legislated changes in federal corporate income tax rates in the United States over the period 1956-2008. It then uses the narrative analysis of Romer and Romer (2009), to determine the primary law and motivation of every piece of change and its consequent impact on marginal tax rates (MTRs) for firms in different income brackets.

As shown in SOI Table 24, since 1956 the Internal Revenue Service (IRS) reports twelve changes in marginal tax rates at 1964Q2, 1965Q1, 1968Q3, 1970Q1, 1971Q2, 1975, 1979Q1, 1982Q1, 1983Q1, 1984Q3, 1987Q3 and 1994. In the following, we detail each reform.

1. **Marginal Tax Cut of 1964Q2**. During 1953-1963, the baseline tax rate was 30% for both low-income and high-income firms - segregated by the income threshold $25,000 - with an additional surtax of 22% for high-income firms.\(^{37}\) In 1964, following the Revenue Act of 1964, the baseline rate declines by 8 percentage points and the surtax increases by 6 percentage points which resulted in the overall 22% and 50% for the two groups. The most significant impact of the Revenue Act of 1964 was reducing the rate of income taxes where it was the single largest first-year tax-cut of the post-WW II era, $11.5 billion, effective on both corporate and individual income (see Ahern (2004)). Consequent to this act, the baseline tax rate declined by 8 percentage points while the surtax for high-income firms increases from 22% to 28% at 1964 and to 32% at 1965. Overall, the tax rate for low-income firms - with income less than $25000 - declined by 8 percentage points from 30% to 22% and with 2 percentage points for high-income firms from 52% to 50%. It clearly means that the reform is in favor of small

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\(^{37}\)Surtax (Super-tax) is a tax levied on top of another tax and can be calculated as a percentage of the baseline tax rate. In the US tax system, the surtax is progressive and will be in larger amounts for higher income brackets. For example, if the surtax is 10%, the final tax rate when the initial rate is 20% would be an overall rate of 22%, while the same surtax imposed on a rate of 60% would result in an overall rate of 66%.

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corporations by a substantial rate reduction for this group – cutting 8 and 2 percentage points for low- and high-income firms is equal to decreasing marginal tax rates of 26.7% and 3.8% (see Lowndes (1964) for a discussion on the Revenue Act of 1964). As discussed by Romer and Romer (2009), the motivation of this tax cut was to faster long-run growth and therefore is considered as an exogenous reform. The Revenue Act of 1964 was a tax cut act proposed by President Kennedy in 1963 but signed into law by President Johnson on February 26, 1964 and had been planned to be implemented in two stages in 1964 and 1965. Since the first round of cuts implemented within 90 days of becoming law, we classify the marginal tax cut of 1964Q2 as unanticipated (see also Mertens and Ravn (2012)).

2. Marginal Tax Cut of 1965Q1. On January 1, 1965, the second and final round of the bill went into effect and the tax rate for high-income firms declined from 50% to 48% by reducing the surtax from 28% to 26%. Therefore, this was restricted to high-income firms. Note that there is another tax cut in 1965 named Excise Tax Reduction Act of 1965. As discussed by Romer and Romer (2009), this excise tax cut was imposed to stimulate long-run growth and improve the efficiency and fairness of the tax system, and thus, was as an exogenous policy. However, since this reform does not impact the marginal rates at any bracket, it is excluded from our analysis. Therefore, the exogenous tax cut in 1965Q1 is the anticipated consequence of the Revenue Act of 1964 and not to the Excise Tax Reduction Act of 1965.

3. Marginal Tax Increase of 1968Q3. The Revenue and Expenditure Control Act of 1968 created a temporary income tax surcharge at the annual rate of 10% on both individuals and corporations applied until July 1, 1969. There were other tax measures incorporated in this particular bill (see Woodworth (1968)). However, the surcharge overshadowed the rest of them and alone was expected to bring in about $12 billion in revenue in one year. Following this act, the tax rates for low-income and high-income firms - segregated by the income threshold $25,000 - increased from 24% and 48% to 24.2% and 52.8%, respectively. Since the motivation for this reform was to prevent the economy from overheating, we consider it as an endogenous reform and exclude it from our analysis (see Romer and Romer (2009)).

4. Marginal Tax Increase of 1970Q1. The 10% surcharge introduced by the Rev-
enue and Expenditure Control Act of 1968 expired in 1969 and the tax rates declined
to 24% and 48% according to the prior law. The Tax Reform Act of 1969 extended the
surcharge at a 5% rate from January 1, 1970 through June 1, 1970. Since this amount
adapted on a semiannual base, this surcharge would be 2.5% on an annualized base.
However, considering the endogenous nature of this tax change, as discussed for the
tax increase of 1968, we exclude it in our analysis. Another reason for excluding this
reform is that our analysis is restricted to tax reductions.

5. **Marginal Tax Cut of 1971Q2.** There is a tax cut from 22.55% and 49.2% to
22% and 48% for low-income and high-income firms on June 1, 1970. However, this
is not due to a tax policy and simply is the return to prior tax rate after finishing
the surcharge introduced by the Tax Reform Act of 1969. Therefore, it has the same
endogenous nature and excluded from our analysis.

6. **Marginal Tax Cut of 1975.** In 1975, US corporation income tax brackets widened
and tax rates declined. This happened by breaking the over $25,000 bracket into
[$25,000 $50,000] and over $50,000. Before this reform, corporate income was subject to
a normal tax at a rate of 22% and a surtax at a rate of 26% (for a total tax rate of 48%).
However, the first $25,000 of corporate income were exempted from the surtax. This
reform increased the surtax exemption from $25,000 to $50,000. Therefore, the first
$50,000 of corporate taxable income was taxed at the 22% rate, while any additional
corporate income was taxed at the 48% rate. In addition, it provided a reduction for
1975 in the corporate normal tax rate from 22% to 20% on the first $25,000 of net
income (with the 22% rate applicable to the second $25,000 of net income). However,
as discussed in Romer and Romer (2009), the aim of the Tax Reduction Act of 1975
was to return economic growth to normal. Hence this tax cut is not exogenous to
macroeconomic variations and it is excluded from our analysis.

7. **Marginal Tax Cut of 1979Q1.** The changes in tax rate in 1979 is due to the
Revenue Act of 1978. This act includes widening tax brackets and cutting tax rates.
The tax cut is very different over income brackets: 18 percentage points for the [$50,000
$75,000] bracket and 2 percentage points for the [$25,000 $50,000] bracket. As discussed
by Romer and Romer (2009), the motivation of this policy was a desire to raise real
growth from normal to above normal and the administration was quite explicit that
in the absence of a tax cut, growth would slow to relatively normal levels. Therefore,
it is an exogenous policy which is included in our narrative series. The Revenue Act
of 1978 signed into law on November 6, 1978 and implemented in the first quarter of
1978. Since these dates are no longer than 90 days apart, we classify the marginal tax
cut of 1979Q1 as unanticipated (see also Mertens and Ravn (2012)).

8-9. **Marginal Tax Cuts of 1982Q1 and 1983Q1.** The 1% tax cut for two subsequent years in 1982 and 1983 for the first two income brackets was due to the Economic Recovery Tax Act of 1981. The Subtitle D of this act for Small Business Provisions was implemented by striking out 17% for the first income bracket and inserting in lieu thereof 15% at 1983 (16% for taxable years beginning in 1982); and by striking out 20% and inserting in lieu thereof 18% at 1983 (19% for taxable years beginning in 1982). Since this act was taken largely for ideological or long-term reasons, and not to return economic growth to normal (see Romer and Romer (2009)), we consider it as an exogenous policy in our analysis. In addition, the Economic Recovery Tax Act of 1981 signed into law by President Reagan on August 13, 1981 and were implemented in the first quarters of 1982 and 1983, therefore we classify the marginal tax cuts of 1982Q1 and 1983Q1 as anticipated (see also Mertens and Ravn (2012)).

10. **Marginal Tax Increase of 1984Q3.** The Deficit Reduction Act of 1984 placed an additional 5 percentage points to the tax rate in order to phase out the benefit of the lower graduated rates for corporations with taxable income between $1,000,000 and $1,405,000. Corporations with taxable income above $1,405,000, in effect, pay a marginal rate of 46%. Although the key motivation for this act was deficit reduction and it is exogenous, however, considering the sign of this change we exclude it from our analysis.

11. **Marginal Tax Cut of 1987Q3.** Following the Tax Reform Act of 1986, the tax rate revised to 15% for taxable income less than $50,000, to 25% for taxable income between $50,000 and $75,000; and to 34% for taxable income in excess of $75,000. The tax increase for corporations with a taxable income in excess of $100,000 was 5% or $11,750, whichever was less. Such rates became effective for tax years beginning on or after July 1, 1987. Taxable income before July 1, 1987 was subject to a two tax rate schedule or a blended tax rate. At this date, an additional 5% tax, not exceeding $11,750, is imposed on taxable income between $100,000 and $335,000 in order to phase out the benefits of the lower graduated rates. Note that this change is not associated with the Omnibus Budget Reconciliation Act of 1987 which was adapted for deficit reduction in early 1987. As discussed by Romer and Romer (2009), since the reform act of 1986 was motivated by a desire to make the tax system fairer, simpler, and more conducive to long-run growth, and not by a desire to return growth to normal,

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we classify it as an exogenous action. The Tax Reform Act of 1986 signed into law by
President Reagan on October 22, 1986 and implemented in the third quarters of 1987,
we classify the marginal tax cut of 1987Q3 as anticipated (see also Mertens and Ravn
(2012)).

12. **Marginal Tax increase of 1994.** An additional 5% tax, not exceeding $11,750,
was imposed on taxable income between $100,000 and $335,000 in order to phase out
the benefits of the lower graduated rates. Moreover, an additional 3%, not exceeding
$100,000, was imposed on taxable income between $15,000,000 and $18,333,333 in order
to phase out the benefits of the lower graduated rates. We also exclude this reform
since tax increases is not the interest of this study.

In all, we can see that among all variations in corporate marginal tax rates, the ones
implemented in 1964Q2, 1965Q1, 1979Q1, 1982Q1 and 1983Q1 and 1987Q3 correspond to
exogenous marginal tax cuts.

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