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# Is There Anything Good About Corporate Tax Cut?

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## Abstract

This paper empirically investigates if the variation in the rate of state-level corporate taxes across the U.S economy has any explanatory power in predicting the variation in R&D expenditures of all U.S. firms listed in the Compustat database. The paper provides evidence on the effects of corporate tax changes on R&D expenditures by using a difference in difference set up. The results suggest that corporate tax cuts do not affect R&D expenditures among all publicly traded firms in the U.S. while an increase in the tax rate leads to a decrease in R&D spending.

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# 1 Introduction

Can fiscal policy be used to influence investments in research and development (R&D)? More precisely, can corporate tax cuts work as an instrument to motivate such investments? This is a pertinent inquiry given investment in research and development is a significant driver of technological progress and economic growth (Zachariadis 2004; Keller 2002; Jones and Williams 1998; Aghion and Howitt, 1992; Griliches 1980; and Romer 1990) especially in advanced developed economies. It is thus evident from empirical and theoretical studies that there is a strong justification for governments to support R&D, including subsidies and incentives for business research. Without such support, companies are likely to underinvest in research (from the standpoint of the economy as a whole) because the results of R&D cannot be fully appropriated by the investing firm. Moreover, existing work does show that changes in corporate tax rates can influence employment (Ljungqvist and Smolyansky, 2016). But can it also influence firm level decision to investment in R&D?

Against this background, this paper empirically examines if the variation in the rate of state-level corporate taxes across different industries in the U.S economy has any explanatory power in predicting the variation in R&D expenditures of all U.S. firms listed in the Compustat database.Using a novel dataset on R&D activity at the firm level since 1994, the paperprovides evidence on the effects of corporate tax changes on R&D expenditures. Using a difference-in difference approach, we find that firms tend to cut back on R&D spending following an increase in state-level corporate taxes relative to firms operating within the same industry group but located in states without any changes to the tax rate. In fact, the point estimates are indicative that across all the publicly listed firms in S&P 500 between 1995 and 2015, a 1% increase in corporate tax leads to a decrease in R&D activity by about 3.4%. Corporate tax cuts, however, does not affect R&D spending. The remainder of this paper is organized as follows. The next section gives an overview of the empirical literature highlighting the determinants of corporate research and development investment. Section 3 looks into the empirical model that have been used for this analysis. Section 4 discusses the data and presents the identification strategy. Section 5 discusses results from the regressions. Lastly, section 6 concludes and provides direction for future work.

# 2 Literature Review

There are a number of studies which indicate the positive relationship between R&D and economic growth (Sylwester 2001; Blanco and Prieger 2016). Lee and Shim (1995) investigate the impact of R&D on a firm's long run performance and competitiveness within the U.S. and Japanese high-tech industries. Their results indicate a positive relationship between R&D expenditures and a firm's market growth in Japan. Zhao and Li (1997)in another study shows the influence of R&D on both export propensity and growth are significant and positive. There has also been attempts to empirically study the relationship between taxes and economic growth. Most such exercises pinpoint that beyond certain threshold, higher taxes hinders economic growth (Romer and Romer 2010; Blanchard and Perotti 2002; Lee and Gordon 2005; Ferede and Dahlby 2012); even after controlling for various other factors such as government spending, business cycle conditions, and monetary policy. Of those studies that distinguish between types of taxes, corporate income taxes are found to be most harmful, followed by personal income taxes, consumption taxes and property taxes. One possible channel through which tax cuts can translate into higher growth is through its implications for innovations. This makes it insightful to scrutinize the exact relationship between corporate tax rates and expenditure on R&D.

Currently, to the best of our knowledge, there exists no firm-level panel examination that studies the effects of corporate taxes on R&D expenditure, but there are some studies that focuses on the sensitivity of firms' R&D expenditure to R&D tax credit. Some of these studies are discussed initially. Along with these studies, some other papers on the determinants of corporate research and development investment have been discussed below. Both lines of research provide the rational for the control variables used in our estimations.

Billings et.al (2001) replicates prior research in assessing the incentive effects of research and development tax credit on research and development spending for a cross section of US manufacturing firms. The paper uses Compustat data for 231 firms from 1992 to 1998 and finds that firms that are eligible for the tax credit spends more on R&D spending than non-eligible firms as the user cost of R&D increases. The study further provides evidence that variables such as leverage, sales and industry R&D intensity influences R&D spending. The point estimates indicate that a 1% increase in the user cost of R&D reduces R&D expenditures of the sample firms by a little over 2%. The estimates also indicate that firms that are eligible for the credit spends approximately 2.6% more on R&D than non-eligible firms for a 1% increase in the user cost of R&D.

Over the past fifteen years, a number of studies examine the determinants of R&D spending across firms. Among them, Scherer (2001), analyze long term trends in industry R&D expenditures and profit margins for the period 1962 to 1996 using simple panel data analysis. The results yield surprisingly new insights over this 35-year period. The author finds a strongshort run correlation (0.96 rank correlation) in the deviations from trends in the U.S pharmaceutical industry's expenditures and profit margins. His results also show that R&D expenditures and profit margins in the pharmaceutical industry generally grew at a slower rate relative to the long-run trend until the late 1970s, when they began a steep upward track. These findings are suggestive that a beneficial competitive cycle may be at work in the pharmaceutical industry. In particular, R&D investment has not only led to innovation and profits in the form of the highly skewed distribution of returns observed here, but profits, or the expectation of profits, produce expanding R&D investments. During the past several years, various versions of the literature described above have been applied to data on the R&D investments in U.S., U.K., French, German, Irish, and Japanese firms. The firms examined are typically the largest and most important manufacturing firms in their economy. Hall (1992) found a large positive elasticity between R&D and cash flow for a large sample of U.S manufacturing firms, using an accelerator-type model. The employed methodology controls for both firm effects and simultaneity. Similarly, using the same data, Himmelberg and Petersen (1994) looks at a panel of 179 U.S. small firms in high-tech industries and find an economically large and statistically significant relationship between R&D investments and internal finance.

Bond, Harhoff, and Van Reenen (1999) in another useful study finds significant differences between the cash flow impacts on R&D and investment for large manufacturing firms in the United Kingdom and Germany. They find no relationship among the German firms in their sample, whereas the investment of non-R&D-doing UK firms does respond. Cash flow helps to predict whether a UK firm does R&D. Mulkay, Hall, and Mairesse (2001) perform a similar exercise analyzing large U.S and French manufacturing firms. They find that the impact of cash flow is much larger among the U.S. firms than in France, both for R&D and for ordinary investments. Bhagat and Welch (1995) uses a nonstructural R&D investment equation with data for the US, UK, Canadian, European, and Japanese firms to explore the determinants of corporate R&D. The paper finds similar results for the 1985 to 1990 period, with stock returns predicting changes in R&D more strongly for the U.S and UK firms. They also report that debt ratios in the U.S are likely to be negatively correlated with R&D expenditure innovations, while in Japan they are positive predictors of innovations in R&D expenditures. Finally, the study finds a significant positive relationship between tax payments and R&D expenditures for Japanese firms, and significant negative relation for medium and small size U.S. firms.

The conclusions from this body of empirical work are several: first, there is good evidence validating the relationship between taxes and growth and R&D expenditure and growth, which makes it insightful to explore the relationship of taxes and R&D expenditure as it might highlight if one of the mechanisms through which taxes influence growth is by influencing increased expenditure on R&D; second, the sensitivity of cash flow, debt ratio and stock returns to R&D expenditures help us to build the rational to control for these variables.

# 3 Research Design

The estimation procedure involves a standard difference-in-difference (DID) approach to examine the effect of changes in state corporate tax rates on firm level R&D expenditure similar to the one used in Ljungqvist and Smolyansky (2016) and Hossain. R (2021).The following model is used to estimate the hypothesized relation:

$$\Delta R\&D_{f,j,s,t} = \beta_1 \Delta T^{-}_{s,t} + \beta_2 \Delta T^{+}_{s,t} + \delta_1 \Delta X_{f,j,s,t} + \alpha_{j,t} + U_{f,j,s,t} \tag{1}$$

where $f$, $j$, $s$ and $t$ index firm, industry, state and time respectively. $R\&D_{f,j,s,t}$ is the amount reflecting the company's contribution to research and development. $T^{-}_{s,t}$ measures the magnitude of a cut in state corporate tax rate; $T^{+}_{s,t}$ measure the magnitude of an increase in state corporate tax rate; $X_{f,j,s,t}$ is a set of firm specific control variables; $\alpha_{j,t}$ are SIC4 industry-year fixed effects which remove unobserved time-varying industry shocks; and $U_{f,j,s,t}$ is the error term. The coefficient of interest, $\beta$, measures the impact of a 1% point change in the corporate tax rate on the change in R&D expenditures measured relative to other firms located in other states belonging to the same industry where there was no tax changes.

First-differencing help to remove state specific fixed effects and firm-specific fixed effects. The key identifying assumption is that conditional on covariates $X_{f,j,s,t}$, treated and control firms share parallel trends in the absence of a tax change. In that case, the estimates of $\beta$ in regression (1) captures the relationship between corporate tax increases and cuts and R&D expenditures. The proposed research design[1] compares all firms in different states belonging to the same industry. We focus on the changes in corporate tax rates at the state level rather than the federal level as tax changes at the state level are more frequent compared to changes in the top federal corporate income tax rate. Since these tax changes occur at multiple periods across different states, we use the DID approach which deals with the problem of confounding variation in economic conditions.

Several variables are included in the specification above which are believed to be important predictors of R&D activity. Apart from corporate tax changes, a firms stock returns might correlate with R&D expenditures. Lach and Schankerman (1989) shows both theoretically and empirically that positive stock returns signal that the firm has strong growth opportunities. Therefore, an increase in R&D might help take advantage of growth opportunities. Similarly Bhagal and Welch (1995) also reports a positive relationship between stock returns and R&D expenditures. Operating cash flow might be a factor that may determine a firms' ability or incentive to invest in R&D. Fazzari, Hubbard, and Petersen (1990) and Whited (1992) shows empirically that firms' operating cash flow has significant effect on corporate capital expenditures. Based on these studies along with some other works (Bhagat and Welch 1995; Minton and Schrand 1999; Mulkay, Hall, and Mairesse 2001) cash flow is expected to be positively related to R&D.

Another variable that may constrain investment in R&D related activity is the degree of financial leverage used by each firm (Bhagat and Welch 1995; Billings 2001). Debt ratio is also used as control variable and is expected to be negatively related with R&D expenses. Factors such as advertising expenses are also expected to influence R&D expenditures. But due to limitations of data at the firm level, it could not be incorporated in our specifications.

# 4 Data

We use data for all industrial U.S. firms (using SIC code) listed on the Compustat Database from 1994 to 2014 to examine the effects of corporate taxes on R&D expenditure. For all variable definitions and details of their construction, see Appendix A. Weselect this time period as it coincides with the availability of consistent data on key variables,

[1]Similar empirical model has been used in Ljungqvist and Smolyansky (2016) and Heider and Ljungqvist (2015)

which is required to examine the relationship between state level corporate taxes and R&D expenditures at the firm level. Firms with more than two years of missing data for R&D over the period 1994-2015 were eliminated. Some additional firms were eliminated because of the lack of data for R&D for a number of the independent variables for the test period. Wealso drop firm-years with negative or missing total assets and firms with a single panel year. Finally, while sorting for firms' headquarter states the sample filter out 1,000 observations of firms that were headquartered outside the U.S.

*Sample Construction: Treatment and Controls*

The sample consists of all U.S active firms listed on the Compustat Database. Moreover, the treatment group consist of firms belonging to an industry headquartered in a state that experience a tax change, while the control group considers firms operating in the same industry but are located in states without tax changes serving. Our model accommodates "repeated treatments" meaning a firm headquartered in a certain state can experience a sequence of tax changes over its time in the panel. Further, a firm experiencing a tax shock can serve as a control later while the firm in the other states which initially served as the control, can be part of the treatment group in later years when it experiences a tax change. Finally, we estimate equation 1 with a sample that includes only years in which one of the states experience es a tax change. Years without a tax change are excluded from the estimation sample as time intervals without a tax change do not provide a treatment group.

# 5 Empirical Results

The set of economic theories postulating the relationship between corporate tax rates and R&D expenditure is rather broad, which makes it difficult to develop a satisfactory comprehensive model capturing the relationship. Keeping this caveat in perspective, our estimations does offer some intuitive results. Table 1 and Table 2 shows the descriptive statistics for the test variables and Table 3 shows the regression estimates for equation 1. The dependent variable is R&D expenditure (as a percentage of total assets) in the current year. We find the following relationships:

*Corporate Tax Changes*

The estimates show that following a corporate tax increase, firms decrease R&D spending by about 3.43% measured relative to other firms belonging to the same industry that are not subject to tax changes in their own headquarter state that year. The effect is significant both statistically and economically. Corporate tax cuts, however, produces no change in R&D spending. There is wide agreement in the literature that corporate tax is negatively correlated with economic growth. Our results to some extent help to understand this relationship better. Experts agree that research and development is the backbone of a globally competitive, knowledge-driven economy. R&D investment helps develop new products and services that drive growth, create jobs, and improve the national welfare. Similarly a decrease in R&D because of tax increase will slow down growth.

*Results for Control Variables*

Table 3 also shows that coefficients for the control variables maintain their expected signs. Debt is negatively related to research and development expenses with coefficients achieving economically and statistically significance (at the 1% level). This finding is consistent with prior studies (Billings 2001; Bhagat and Welch 1995). This results are also consistent with Myers (1977), which notes that firms that have significant R&D opportunities are unlikely to issue much debt.

Operating cash flow and stock returns are positively related to R&D with the coefficients achieving statistical significance at the 5% level. Scholars always argue that firm's internally generated operating cash flows are the most obvious source of R&D capital (Bloch 2005; Myers and Majluf 1984; Hall et.al 1999). However, there are some studies which shows evidence for U.S firms that are opposite to this finding (Bhagat and Welch 1995). The positive coefficient estimate for stock returns is consistent with the hypothesis that higher returns make firms hopeful about their future growth possibilities and since there is a strong positive relation between R&D and growth, these firms increase their investment in R&D to take full advantage of such growth opportunities (Lach and Schangkerman, 1989).

*Firm size differences*

To investigate if the results are driven by the heterogeneity in firm size, we constructed a subsample based on asset size. Firms have been categorized in three groups. The first groups consist of all the large firms whose total asset sizes were greater than $ 500 million.[2] The second group includes medium size firm (asset size between $100 and $500 million) and the third group consists of only small firms whose asset sizes are smaller than $100 million. Summary statistics on asset size for sample firms are provided in Table 4. Regression results for the determinants of R&D expenditures among these firms are summarized in table 5.

The results in Table 5 are generally similar to those in table 3. Large U.S firms react strongly to a corporate tax increase. An increase in tax by 1% leads to a decrease in R&D spending by about 5.5% among the large firms. For medium and small firms, the coefficient decreases to about 4.2% - 4.3%. The remaining results among small, medium and large firms remain almost same with only one exception. There is a significant (both statistically and economically) negative relation between debt ratio and R&D among small and medium firms while there is no relationship among large U.S. firms. This according to prior studies underscoresthat debt is likely to cause harm for R&D only to firms vulnerable to severe financial distress (small firms). Since large firms tend not to be liquidated in financial distress, the amount they spend on R&D is probably less sensitive to their debt level. Our base line R&D measure scales the expenditure by total assets. For further robustness check we deflate both our dependent and independent variables by sales data. Table 6 presents these further robustness check. The findings remain qualitatively similar.

# 6 Conclusion and Caveats

Throughout the US corporate tax history, politicians and businessmen belonging to both

[2]The cutoff was selected based on Bhagat and Welch (1995) to provide as large a sample as possible.

poles of the political and ideological continuum have debated how corporate tax rates influence economic outcomes. Moreover, while the debate remains largely contentious and unsettled from the lens of politicians, the onus is on social scientists to provide new evidence concerning how changes in corporate taxes influence key economic outcomes such as employment, innovation, growth, etc. This paper is motivated by such a rationale, as it examines the effect of the corporate tax changes on R&D activity using a panel sample of U.S. firms over the 1994-2014 period. In particular, evidence from our examination shows that a 1% increase in corporate tax leads to a decrease in R&D expenditure by about 3.4%. Corporate tax cuts, however, does not affect R&D expenditure. The results remain consistent even after accounting for firm size. Several other variables such as leverage, cash flow and stock returns are also shown to influence R&D activity. The results for the control variables are in accord with prior findings. While interpreting these results, it is also important to keep in mind of some limitations of this research - with the most important drawback being that the amount of firm level R&D expenses that qualify for the research credit under Internal Revenue Code Section 41 are not available. The other caveat is using data from Compustat. Compustat reports the address of a firm's current principal executive office, not its historic headquarter location.

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# A Appendix: Variables

My focus is to examine the impact of state corporate taxes on firm level R&D. I consider the following variables:[3].

- *Research and development expense:* (Compustat Business Information Files)(Data item # 46) This supplementary Income Statement item represents all costs incurred relating to development of new products and services. It specifically includes (amortized) software costs and software expenses.

- *Tax Increases and Tax Cuts:* I examine all state corporate tax changes from 1994 to 2015 to construct the variable measuring tax increases and tax cuts. I take the tax increase and decrease data from Heider and Ljungqvist (2014) who report the list of state corporate income tax changes from 1989 to 2011 in their paper. So, I take those data from the appendix of their paper and the remaining data were obtained from the Tax Foundation website. I focus on changes in the top statutory marginal tax rate as states either have a flat corporate tax rate structure or they charge the top rate on even relatively low levels of income.

Over the past two decades, academic research has found significant results when studying the determinants of R&D expenditures. Consistent with prior literature (Bhagat and Welch (1995); Billings et.al (2001)) I control for standard firm level variables which are described below:

- *Debt* (Data item # 9 + # 34) It is the sum of long-term debt and debt in current liabilities.

- *Stock returns* Returns are computed over the fiscal year of the company. This involves a fairly standard procedure as used in literature. The monthly return data comes from the CRSP Compustat database.

- *Operating Cash Flow* (Data item # 13 -( # 15+ # 16 + # 19 + # 21)) Cash Flow, as used in Titman, Wei, and Xie (2004). It is defined as Cash Flow =(Operating income before depreciation - interest expenses - taxes - preferred dividends - common dividends).

[3] I deflate these variables to adjust for firm size by assets (Data item # 6). For robustness check, I deflate using sales data (data item # 12) Since, I divide both dependent and independent variables (except return), they could also be considered as heterogeneity adjustments as mentioned in the literature.

Table 1: Summary Statistics

| | Tax increases | Tax cuts |
|---|---|---|
| Mean tax change | 2.02% | -0.53% |
| Standard deviation | 0.44% | 0.41% |
| Minimum tax change | 1.25% | -0.032% |
| Median tax change | 2.20% | -0.46% |
| Maximum tax change | 3.00% | -2.00% |
| Number of tax changes | 15 | 50 |

The table above reports summary statistics of the 65 changes in state corporate income tax rates that occurred over the period from 1994 to 2014. The data come from the information listed in Appendices A and B of Heider and Ljungqvist (2015) and the tax foundation website. Throughout the analysis, the paper focuses on changes in the top statutory marginal tax rate.

Table 2: Descriptive Statistics

| | Mean | Standard Deviation | Maximum | Minimum |
|---|---|---|---|---|
| R&D | 4.04 | 9.61 | 237.30 | 0.00342 |
| Debt | 23.58 | 26.28 | 575.15 | 0.0017 |
| OCF | 3.214 | 31.30 | 67.11 | -1085 |
| Return | 8.80 | 17.94 | 34.11 | -38.50 |
| Sample Size | | 2,252 | | |

*R&D* is the current-year firm expenditure on research and development as a percentage of total assets.

*Debt* is the ratio of firm's long-term debt and debt in current liabilities to total assets.

*OCF* is the operating cash flow

*Returns* is the annual stock return in own currency

*All values except returns are reported as a percentage of total assets.

Table 3: Regression results for determinants of R&D expenditure

| | *Dependent variable: Change in Log R&D Expenditure* |
|---|---|
| Magnitude of Tax Increase | $-0.0343^{***}$ |
| | (0.016) |
| Magnitude of Tax Cuts | 0.0116 |
| | (0.0876) |
| Debt | $-0.0623^{*}$ |
| | (0.036) |
| OCF | $0.0454^{**}$ |
| | (0.023) |
| Return | $(0.0546)^{**}$ |
| | (0.0257) |
| Industry-Year Fixed Effects | × |
| Sample Size | 1,967 |
| *Note:* | $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01 |

Table 4: Summary statistics on asset size in millions of dollars of sample firms

| | *All Firms Headquartered in the U.S* |
|---|---|
| Sample Size | 2,252 |
| Mean | 8,272.2 |
| Median | 579.7 |
| Minimum | 0.4 |
| Maximum | 797,769.0 |
| | |
| **Percentile** | |
| 10 | 26.09 |
| 20 | 79.21 |
| 30 | 211.66 |
| 40 | 385.71 |
| 50 | 579.70 |
| 60 | 831.58 |
| 70 | 1399.32 |
| 80 | 2796.11 |
| 90 | 6824.35 |

Table 5: Regression results for determinants of R&D expenditure for small, medium and large-size U.S. firms

| | *Dependent variable: Change in Log R&D Expenditure* | | |
|---|---|---|---|
| | Size > \$500M | Size = (\$100M, \$500M) | Size < \$100M |
| Magnitude of Tax Increase | $-0.0546^{***}$ | $-0.0416^{**}$ | $-0.0434^{*}$ |
| | (0.018) | (0.0208) | (0.0228) |
| Magnitude of Tax Cuts | 0.0236 | 0.0121 | 0.0323 |
| | (0.0641) | (0.045) | (0.0356) |
| Debt | $-0.0143$ | $-0.0432^{*}$ | $-0.0444^{*}$ |
| | (0.0240) | (0.0233) | (0.0253) |
| OCF | $0.0432^{*}$ | $0.0522^{*}$ | $0.0442^{*}$ |
| | (0.026) | (0.031) | (0.0227) |
| Return | $0.0734^{**}$ | $0.0613^{*}$ | $0.0546^{*}$ |
| | (0.0346) | (0.0342) | (0.0322) |
| Industry-Year Fixed Effects | × | × | × |
| Sample Size | 1,219 | 527 | 506 |
| *Note:* | | | $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01 |

Table 6: Further Robustness Checks for determinants of R&D expenditure

| | *Dependent variable: Change in Log R&D Expenditure* |
|---|---|
| Magnitude of Tax Increase | $-0.0212^{**}$ |
| | (0.011) |
| Magnitude of Tax Cuts | 0.0132 |
| | (0.0554) |
| Debt | $-0.0541^{**}$ |
| | (0.025) |
| OCF | $0.0512^{***}$ |
| | (0.013) |
| Return | $(0.0333)^{*}$ |
| | (0.0185) |
| Industry-Year Fixed Effects | × |
| Sample Size | 1,967 |
| *Note:* | $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01 |