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The Tax Effect on Capital Structure

-An Empirical Investigation of Tax Shield Utilization Following the Tax Cuts and Jobs Act

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Abstract

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Title:	The Tax Effect on Capital Structure: An empirical investigation of tax shield utilization following the Tax Cuts and Jobs Act
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Keywords:	Financial policy, difference-in-differences, capital structure, static trade-off theory, dynamic trade-off theory
Purpose:	The purpose of this paper is to empirically investigate the support for trade-off theory, especially in relation to severe downwards tax shocks.
Method:	The base econometric methodology used is a difference-in-differences estimation. To properly deal with potential endogeneity issues, it is then complemented with a more granular matching procedure conducted using propensity scores.
Theory:	The broad theoretical framework is based on the classical assumptions of perfect capital markets. Extending upon this, trade-off theory is considered; both in its dynamic and in its static forms.
Empirical foundation:	2,195 firm-year observations between 2017 and 2018 make up the empirical foundation of this paper.
Conclusion:	Mixed support regarding firm capital structure reaction to the Tax Cut and Jobs Act is found. In the main difference-in-differences estimation, support is found for the predictions of trade-off theory after the inclusion of control variables aiming to capture shareholder distribution and capital structure optimization. These results do not prove robust to a more granular matching procedure. A unique contribution is made through the results indicating that even large tax changes may be unable to provoke a downward reaction in leverage ratios. Further, this study exemplifies that to draw meaningful conclusions from policy changes on taxes, standard difference-in-differences estimations may not suffice.

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1.Introduction

1.1 Background

As purportedly stated in a Morgan Stanley advert, while there is a legal obligation to pay taxes, there is no legal obligation to leave a tip (Johnson and Campbell, 2008, p. 107). Intuitively, all else being equal, for a firm to maximize its value, it should minimize its tax burden. As such, it should come to no surprise that in McKinsey (2018), practitioners highlight the potential value-maximization through debt usage by pointing to the advantageous tax treatment of interest payments. On the other hand, they also caution against rising corporate debt levels.

In corporate finance theory, on the other hand, how capital structure choices can be utilized to maximize firm value, is a debate that is far from settled. The propositions of Modigliani and Miller (1958) state that capital structure is irrelevant to a firm's value. Yet, in a later publication, Modigliani and Miller (1963) acknowledge that in the presence of taxes debt may be preferable to equity as a consequence of its interest payments being tax deductible.

They are not the only ones to acknowledge that taxes and other market imperfections may influence the determinants of capital structure. Some, such as Majluf and Myers (1984), focus on market imperfections in the form of adverse selection costs and argue that firms prefer financing using internally generated funds to externally generated funds, due to the absence of agency and adverse selection costs that are associated with the latter. Others, such as Kraus and Litzenberger (1973), argue that firm capital structure is a consequence of firms trading off the tax benefits from debt against the financial distress costs of debt. This trade-off theory is expanded upon by Fischer, Heinkel and Zechner (1989) who claim that in the presence of transaction costs, small tax changes may not make capital structure adjustment worthwhile. Consequently, in their dynamic trade-off theory, they argue that firms have a leverage range, and adjust capital structure only when leverage ratios have drifted too far in either direction. Finally, in complete trade-off theories, Stulz (1990) and Morellec (2003) argue that the benefits of debt are traded off not only against financial distress costs associated with debt, but also the agency costs associated with taking on debt.

In recent years, the Trump administration passed the Tax Cuts and Jobs Act of 2017 (hereon referred to as the TCJA). The act not only decreased the U.S. federal corporate income tax from a progressive scale with a 35% tax in the top bracket, to a flat 21% income tax rate, but also made state taxes fully deductible from federal taxes (Congress, 2017). If capital structure

choices are in fact determined by tax rates, this vast exogenous shock to taxes should have an impact on U.S. firm capital structure. We aim to utilize it to draw conclusions about the potential causal effect of taxes on leverage ratios.

In empirical studies of the tax effects on capital structure, evidence is mixed. While some find that taxes are a good determinant of leverage ratios (Givoly et al., 1992; Faccio and Xu, 2015; Faulklander and Smith, 2016), others fail to find such support (Fama and French, 2005). Likewise, Graham (2000) argues that firms are underutilizing leverage compared to what is predicted to be optimal under their tax conditions; a claim disputed by Blouin, Core and Guay (2010).

Heider and Ljungqvist (2015) argue that a common problem in earlier research of capital structure responses to taxes is a failure to properly address endogeneity. They argue that their difference-in-differences investigation of how responsive firm capital structure is to changes in state taxes allows them to make causal interpretations, and find that while leverage increases with taxes, firms are unresponsive to tax decreases. One way that they explain their findings is through the dynamic trade-off theory, suggesting that the tax decreases may not be large enough to sufficiently justify a downward response in leverage. In addition, they also argue that managers may be reluctant to decrease leverage since such action may benefit debtholders at the expense of equity holders.

1.2 Purpose and research questions

Although not an unresearched area, there is clearly still no consensus on the impact and magnitude of taxes on firm capital structure. Still, essentially no one remains unaffected by tax policies, and the interests of countless stakeholder groups are likely considered when such policies are set. Establishing the extent to which leverage ratios are affected by taxes are as such not only important to bridge an important knowledge gap in the literature, but also important from a policy perspective; if leverage ratios are unresponsive to tax changes, firm leverage would be pointless to consider when discussing policy changes.

As stated by Heider and Ljungqvist (2015), the extent to which existing studies can convincingly handle endogeneity and causal claims is also mixed. Since major shocks to taxes are rare, making full use of those available seems especially important. To the best of our knowledge, the impact of the TCJA on firm capital structure is still unresearched yet presents a great opportunity to investigate the downwards response of leverage to tax shocks. While the

focus on the TCJA means that the full trade-off theory cannot be tested in the sense that it does not enable the study of firm reactions to tax increases, the sheer size of the tax cut allows for potentially more accurate estimations of reactions to tax decreases than previous tax changes.

1.3 Research question

Bearing in mind the above discussion and the findings of previous research, the purpose of this paper is to add evidence pertaining to the effect of tax decreases on firm capital structure. As such, the main research question is formulated as follows:

As a consequence of a reduced interest tax shield, can firms be predicted to decrease their ratio between debt and market value of equity following major tax reductions?

1.4 Scope

Given the need for access to detailed financial data on firms, the scope is restricted to publicly traded companies. Whereas some data for private firms may be possible to access on a case-by-case basis, such data would lack the comparability and transparency that the usage of publicly traded firms ensures.

The sample is further limited to companies that are listed within the S&P 1500, i.e. the aggregate of the S&P 400, 500, and 600. Furthermore, the S&P 1500 includes the major of companies traded in the U.S. exchanges such as Nasdaq and the New York Stock Exchange (NYSE). By utilizing the S&P 1500, a wide net is cast in terms of sampled firms that still share a common framework of listing guidelines, ensuring an extent of comparability between U.S. incorporated firms and foreign incorporated firms. Since the firms included in these indices are many, a sufficient number of observations can be reached even without access to private firm data.

1.5 Findings

The empirical backbone of this paper is a sample of 2,197 firm-year observations. First, the average treatment effect is estimated using a difference-in-differences approach. By adding new control variables in addition to those traditionally included in the literature, support is found for the hypothesis that firms respond to the TCJA by lowering their debt-to-equity ratio.

To improve the parallel trends assumption underlying the difference-in-differences approach, a robustness test is then conducted by performing the same regression on the different S&P indices separately. Following these robustness tests, support is found exclusively in mid-

capitalization firms. Finally, a robustness test was made in which foreign firms that also received a tax reduction, albeit smaller, were excluded. The results remained robust.

Recognizing that the differences in firm characteristics may cause a parallel trends violation regardless of the previous measures undertaken to ensure comparability, the treatment effect is also estimated by matching treated firms to firms in the control group. In doing so, comparability is improved. Initially, observations are matched on size and industry. In a first robustness test, firms are matched on tangibility and profitability as well. Then, shareholder distribution and a proxy for capital structure optimization are also added. All matched estimations of treatment effects fail to find statistically significant support for firm reactions to tax decreases.

Although the difference-in-differences approach does find support for the hypothesis that firms respond to tax reductions by decreasing their debt-to-equity ratios, this finding was not robust to a more granular matching procedure. These findings present a contribution in several ways. Firstly, the inclusion of new control variables led to a significant result in the difference-in-differences estimation. Secondly, when deploying a granular matching procedure, no support for the hypothesis is found. In aggregate, these findings stress the importance of convincing treatment-control groups when investigating the effects of policy changes.

2. The U.S. Tax regime

In this chapter, a brief introduction is given to the U.S. tax system. While the complexities of the tax system are not the focal point of this paper, contextualization of previous research and the setting of the paper is important.

The US tax system consists of both federal and state taxes. States impose corporate taxes differently; for example, Dyreng, Lindsey and Thornock (2013) acknowledge that Delaware has historically been seen as a tax haven. Though stating that between 15% and 24% of the total state tax burden would traditionally be saved by moving to Delaware, they add that the advantages of incorporating in Delaware have declined. In Heider and Ljungqvist (2015), the fact that state taxes are only part deductible from the federal corporate income taxes is used to stress the potential importance of state taxes on total firm tax burden, and thus the potential effect of state taxes on firm capital structure.

Introduced in 1909, the U.S. federal corporate income tax has been in effect longer than the equivalent income tax for individuals (Shaviro, 2009). While the corporate tax rate initially was set at 1%, there has been significant deviation in the tax rate in the 20th and 21st century, reaching a maximum of 52.8% in 1969. In the 21st century in particular, corporate taxes in the U.S. were higher compared to the OECD average, and in 2017 the US corporate income tax rate was 35% while the average in OECD was 22.42% (OECD Statistics, 2020). Citing tax-planning incentivized by a combination of increased capital mobility and declining average global tax rates, Shaviro (2009) calls for a reform of the U.S. federal tax rate.

Prior to the TCJA of 2017, the latest major federal tax decrease was passed in the Tax Reform Act of 1986, which lowered the federal income tax rate while simultaneously restricting the extent that non-debt related tax shields could be used (Givoly, Hayn, Ofer & Sarig, 1992). Naturally, while the decrease of tax rates intuitively should make debt less attractive, the restriction on other tax deductions increases the relative incentive to take on debt.

2.1 The Tax Cuts and Jobs Act of 2017

As stated, Shaviro (2009) argues that the U.S. corporate taxes in the 21st century had become less competitive following increased capital mobility and globalization. Prior to receiving congressional approval for the TCJA in late 2017, the U.S. had one of the highest federal corporate income taxes in the OECD (OECD, 2020). Effective per the 1st of January 2018, the U.S. federal corporate income tax rate was changed to a flat 21% tax rate (Congress, 2020).

Prior, while the minimum tax rate of 15% applied to corporate income not exceeding $50,000, any income exceeding $100,000 was taxed at rates of 34% or higher (RSM, 2017).

Whereas taxes on repatriated income were already previously charged exclusively on the amount of U.S. taxes that exceeded foreign taxes, the TCJA also decreases the repatriation tax on foreign earnings from 35% to 15% on foreign earnings held in cash or cash equivalents, and 8% on non-cash earnings (Congress, 2020). Due to this reform 78% of the alleged earnings held abroad by U.S. firms have been repatriated in 2018 (Federal Reserve, 2020), suggesting that the tax burden for U.S. firms arising from repatriation has decreased. This ties together well with the U.S. post-TCJA tax rate being below the OECD average (OECD, 2020).

While certainly making the U.S. tax environment more competitive, the TCJA still contained some limitations to the decrease in taxes. What particularly sets this tax reform apart from previous reforms, is the fact that state taxes are now fully deductible from federal taxes (Congress, 2020). As such, any state income taxes paid can be deducted from the federal taxable income, lowering the effective tax rate even more. Previously, Heider and Ljungqvist (2015) have argued that one reason that state taxes influence firm capital structure was that they are not fully deductible from federal corporate taxes. Post-TCJA, the state taxes still increase the tax burden since they are not fully offset by the full deduction from federal taxes. Regardless, state taxes can be argued to have less impact following the TCJA. Additional limitations may further differentiate the post-TCJA tax system to the previous. For example, the TCJA imposes limitations on interest rate deductions; limiting the amount of interest that can be deducted to the sum of interest income for the year, 30% of adjusted taxable income, and interest paid on debt with the purpose to finance acquisition of motor vehicles (Congress, 2020). Though, all business interests that are not allowed as a deduction for any year may be carried forward indefinitely in corporations (Congress, 2020).

To summarize, the major change in the federal corporate tax rate in 2017 constitutes the first exogenous event to U.S. federal corporate income taxes of this magnitude since the 1986 Tax Reform Act, and allows for testing of the impact of taxation on firm capital structure. Its characteristics also differentiates it from previously studied tax reforms. In addition to its vast size, several new restrictions on deductions were imposed. So, while a similar setting was utilized in Govily et al. (1992), contemporary conditions can still be argued to differ from the conditions present at the time.

3. Theoretical framework

In this chapter, the theoretical framework of the thesis is presented.

The foundation of the theoretical framework underlying this paper are the propositions of Modigliani and Miller (1958). Their propositions assume perfect capital markets; conditions under which many theories that have been developed since are based on. These assumptions are clearly too aggressive to hold. However, by relaxing them one-or-few at a time, they provide a useful toolbox for ceteris paribus analysis of corporate finance phenomena. Using the work of Modigliani and Miller (1958), in other research, theories have been developed through the addition of market imperfections. Such imperfections that have been considered are for example information asymmetry leading to both agency costs and adverse selection costs, and corporate taxes.

The focus of this paper is the relaxation of the tax assumption as well as the assumption of no information asymmetry - conditions from which trade-off theory is derived. In the following theory subsections, a top-down presentation of relevant theory is made, starting with the theorems of Modigliani and Miller's (1958, 1963), adding on agency theory and information asymmetry, and finally presenting trade-off theory.

3.1 The relevance of capital structure

Modigliani and Miller (1958) argue that decisions about capital structure and the cost of capital can be motivated by two criteria: profit maximization and firm market value maximization. While they acknowledge that both criteria can be axiomatically used to determine optimal levels of risk taking and financing decisions, they argue that it is easier done with the latter and take this approach in their work. By focusing on value maximization, the value of the firm is argued to not only dependent on the existing equity holders but all potential shareholders.

3.1.1 MM proposition I

In Modigliani and Miller (1958), their first proposition is deduced under the assumption of perfect capital markets. For this assumption to be satisfied, they argue that there cannot be any taxes, transaction or issuance costs and no information asymmetry. Moreover, they operate under the assumption that all market participant can trade securities at fair value prices, and that none of them can influence the market prices.

Further, the market value of the firm's assets is argued to be the present value of all cash flow that they generate. Again, in the absence of market frictions, they argue that all cash flows from a firm end up in the hands of either equity holders or creditors. As such, a change in capital structure is argued to merely be a change in cash flow allocation. Under the no arbitrage assumption, since the present value of cash flows determine the market value of assets, and since all cash flows are allocated either to debt holders or equity holders, the market value of the firm's assets has to equal the market value of its debt and equity. So, in their first proposition, they conclude that a firm's value is independent of capital structure since capital structure under perfect capital market assumptions does not influence firm cash flow.

Moreover, Modigliani and Miller (1958) claim that the preference of capital structure in regard to a specific shareholder is also irrelevant. If a shareholder would prefer another capital structure, they argue that as long as he can borrow and lend at the same interest rates as the firm considered, he can create his desired capital structure by taking up leverage to buy securities and subsequently change the capital structure in his own portfolio. In conclusion, Modigliani and Miller's (1958) first proposition that a firm's value is independent of its capital structure.

3.1.2 MM proposition II

In their second proposition, Modigliani and Miller (1958) conclude that the expected return of a firm's levered equity is equal to the expected return of the same firm without leverage, plus additional compensation for financial risk. They claim that as the leverage of a firm is increased, so is its financial risk, and absent any informational asymmetry and other market frictions the expected return (and thus cost of equity) will increase with leverage. Their conclusion is that without market frictions, a firm's cost of capital is independent of its capital structure.

3.1.3 A correction of proposition I and II.

In Modigliani and Miller (1963), a correction to the propositions in Modigliani and Miller (1958) is published, in which they acknowledge that the tax-shield has a larger effect than first argued. Since interest payments to creditors are tax deductible, the tax-shield of leverage decreases the portion of cash flows that is paid to the government. Subsequently, they argue that cash flows which the firm's assets generate to equity holders and creditors are larger with leverage, and thus additional debt can increase the market value of the firm. However, it is stressed that the tax-shield alone is not a reason to increase a firm's debt-levels to the highest level possible. They also argue that other factors need to be taken into consideration such as

financial flexibility and the costs that are associated with debt, such as covenants that are imposed on the firm as well as the risk of default. Modigliani and Miller (1963) conclude that there are benefits and costs of taking up debt that always need to be taken into consideration when determining capital structures, stating that depending on firm characteristics, in some scenarios retained earnings may be a better financing option than issuing debt.

3.2 Agency costs

Jensen and Meckling (1976) conclude that agency costs, i.e. the costs arising due to diverging interests between those with ownership (principal) and those in control of the firm (agent), are present both in equity and in debt financing. A prerequisite for such agency costs to occur is an informational asymmetry between the agent and the principal – in other words, a violation of the perfect capital markets assumption. Furthermore, they categorize firm financing into inside equity, which is equity held by firm insiders, outside equity, which is equity held by those who are not firm insiders, and debt. They argue that the agency costs associated with equity will be zero if the firm is financed entirely by inside equity. This is explained by the fact that if the people who own the firm control it, there is no opportunity for managers to exploit equity holders, since they would simply be exploiting themselves. With outside equity holders, however, they claim that there is a risk of firm insiders not acting in the interests of outside equity. Consequently, they deduce that as the proportion of outside equity increases, so do the agency costs associated with equity.

In terms of debt, Jensen and Meckling (1976) also point out that when the assumption of perfect information is relaxed, a conflict will occur between debt holders and equity holders. Under the premise that firm managers are hired to serve the interest of equity holders, creditors will be able to anticipate that managers will behave in the interests of shareholders rather than in the interest of creditors and will thus require compensation for the added risk. Similarly, to raising outside equity, raising external debt also increases agency costs.

3.3 The asset substitution problem

Gavish and Kalay (1983) discuss the theory of the asset substitution problem, in which managers are argued to have incentive to increase the risk of firm investments after debt is already incurred. They draw this conclusion from Merton's (1974) argument that levered equity is identical to a European call option on a firm's assets, and that increased volatility increases the risk of the firm defaulting on its debt. Whereas debt loses value with increased risk of

default, using Black and Scholes (1973) option valuation model, firm equity value can be deduced to be increased with higher volatility. This is a consequence of a widened cash-flow distribution in combination with limited liability; whereas equity holders reap all the fruits of the right-side distribution tail, they do not bear the loss associated with the left-side distribution. Instead, losses beyond the default point are fully born by creditors. So, Gavish and Kalay (1983) argue that to maximize the value of equity, firm managers may increase the risk of the firm's investments after taking on debt.

Since the costs associated with creditors anticipating this type of behavior is set prior to the behavior actually occurring, firms can be assumed to typically have to bear these costs regardless of whether they will engage in the behavior or not - a phenomenon described by Ogden, Jen and O'Connor (2003) as adverse selection costs. They argue that since it is not possible to discriminate between those who will engage in poor behavior *ex-ante*, costs will be borne by everyone. As taxes decrease, profitable firms will likely have some incentive to lower the leverage levels. On the other hand, Heider and Ljungqvist (2015) state that by lowering the level of leverage they also lower the volatility of the firm's performance, and thus the value of the equity holders' hypothetical call options on the firm. While a firm's value could potentially be increased by lowering the leverage to a less suboptimal level, there is a risk that managers are instead enriching equity holders at the expense of creditors by distributing the additional proceeds following the tax reduction.

3.4 Trade-off theory

So far, it has been discussed how under perfect capital markets assumptions, the choice between debt and equity may be irrelevant to the cost of capital, whereas in the presence of information asymmetry there are additional costs introduced to both equity- and debtholders. With taxation introduced, Modigliani and Miller's (1958) assumptions are no longer valid. Modigliani and Miller (1963) acknowledge that the introduction of taxation could be argued to increase the propensity to take up debt, since the interest payments are deductible from corporate taxes.

3.4.1 Static trade-off Theory

First, recapitulation of the early stances on taxes and firm capital structure is necessary. Modigliani and Miller (1963) correct the original propositions of Modigliani and Miller (1958), and acknowledge that taxes matter in capital structure decisions. They contradict the original claim that cash flows generated from a firm's assets are independent of financing, by acknowledging that debt financing increases the portion of cash that is distributed to equity and

debtholders since it lowers the portion that is paid to the government. However, they still argue that taking up debt is not always the best answer since other costs are inflicted on the firm due to covenants and the risk of default.

In addition to the critique brought forward by Modigliani and Miller (1963), when presenting the static trade-off theory Kraus and Litzenberger (1973) also question the assumption by Modigliani and Miller (1958) that implies that firms can always pay the fixed cash outflows of debt. Instead, they argue that a risk of bankruptcy exists, which implies that firms have to bear financial distress costs. Expanding upon Modigliani and Miller (1963), they theorize that a theoretical optimal capital structure of a firm exists where the marginal benefit of debt is equal to the marginal cost. This occurs at the intercept between the benefits of debt arising from the tax shield and the costs of incurring debt arising from deadweight financial distress costs. The implication of their findings is that capital structure optimization is a valid concern of managers that wish to maximize firm value; focusing only on finding positive investment opportunities may not be sufficient to fully reach this goal.

3.4.2 Dynamic trade-off theory

Fischer, Heinkel and Zeichner (1989) expand upon the static trade-off theory, questioning the assumption that firms can alter their capital structure without transaction costs. They introduce a dynamic trade-off theory, and argue that with the presence of transaction costs, firms instead have a range of optimal capital structure, only adjusting their capital structure after the costs of having suboptimal leverage exceed the costs of rebalancing the capital structure to its optimum. Support is found for changes in transaction costs having an impact on firm capital structure.

3.4.3 Complete trade-off theory

In addition to the financial distress costs associated with debt, Stulz (1990) suggests that a trade-off between the agency costs of financing and the reduction of agency costs given by financing needs to be considered. Morellec (2003) also proposes that a trade-off between benefits and costs of debt should include the agency costs associated with carrying debt. Thus, when aggregating the insights from earlier research, a complete trade-off theory can be thought of as trading off the benefits of debt from tax reductions as well as curtailed agency costs between managers and equity holders, and costs of debt arising from agency costs and informational asymmetry. The base idea that the optimal capital structure is at the intersect between marginal

benefits of debt and marginal costs of debt remain; however, in the complete trade-off theory, the marginal costs of debt include more than just the increased financial distress costs.

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4. Literature review

In this chapter, an overview is given on the research of capital structure, specifically as it relates to tax effects on leverage ratios.

In the literature that investigates the determinants of firm capital structure, evidence is mixed. Shyam-Sunder and Myers (1999) investigate capital structure determinants of 157 firms between 1971 and 1989 to conclude if the trade-off theory or the pecking-order theory is the better determinant of capital structure. They fail to find support for trade-off theory, but find support for the pecking-order theory being a good descriptor of firm financing. However, Frank and Goyal (2003) reinvent the tests of Shyam-Sunder and Myers (1999) with a larger sample, instead consisting of 768 firms between 1971 and 1998, and unlike Shyam-Sunder and Myers (1999) they are unable to find support for pecking-order theory. They argue that a potential reason for this is the fact that Shyam-Sunder and Myers (1999) only include larger firms, which may be more inclined to finance in accordance with the pecking order theory. Fama and French (2005) on the other hand argue that both the pecking-order theory and the trade-off theory have low explanatory power when they investigate small, medium sized and large firms between 1973 and 2002. Moreover, they cannot find support for the idea that larger firms are more inclined to abide by the rules of pecking-order theory than smaller firms

Determining optimal capital structure is something scholars have been trying in the last decades and some consensus has been found. Graham (2000) observes, from an 87 643 firm-year sample between 1973-1994 that firms may be significantly underlevered compared to the presumed value-creating optimum. Subsequently, the conclusion of Graham (2000) can be argued to be evidence against firms actively managing their capital structure using a trade-off theory rationale. The notion by Graham (2000) that firms are underlevered has been disputed. One potential explanation for firms being underlevered is the effect that firms with no leverage have (Korteweg, 2010). Molina (2005) further contradicts the findings of Graham (2000) when investigating 2,678 firm–year observations from 1988 to 2002. He instead suggests that firms that are underlevered may suffer from understated ex-ante costs of financial distress. The same conclusion is drawn when investigating financial distress across 2505 firms (Glover, 2016). Others indicate that the findings of Graham (2000) are problematic, but not due to incorrect estimates of marginal costs of debt. Based on a 157 513 firm-year observation sample between 1980 and 2007, Blouin, Core and Guay (2010) instead draw the conclusion that the result of Graham (2000) is a consequence of incorrect estimations of the marginal tax benefit of additional debt.

Although some capital structure research determinants have contradicted the trade-off theory, there are plenty of empirical findings that support it. Givoly et al. (1992) utilizes the Tax Reform Act of 1986 with data of approximately 900 firm-year observations between 1984 and 1987. The years of 1984 and 1985 are used as control years for previous changes. Their findings suggest that trade-off theory is a good predictor of capital structure. Likewise, examining twenty-year debt levels of 851 firms, Bradley, Jarrell and Kim (1984) find that consistent with trade-off theory, leverage decreases as expected costs of financial distress increase. Also, they conclude that leverage varies with industry, but that non-debt tax shields are not a substitute for tax shields of debt. With a focus on capital budgeting rather than capital structure, MacKie-Mason (1990) finds support for taxes as capital structure determinants for U.S. firms when utilizing an incremental approach rather than using leverage ratios as dependent variables when taxes change. By observing 1 747 public offerings of debt and equity between 1977 and 1987 he concluded that firms financing decisions do depend on marginal tax levels. Additional support for trade-off theory is found by Faulkender and Smith (2016), who study capital structure determinants for multinationals. Using 38 894 observations between 1995 and 2011 and observe changes in tax rates as well as differences in tax-rates between subsidiaries. Utilizing another international setting Faccio and Xu (2015) examine trade-off theory with a sample of 32 182 firms and a total of 252 089 observations and 500 changes in statutory tax rates in 29 OECD countries between 1981 - 2009. By including personal taxes in their model their findings support trade-off theory as a capital structure predictor. Additionally, they find that the results are stronger for more profitable firms.

Controlling for the determinants found by Frank and Goyal (2009), Heider and Ljungqvist (2015) investigate state tax changes in the U.S. between 1989 and 2011. Using a difference-in-difference estimation with states as treatment and control groups, they observe that firms respond to tax increases by increasing leverage but are unresponsive to tax decreases. They argue that the reason they only find support for upwards leverage adjustment is that the tax decreases studied are too small to make an impact, i.e., they claim to find support for the dynamic trade-off theory. These insights also align well with the conclusions of Fischer, Heinkel and Zechner (1989); based on a 999 firm sample spanning between 1977 and 1985, they deduce that small fluctuations in tax shields may not justify the costs associated with equity issuance necessary to decrease leverage. On this note, van Binsbergen, Graham and Yang (2010) investigate 126 611 firm-year observations between 1980-2007 and find that while deviation from optimal capital structure is costly, the cost is not linear, implying that being

slightly off-target is not necessarily problematic. Moreover, Heider and Ljungqvist (2015) argue that their findings can be related to the conflict of interest between debt holders and equity holders described in section 3.3 [The asset substitution problem]; namely, following exogenous decreases in marginal benefit of debt, equity holders are unable to draw benefits of lowering leverage - instead, decreasing leverage would lower the value of their hypothetical call option on the firm's assets. Additionally, Graham's (2000) conclusion that firms are below their optimal capital structure suggests that firms will not lower their debt levels due to the tax-decrease and instead be more adjacent to their optimal level.

Concluding the findings of earlier literature, it is evident that there is no consensus around neither static nor dynamic trade-off theory, much less if there is a single greatest determinant of financing policy, and the need for research on the extent to which firms are actively trying to trade off tax benefits of debt against additional costs of debt remains.

Finally, while there is no consensus regarding the extent to which tax rates influence firm leverage ratios, the TCJA has certainly made the potential tax shields of debt smaller. All else equal, the marginal benefit of debt for all affected profitable firms should then be lower than prior to the tax decrease. If firms actively trade the benefits of debt against the costs of debt, and try to ensure that the marginal benefit of debt is equal to the marginal cost of debt, the affected firms should lower the extent of debt financing following the TCJA. Granted, it should be acknowledged that country of incorporation does not fully capture where taxes are paid; still, due to the repatriation of U.S. taxes, it is reasonable to assume that U.S. firms are fully exposed to the U.S. corporate income tax whereas non-U.S. firms are not. If a firm is registered in the U.S., taxes paid abroad are as illustrated in chapter 2 on the one hand deducted from the tax paid in the U.S. On the other hand, all profit is subject to taxation in the U.S., which is not the case for non-U.S. firms. So, based on the above discussion, the following hypothesis is formulated:

H_0: The capital structure of firms receiving the 2018 tax cut will remain unchanged relative to those who did not receive the tax cut.

H_1: The capital structure of firms receiving the 2018 tax cut will change relative to those who did not receive the tax cut.

5. Method

In this chapter, the scientific approach is initially outlined. Thereafter, focus is placed on discussing the models considered and their benefits and drawbacks.

5.1 Scientific approach

This paper takes a deductive scientific approach. Based on the theoretical models presented and the findings of previous research, a hypothesis is formulated regarding the expected effect of the TCJA on firm leverage levels. Based on the econometric approach considered, the validity of the hypothesis is then evaluated.

A key advantage of the research method that will be outlined below is its focus on causality; without a convincing method to deal with causality, the validity of the hypothesis evaluation would be severely lacking. As such, the methodology of the paper closely follows recommendations by Roberts and Whited (2013) on how to deal with endogeneity. In addition, replicability should be high due to the analysis being made on publicly available corporate data. Using standardized econometric procedures also ensure a high degree of replicability in that if someone is to undertake the same research method, it should yield the same result.

5.2 Difference-in-differences model

5.2.1 The Main Model

As mentioned above, this paper tests if firms respond to the TCJA by reducing debt-to-equity levels. The main model is based on the specifications of earlier research (Heider and Ljungqvist, 2015; Frank and Goyal, 2009). The data in this study is made up of sampled firms in 2017 and 2018. Since each individual firm is sampled in both periods, what emerges is a two-period panel data set. This is an apparent treatment and control setting, in which firms receiving the tax cut (firms incorporated in the U.S.) are the treatment group, and the remainder (non-U.S. firms) the control group.

Difference-in-differences models are explained by Roberts and Whited (2013) as a combination of a cross-sectional difference estimation that involves a treatment and control group over one time period, and a time-series difference estimation that involves only a treatment group but more than one time period. Under the assumption that there is a parallel trend in the development of the dependent variable between the two groups, they suggest that the treatment

effect can estimated by comparing the two groups before and after the treatment has occurred. The mathematical model is outlined as follows:

$$y = \beta_0 + \beta_1 d \times p + \beta_2 d + \beta_3 p + u$$

Where d is a dummy variable assuming the value of 1 if an observation is in the treated group, and p is a dummy variable taking the value of 1 in the period in which the treatment occurs. Assuming that $E(u|d,p) = 0$, they thereafter derive the following conditional means:

$$E(y|d = 1, p = 1) = \beta_0 + \beta_1 + \beta_2 + \beta_3$$
$$E(y|d = 1, p = 0) = \beta_0 + \beta_2$$
$$E(y|d = 0, p = 1) = \beta_0 + \beta_3$$
$$E(y|d = 0, p = 0) = \beta_0$$

Consequently, the treatment effect is captured in β_1, whereas the difference between the treatment and control groups pre-treatment are captured by β_2, and the difference between the groups post-treatment are finally captured by the sum of β_1 and β_2.

Roberts and Whited's (2013) conceptualization of a difference-in-differences estimation is recreated in the below figure:

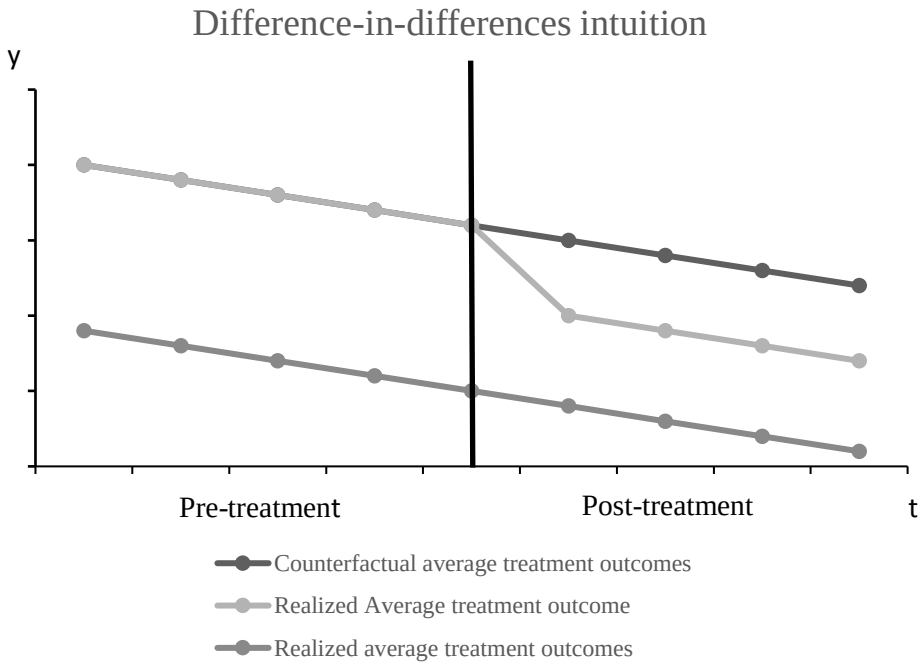

Figure 1 Difference-in-differences intuition

As can be observed in the above figure, prior to the treatment occurring, the trends between the two groups were identical. Following the treatment, however, the trend in the treatment group is seen to pivot compared to the control group, despite having a higher dependent variable value in absolute terms. In the setting of this paper, even if leverage levels were generally falling, the treatment in the form of a tax cut for U.S. firms should result in a greater fall in U.S. firms than what would be expected in the absence of treatment. The difference-in-differences model is thus specified as follows:

$$Debt\ to\ Equity_i = \beta_0 + \delta 2018_i + \beta US_i + \delta 2018 \times \beta US_i + \beta Market - to - Book_i + \beta Tangibility_i + \beta Size_i + \beta Return\ on\ Assts_i + \beta Size_i + \beta Shareholder\ Distribution_i + \beta Overlevered_i + u_i$$

The dependent variable is constructed as the long-term book value of leverage over the total market value of equity. Its long-term nature should make this measure a better indication of how firms plan to react to the TCJA, since it is presumably not influenced by short-term needs for cash. Using this measure is further consistent with previous research, and will allow for the results to be a meaningful contribution to the current scientific debate regarding trade-off theory without being influenced by:

$$Debt\ to\ Equity = \frac{Long\ Term\ Debt}{Market\ Value\ of\ Equity}$$

There is no specific *ex-ante* expectation of the debt-to-equity ratio since the direction of the leverage trend is unknown. However, it is hypothesized that if leverage ratios are increasing, ratios in the treatment group will not increase as much as the control group. Conversely, if leverage ratios are falling, ratios are expected to fall further in the treated group than in the control group.

The variable $\delta 2018$ captures the difference in the non-U.S. firms between 2017 and 2018. Similarly, βUS captures the pre-TCJA difference between U.S. and non-U.S. firms. With no reason to expect a different leverage ratio in firms incorporated in the U.S. compared to those incorporated abroad, the coefficient of βUS can be expected to be either positive or negative. The same line of thinking can be applied to the coefficient of $\delta 2018$; whereas the relative

difference in leverage is expected to decrease in 2018 for treated firms, there is no reason to assume that non-U.S. firms will change leverage in a specific direction. Instead, the control group should follow previous trends.

The interaction between them, $\delta 2018 \times \beta \text{US}$, captures the average treatment effect (ATE) associated with being incorporated in the U.S. and receiving the tax cut in 2018. This treatment effect is the main variable of interest in the study since it can be used to interpret the tax effects on leverage. Naturally, if the hypothesis that the tax cut in fact lead to a decrease in leverage ratio is true, $\delta 2018 \times \beta \text{US}$ is expected to display a negative coefficient.

5.2.2 Control variables from previous literature

The first set of control variables comes from the findings of previous literature. By observing individual firms over the two periods, firm fixed effects (i.e. covariates that are identical in both time periods, such as industry) can be controlled for. This makes the inclusion of industry dummies in the regression redundant, despite earlier research finding industry to be a key determinant of leverage; since they can reasonably be assumed to stay fixed between the years, the effect of industry will be differenced away between the two years considered.

Instead, the control variables presented by Frank and Goyal (2009) and further supported by Heider and Ljungqvist (2015) as the main determinants of leverage are included. These are the market-to-book value of assets, tangibility, return on assets, and firm size. Given the composition of the sample, there are presumably vast differences in size. It would be unreasonable to expect that the relationship would be completely linear; if a firm adds a dollar's worth of assets when it has none, it has made a far greater improvement in its assets base compared to a firm with a billion dollars' worth of assets adding a single dollar's worth. To control for this non-linear relationship, the natural logarithm of total assets is calculated. The computations of the variables are done as follows:

1. $Market\ to\ Book\ ratio = \frac{Market\ Value\ of\ Equity}{Total\ Assets}$

2. $Tangiblity = \frac{PPE}{Total\ Assets}$

3. $Return\ on\ assets = \frac{EBITDA}{Total\ Assets}$

4. $Size = Log(Total\ Assets)$

Market-to-book ratio is included to capture the investment possibilities of each firm since it is a determinant of financing decisions. In trade-off theory research, market-to-book ratio is expected to have a negative impact on debt levels, since growth opportunities imply higher financial distress costs (Frank and Goyal, 2009). Furthermore, tangibility is expected to have a positive relationship with the dependent variable since a higher tangibility would lead to higher opportunities to collateralize debt and thus better access to debt financing. Return on assets, captures the profitability of the firm, and is expected to have a negative relationship to the dependent variable since a higher EBITDA creates a higher incentive to have an effective tax-shield, due to the fact that only profitable companies pay taxes. To control for firm size, the log of total assets is used and is expected to have a positive relationship with the dependent variable since larger firms are argued to have better access to capital markets and less information asymmetry which makes it easier for them to attain external financing.

5.2.3 Additional control variables

To proxy for an estimation of whether firms are taking on leverage to a point where marginal cost of debt exceeds marginal benefit of debt, estimates of the two are calculated. These are finally included in a binary variable taking the value of 1, if marginal cost exceeds marginal benefit.

The marginal cost is estimated using van Binsbergen, Graham and Yang's (2011) empirical model of marginal cost of debt:

$$MC = a + B * IOB$$

The detailed calculations of marginal costs are included in appendix A.

While it is acknowledged that the findings of Van Binsbergen, Graham and Yang (2011) rest on aggressive assumptions, the only way to attain an optimal capital structure through a proxy, since it cannot be observed. Nevertheless, the validity of the marginal cost estimation is contingent on the sample used in this study being comparable to the one used to reach the

findings; still, the estimation may give an indication of whether an individual company is concerned with deviation from a theoretical optimal capital structure.

Thereafter, the marginal benefit of debt must be considered. While previous work such as that of Graham (2000) models firm performance to estimate firm tax bracket, the TCJA introduces a flat corporate tax across all income levels in the U.S. Consequently, the relevance of firm performance is now more limited than it was before. On the one hand, firm performance in the sense that not generating sufficient income to cover interest payments fully will also impair the possibilities of utilizing the full tax shields. On the other hand, differences in marginal benefit of debt previously attributable to different tax brackets are now essentially eliminated.

So, in order to reach an estimate of the marginal benefit of debt, Ohlson's (1980) logit model of probability of default ("O-score") is computed (the exact formula can be found in appendix B). Since he presents a logit model, the probability of default is computed as follows

$$Prob(Default) = \frac{e^{Score}}{(1 + e^{Score})}$$

With the probability of default estimated, the marginal benefit of debt can then be adjusted for the probability of the firm not being able to meet its financial obligations, and thus not be able to draw benefit of the tax shield of debt. Graham (2000) stresses that theoretically, even if a firm makes a loss in the short run, the firm will have a tax-loss carryforward that carries value. If a firm completely defaults, however, this is not the case; the residual claim of equity holders on the firm's assets will at that point be zero and any remaining tax-loss carryforward will be worthless. While it could be argued that the estimation of the tax shield is still inaccurate due to the value only being adjusted downwards at the point of default, the alternative (i.e. predicting many scenarios of performance for each individual firm) would also be associated with risk of inaccuracy. So, the marginal benefit of debt is estimated using the following equation:

$$MB = Tax\ rate \times Prob(Default)$$

Despite the limitations to this approach, by concluding that findings are robust also to these estimates, a greater confidence in that the endogeneity issues occurring because of omitted variables have been mitigated is warranted.

Finally, for the variable overleveraged, for any observation where the following formula is true, a value of 1 is assigned:

$$MC > MB$$

For the rest of the observations, a value of zero is assigned.

An additional control variable is added to control for the risk of firms enriching equity holders at the expense of debtholders. Based on Merton's (1974) model discussed more in-depth in section 3.3 [The assets substitution problem], Heider and Ljungqvist (2015) attribute their findings of firms not adjusting their capital structure to an agency conflict between equity holders and debt holders. They argue that equity holders reduce the value of their call option on the firm's assets if they are to reduce the leverage levels. Bearing this in mind, shareholder distribution is expected to have a positive relationship to debt values. To control for this potential phenomenon, the firm distribution to shareholders is included as an explanatory variable. This is computed by adding the dividend paid with the total money spent repurchasing firm equity, and dividing this sum by the firm's total assets in order to scale it by firm size:

$$Shareholder\ distribution = \frac{Total\ Dividend + Total\ repuchases}{Total\ Assets}$$

5.3 Sample selection

The sample chosen consists of the S&P 1500; i.e. the aggregate of companies in the S&P 500, S&P 400, and S&P 600 indices. The reason that small-capitalization, mid-capitalization, and large-capitalization indices are used is due to the contradicting findings of earlier research in relation to capital structure and size. Moreover, a main objective of this study is to ensure that the firms in the treated and control groups are as comparable as possible. By the usage of S&P indices the similarity between firms is increased since they all need to meet the same requirements for index listing. The similarity between the observations is important since the more the treatment and control groups deviate from being identical, the weaker the causal interpretation using the treatment-control setting is. So, whereas the control group consisting of non-U.S. firms, and the treated group consisting of U.S. incorporated firms, are different in country of incorporation and thus serve under different tax regimes, the companies still abide by the same requirements to participate in the indices.

On the basis of facing different regulatory frameworks, firms within the financial services- and insurance industries have been removed from the sample. In addition, Real estate investment trusts have been excluded due to facing far less aggressive taxation schemes (PwC, 2020).

The data is collected exclusively from Compustat. The fact that the database is used extensively in earlier research serves as a stamp of approval of its quality. Furthermore, its vast size ensures that all data can be collected from one place, without the otherwise added risk of comparability being compromised.

5.4 Model assumptions of endogeneity

Wooldridge (2016, p. 158) lists six assumptions for ordinary least squares regression to be valid: linearity, random sampling, no perfect collinearity, no endogeneity, constant variance in error terms (homoscedasticity) and a normal distribution of error terms. Linearity is handled in the sense that if a control variable is expected to have a non-linear relationship to the dependent variable based on economic justifications, this is investigated further, as in the case of total assets discussed in section 5.2.2. Absent a justification for why a non-linear relationship would be present, the variable is assumed to be linear. No systematic sampling is done; all firms within the confines of the selection criteria are included. Perfect collinearity and homoscedasticity will both be tested for. Regarding normal distribution of errors, Wooldridge (2016) acknowledges that even when error terms are not collected from a clear normal distribution, the assumption can still be assumed to hold through the central limiting theorem, given that the sample size is large enough. Given the 2,197 firm-year observations used in this study, this assumption is argued to be satisfied. No endogeneity is the final key assumption, which we devote the next subsections to discussing.

5.4.1 Omitted variable bias

If a variable that influences the dependent variable had failed to be included in the model, the implication is that the dependent variable would be correlated with the error term; as such, the omission of a variable influencing debt-to-equity causes endogeneity. To ensure that this is not the case, several control variables are included in the model. These are based on economic intuition and the outcomes of prior research, and the characteristics of these variables are discussed in detail in section 5.2.2 [Control variables from previous literature] and 5.2.3 [Additional control variables]. They are included to ensure that no correlation between the error term and the main explanatory variable are present.

5.4.2 Reverse causality

Whereas endogeneity in the form of reverse causality can be properly addressed if the assumptions underlying difference-in-differences estimations hold, the assumption that there is a parallel trend between the treatment and control group is more aggressive in this paper compared to, for example, Heider and Ljungqvist (2015). First, there clearly is a great diversity of company characteristics within the sample groups, not only in terms of industry but also in other characteristics such as financing and size. Secondly, they are located in different countries, suggesting greater differences in regulatory regimes.

Roberts and Whited (2013) suggest that a key method of ensuring validity of difference-in-differences estimations is to ensure that the treatment and control groups are balanced. When investigating companies listed in the U.S. and dividing the treated and control groups by those incorporated in the U.S., there is a clear risk of the groups being unbalanced. If the treatment group is much larger than the control group, there is a risk of the assumptions underlying the estimation being violated. These facts lead to the ex-ante conclusion that the parallel trend assumption may not hold. To reach a more accurate treatment-control setting, observations in the treatment group have been matched to relevant observations in the control group.

5.4.3 Matching

Roberts and Whited (2013) propose addressing clear uncertainty about the parallel trends assumption by matching companies within the treatment group to corresponding companies in the control group in order to estimate a causal treatment effect. To enhance the comparability between the treatment and control group and further satisfy the assumption, observations are matched based on firm industry and size. Industry is measured by SIC code dummies and size is measured as the natural logarithm of total assets.

They further argue that two assumptions need to be acknowledged to derive an average treatment effect (ATE) from a matched treatment-control setting. The first assumption that they recognize is unconfoundedness, i.e. that the potential outcomes of the treatment are uncorrelated to the control group and the covariates that determine them. In other words, assignment to the treatment and control groups needs to be random. In the context of this paper, the assignment to the treatment or control group is based on incorporation; since this clearly has no effect on the occurrence of the TCJA, the assignment can be considered random. Additionally, the covariates that are used to match observations between the groups are

independent of location of incorporation and headquarters as well as the tax reduction. Thus, no violation of the first assumption is made.

The second assumption is referred to by Roberts and Whited (2013) as overlap. They state that the prerequisite for this assumption to be satisfied is that for each covariate considered in the matching, there is a probability to be assigned to either of the groups. Regarding location of headquarters, it is possible to determine that overlap assumption is satisfied. Even though most of the firms that are listed in the S&P 1500 are incorporated in the U.S., there is a possibility to be located outside of the U.S. as well. Regarding other covariates used for matching, the dispersity within each group is large, also suggesting that the overlap assumption is satisfied.

Roberts and Whited (2013) propose propensity-score matching when measuring non-binary variables; whereas exclusively using binary variables ensures a high probability of exact matches being present, a realistic empirical finance setting includes continuous variables. This virtually ensures that no exact matches will exist. In the context of this paper, several covariates need to be considered. Per their suggestions, to match the companies in the treatment group to those in the control group, a propensity score is calculated for each observation. Their one-dimensional propensity score *ps*(x), defined as the probability of belonging to either to the treatment or the control group, can be utilized by using covariates (*X):*

$$ps(x) \equiv \Pr(d = 1|X) = E(d|X)$$

For illustrative purposes, if only firm size had been considered, firms in the treatment group would be matched to the closest firm in terms of size in the control group. By computing a single score from all of the covariates considered in the matching procedure, a simultaneous matching based on multiple covariates is enabled.

Under the condition of unconfoundedness, Roberts and Whited (2013) propose matching based on the calculated propensity-score is possible utilizing the following formula:

$$\sum_{j|d_j \neq d_i} l\left(\left|\widehat{ps}(X_j) - \widehat{ps}(X_i)\right| \leq |\widehat{ps}(X_l) - \widehat{ps}(X_i)|\right) = m$$

Where *i* is the treated variables and $l_m(I)$ equals the index that is created with the propensity score matching, and m is the match. By utilizing the absolute values of differences in propensity scores, distances are computed and matching on the highest proximity is made possible. In other

words, the propensity score allows for a match where the observations in the treated and control group are matched based on the closest propensity score in terms of the covariates which are used simultaneously to define the index.

The choice of matching procedure can influence matching result, stressing the importance of making a well thought-through choice. Hirano, Imbens and Ridder (2003) argue that using a straight propensity score may lead to a loss of efficiency, since all covariates are weighted equally. Instead, they propose the usage of a weighted propensity score using the non-parametric traits of the covariates. In doing so, they claim that a match with higher resemblance to the treated observations is given a higher strength. Thus, weighted propensity score matching is used in this paper.

Since a larger number of the companies in S&P indices are located in the U.S., matching with replacement is used since the objective of this study is to find as similar matches as possible to lower the bias; however, this is done at the expense of precision (Roberts and Whited, 2013). Specifically, this means that the *mth* closets match may be the same observation for multiple companies. This is likely to be the case in this study due to the supernumerary of U.S. firms.

To summarize, under the assumption of unconfoundedness and overlap a comparison between treatment and control is possible. Thereafter, Roberts and Whited (2013) propose computing the average treatment effect (ATE), i.e. the average difference between treated and controlled firms using the following formula:

$$ATE = E[y|d = 1, X = X'] - E[y|d = 0, X = X']$$

5.6.4 Robustness test for the matching procedure

To ensure that the matching is robust, two additional approaches are utilized. Firstly, the matching is done in sequences, where the average treatment effect is defined several times and additional covariates are added to the propensity score in each test. For the full utilization of the tax-shield firms need to be sufficiently profitable, since there otherwise would be no taxable income to deduct interest payments from. To ensure that the profitability of treated and controlled firms is similar, return on assets is added to the matching criteria of the first robustness test. Additionally, tangibility is added in the first robustness test, and should capture the extent to which a firm has collateralizable assets and thus ability to take on debt.

The second robustness test extends on the first two matching procedures by incorporating overleveraged and Shareholder distribution. Market-to-book value is not used for additional matching since it does not satisfy the assumption to be unaffected by the treatment, as firm market values are at risk of having been affected by a decrease in corporate income tax.

So far, the focus of the matching has revolved around ensuring parallel trends and that the observations in the control group are comparable to the treated. However, since the differences in sizes between treated and control are substantial, a robustness check is carried out to test whether increased similarity by treated and control will alter the results. To ensure this a caliper approach is used, where observations failing to be matched within a 50% range are excluded. The advantage of this approach is that it raises the quality of the matches in comparison to only using a propensity score (Roberts and Whited, 2013). After the range of 50% is determined a weighted propensity score is utilized to match the remaining observations, within the treatment and control group.

6. Data description

In this chapter, the characteristics of the whole sample are first presented. Then, descriptive statistics for subsets of the sample are discussed.

When aggregating the firms in the final sample for both years considered, 2,195 firm-year observations remain. The vast majority of these observations are incorporated in the U.S.; however, 84 firm-year observations are incorporated in foreign countries. In table 1 the country of incorporation, as well as the changes in taxes between 2017 and 2018 is displayed. It is observable that a substantial tax-decrease of 10% occurred in France. Otherwise the tax-environments of these countries have remained stable except in Luxembourg, where a small tax decrease of 1.1% was passed. In conclusion, only two foreign firms were affected by a tax-change in 2017/2018.

Table 1. Tax changes outside of the U.S. in 2017/2018

Country	Number of Companies	Tax change 2017/2018
Ireland	14	0%
Bermuda	5	0%
Cayman Islands	4	0%
United Kingdom	4	0%
The Netherlands	3	0%
Switzerland	3	0%
Jersey	2	0%
British Virgin Islands	1	0%
Curracao	1	0%
France	1	-10%
Liberia	1	0%
Luxembourg	1	-1.10%
Marshall Islands	1	0%
Panama	1	0%

Source: OECD, 2020

In table 2, it can be observed that large deviations between the debt-to-equity ratios between the firms in S&P 1500 exist. The firm with the highest debt-to-equity ratio of 40.85 is observed in 2018 and the lowest value is incurred by firms without debt. The value of 40.85 is considered to be a heavy outlier since the standard deviation of debt-to-equity in 2018 is merely 1.48. To ensure that heavy outliers do not influence the result in an unproportionally way, the debt-to equity ratio is winsorized at a 2.5% threshold, meaning that observations

outside of the threshold assume the value of the closest observation within the range. Still, the dispersion in debt-to-equity suggests that substantial inter-firm differences in tax shield utilization do exist.

The mean and the median debt-to-equity ratios for domestic firms are smaller than for foreign firms, see table 3 and 4. This suggest that firms outside US have higher debt levels relative to those within. Additionally, the mean and median debt levels increased for the whole sample between 2017 and 2018 from 35% and 18% respectively to 48% and 22%. However, the increase was larger for foreign than domestic firms. The fact that foreign debt levels increased more than domestic are, without making any inferential conclusion, aligned with the predictions of trade-off theory.

Table 2. Descriptive statistics for all firms

		S&P 1500						
		Debt-to-equity	Market-to-book	Total Assets	Return on assets	Tangibility	Overleveraged	Shareholder distribution
2017	Mean	0.35	1.92	13852.79	0.13	0.26	0.37	0.05
	Median	0.18	1.30	2941.62	0.12	0.17	0.00	0.03
	Standard deviation	1.00	4.07	36233.91	0.10	0.24	0.48	0.09
	Max	28.42	123.37	444097.00	0.68	0.97	1.00	1.38
	Min	0.00	0.03	29.76	-1.38	0.00	0.00	0.00
	N	1099	1099	1099	1099	1099	1099	1068
2018	Mean	0.48	1.68	14499.37	0.14	0.26	0.46	0.07
	Median	0.22	1.09	3183.98	0.13	0.17	0.00	0.03
	Standard deviation	1.48	2.13	37911.47	0.09	0.24	0.50	0.11
	Max	40.85	43.64	531864.00	0.75	0.96	1.00	1.76
	Min	0.00	0.02	47.71	-0.92	0.00	0.00	0.00
	N	1096	1096	1096	1096	1096	1096	1057

Table 3. Descriptive statistics for domestic firms

		Headquarters in the US (Treated)						
		Debt-to-equity	Market-to-book	Total Assets	Return on assets	Tangibility	Overleveraged	Shareholder distribution
2017	Mean	0.34	1.95	13649.90	0.13	0.26	0.38	0.05
	Median	0.18	1.32	2883.10	0.13	0.17	0.00	0.03
	Standard deviation	1.00	4.14	36610.17	0.10	0.24	0.49	0.09
	Max	28.42	123.37	444097.00	0.68	0.97	1.00	1.38
	Min	0.00	0.03	29.76	-1.38	0.00	0.00	0.00
	N	1057	1057	1057	1057	1057	1057	1027
2018	Mean	0.47	1.71	14274.85	0.14	0.26	0.47	0.07
	Median	0.21	1.10	3074.75	0.13	0.17	0.00	0.03
	Standard deviation	1.49	2.16	38308.55	0.09	0.24	0.50	0.11
	Max	40.85	43.64	531864.00	0.75	0.96	1.00	1.76
	Min	0.00	0.02	47.71	-0.92	0.00	0.00	0.00
	N	1054	1054	1054	1054	1054	1054	1015

Table 4 Descriptive statsitcs for foreign firms

		Headquarters outside the US (Controll)						
		Debt-to-equity	Market-to-book	Total Assets	Return on assets	Tangibility	Overleveraged	Shareholder distribution
2017	Mean	0.55	1.34	18958.84	0.13	0.27	0.24	0.05
	Median	0.22	1.15	11632.19	0.12	0.16	0.00	0.04
	Standard deviation	0.93	1.32	24722.57	0.06	0.28	0.43	0.05
	Max	4.78	8.28	118341.90	0.25	0.89	1.00	0.20
	Min	0.00	0.10	480.03	0.04	0.02	0.00	0.00
	N	42	42	42	42	42	42	41
2018	Mean	0.80	1.08	20133.67	0.13	0.26	0.26	0.06
	Median	0.29	0.83	10537.20	0.12	0.16	0.00	0.04
	Standard deviation	1.36	0.95	25714.11	0.06	0.27	0.45	0.05
	Max	6.00	4.42	101787.60	0.29	0.92	1.00	0.19
	Min	0.00	0.07	485.49	0.04	0.02	0.00	0.00
	N	42	42	42	42	42	42	42

While observing the firm's ability to utilize the tax-shield the return on assets (ROA) are used as a measure. Since the mean and median display similar values of 13% and 12% respectively in 2017, the majority of companies are assumed to be profitable. The standard deviation of ROA of 10% in relation to its 13% mean is further indication of this fact. Though, in 2017, there is a large disparity between the maximum value of 68%, and the minimum value of -138%. The firms with a ROA below 0 are unable to take advantage of tax shields and are thus not expected to alter their capital structure. However, they are assumed to be few and subsequently, not heavily influence the outcome of the model. Moreover, it is possible that they have low debt levels since it may be harder for unprofitable companies to access external financing. Except for a substantially increased minimum between 2017 and 2018, the values remain constant. Comparing domestic and foreign firms, the ROA is similar, but negative ROA occurs only in U.S. firms.

The firms' investment opportunities may co-determine debt-to-equity ratios. In 2017, the mean market value to book value of the sampled firms was 1.92 while the median was 1.30. At 4.07, market-to-book value has a high standard deviation in relation to the mean, which is expected due to the dispersion of industries represented in the sample, see table 5. Subsequently, the distribution of market-to-book value was right-skewed, suggesting that some firms enjoyed greater investment opportunities and subsequently increased the mean. This large dispersion can also be seen through the range between the maximum and minimum market-to-book value. The firm with maximum value displays a valuation of its assets by 123.4 times while the firm with the lowest valued assets was only valued at 0.03 times its book value. Between 2017 and 2018 the average as well as median market-to-book value decreased in the S&P 1500 to 1.68 and 1.09 respectively, suggesting that the investment opportunities of firms have declined. The differences are larger for foreign firms than domestic firms for both the median and mean. It is

also observable that the maximum investment opportunity decreases drastically between 2017 and 2018 from 123.37 to 43.64 in the whole sample.

Due to the diversity of firms that are included in the S&P 1500, their ability to take on new debt will differ. Larger firms are expected to have greater access to capital markets. As expected, since the firms are a part of the S&P 1500, and the composition of the index includes many different industries, the sizes of the firms vary a lot. The largest firm in 2017 displays total assets of $444 097 million, whereas the smallest firm only displays assets of $30 million. It is also observable that the median of $2 942 million deviates a lot from the mean of $13 853 million, suggesting that the distribution of size is again significantly right-skewed. Between 2017 and 2018 the sizes of the S&P 1500 firms increase. A major increase can be observed on the maximum observation with total assets accumulating to $531 864 million. Despite the largest as well as the smallest firms both being located in the U.S., the foreign firms are larger on average. If size as predicted is a determinant of access to debt capital markets, this suggests that U.S. firms are less suited to take on leverage.

Continuing, firms with high tangibility are assumed to have an asset base better suited as collateral for debt. In the sample, there is a huge diversity in tangibility, ranging from a minimum of 0% to a maximum of 97% in 2017. This disparity in tangibility is expected due to the various industries that are included in S&P 1500. However, the median and mean were 17% and 26% respectively. As such, most firms have some assets that can presumably can either be used or are used as collateral. Though no significant change in tangibility is observed between the years, it is noteworthy that the tangibility is comparable between the treated and the control group, indicating that differences in tangibility may not cause the differences in leverage that is observed between the two.

As mentioned, two more unorthodox control variables in addition to those traditionally found in capital structure literature are included in this study: overleveraged, which is a dummy variable proxy for whether firms are taking on excessive leverage as compared to a theoretical optimum, and Shareholder distribution. As overleveraged is a dummy variable, it is observable that in 2017, 37% of the firms were overleveraged and in 2018, the same figure has increased to 46%, which could potentially be a consequence of the TCJA.

Finally, the average and median shareholder distribution levels expressed as a ratio to total assets in 2017 were 5% and 3% respectively. Interestingly, the maximum value was 138%.

While this initially seems odd, upon further investigation it is concluded to be the result of a stock repurchase presumably not recorded as treasury shares. In 2018, mean increased to 7% while the median remained fairly constant. This increase is displayed in domestic firms as well, indicating that it is not a result of the TCJA.

Table 5. Industry classification

Industry	Mining	Construction	Manufacturing	Transportation	Wholesale	Retail	Services	Non-classified
Number of firms	112	52	1113	248	90	192	386	4

The firms represented in this paper are operating in various industries as seen in table 5. Even though a substantial number of the companies are operating in the manufacturing industry, many are also in the transportation, retail and services industries. The variation in industry is expected since the S&P 1500 is a market index. Had more granular SIC codes been used, even greater dispersion would likely be observed. The fact that some industries are less common than others is an indication that the parallel trends assumption of the difference-in-differences estimation may be violated. Still, such a setting is difficult to avoid when investigating a federal, nation-wide tax. In order to mitigate the potential problems associated with a trend violation, a matching procedure including other covariates is also undertaken.

7. Results

In this chapter, the regression results are presented. Following the chronological order of the methodology presentation, the difference-in-differences estimation is first presented, followed by the matched ATE estimations.

7.1. Regression diagnostics

7.1.1 Perfect collinearity

As specified in the methodology section, a key assumption behind OLS is that there is no perfect collinearity. Following Wooldridge (2016), the OLS procedure estimates the effect of a change in the dependent variable following a change in an independent variable, holding all other independent variables constant. If there is a very high degree of correlation, it is hard to imagine that a change in an independent variable does not coincide with a change in a variable to which it is correlated. As a consequence, *ceteris paribus* interpretation is increasingly difficult, and it may not be possible to gauge which independent variable causes the change. From the correlation matrix in table 6, it is possible to gauge that the highest correlation measured between any two variables is approximately 0.47. These results indicate that there are no problematic levels of multicollinearity in the sample.

Table 6. Correlation matrix

	Debt-to-market	Market-to-Book	Tangibility	Size	Return on Assets	Shareholder Distribution
Debt-to-market	1.00					
Market-to-Book	-0.11	1.00				
Tangibility	0.13	-0.15	1.00			
Size	0.12	-0.21	0.19	1.00		
Return on Assets	-0.09	-0.15	0.06	0.02	1.00	
Shareholder Distribution	-0.10	0.47	-0.09	-0.04	0.24	1.00

7.1.2 Heteroskedasticity

According to Wooldridge (2016), heteroskedasticity is present when the OLS assumption of constant variance in the error term is violated. He proposes testing for this using White's test for heteroskedasticity since it is stated to offer the added advantage of testing for non-linear forms of heteroskedasticity. The results of White's test for heteroskedasticity can be found in table 7. The null hypothesis in this test is that heteroskedasticity is not present, i.e. that the error terms are homoskedastic. With a p-value of 0.00, the null hypothesis of homoskedasticity is rejected on the 1% significance level.

In order to deal with this issue, per the recommendations of Wooldridge (2016), standard errors robust to heteroskedasticity are used. This mitigates the biased standard errors that will

otherwise influence the estimation. Since panel data is used, and the debt levels and other covariates in 2017 undoubtedly being heavily correlated to those in 2018, the robust standard errors are clustered around each company ID.

Table 7. White's test for heteroskedasticity

White's test for Ho: homoskedasticity
against Ha: unrestricted heteroskedasticity

chi2(29) = 203.49
Prob > chi2 = 0.0000

Cameron & Trivedi's decomposition of IM-test

Source	chi2	df	p-value
Heteroskedasticity	203.49	29	0.000
Skewness	98.77	7	0.000
Kurtosis	37.26	1	0.000
Total	339.52	37	0.000

7.2 Results and discussion

7.2.1 Difference-in-Differences

Table 8. Difference-in-differences regression

In all regressions below, debt-to-equity is the dependent variable. The first regression is the base difference-in-differences estimation. In the second, overleveraged is added. In the third, shareholder distribution is also included.

	(1)	(2)	(3)
VARIABLES	Debt-to-equity	Debt-to-equity	Debt-to-equity
Year	0.1389***	0.1328***	0.2010***
	(0.0462)	(0.0476)	(0.0761)
Treated	-0.1329	-0.2150**	-0.1542*
	(0.1098)	(0.1073)	(0.0895)
Treated x Year	-0.0520	-0.0739	-0.1389*
	(0.0470)	(0.0486)	(0.0764)
Market-to-book	-0.0307***	-0.0235***	-0.0190**
	(0.0113)	(0.0085)	(0.0081)
Tangibility	0.5126***	0.3732***	0.3647***
	(0.0755)	(0.0737)	(0.0710)
Size	0.0465***	0.0167**	0.0163**
	(0.0084)	(0.0079)	(0.0080)
Return On Assets	-1.1131***	-0.8595***	-0.8007***
	(0.1705)	(0.1436)	(0.1395)
Overleveraged		0.3414***	0.3416***
		(0.0307)	(0.0303)
Shareholder distribution			-0.2482*
			(0.1334)
Constant	0.1369	0.3213**	0.2609**
	(0.1353)	(0.1303)	(0.1155)
Observations	2.195	2.195	2.125
R-squared	0.1901	0.2727	0.2751

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8 shows the difference-in-differences regressions. In regression (1), which is based on the studies of Heider and Ljungqvist (2015) and Frank and Goyal (2009), it is observable from the coefficient of Year that the firms in the control group increase debt-to-market ratios by 13.9 % between 2017 and 2018. Under the assumption that there is a parallel trend between the treated and control group, Year can then be concluded to capture the effect between 2017 and 2018 in the treatment group had the tax decrease not happened. Furthermore, though not statistically significant, the coefficient of Treated suggests that prior to the tax reduction, the debt levels in firms within the U.S. were 13.3% lower on average than in foreign companies. Combining the two into the interaction variable Treated x Year, it is possible to derive the average treatment effect. Even though the ATE of –5.20% does indicate that the effect of the TCJA on leverage is as expected, it is statistically insignificant, and consequently no conclusion can be drawn regarding the validity of the hypothesis. These results are aligned with Heider and

Ljungqvist (2015) who cannot find support that firms alter their capital structure due to tax reductions. However, the results oppose the findings of Givoly et al. (1992) who examine the 1986 reduction in federal corporate income tax and find that firms decreased their debt levels following reform. As mentioned, though, they study firms from another era with different institutional settings, which may influence their results. Moreover, by regressing solely on a treatment group and not including a control group, endogeneity was not addressed to the fullest extent possible.

All control variables are statistically significant at the 1% level. In addition, all relationships of the control variables to debt-to-market ratios followed the *ex-ante* expectations outlined in section 5.2.2. First, a 10% increase in market-to-book ratio is associated with an approximate decrease of –0.3% in debt-to-equity ratio, in line with the idea that distress costs increase with market-to-book ratio. Firm size displayed a positive correlation to debt-ratio, which is in line with expectations; in theory, larger firms should have greater and cheaper access to capital markets given that they suffer from less information asymmetry. It is observable that if Size increases by 10% the debt ratio on average increases by 0.48% using the exact formula to determine the outcome of a linear-log relationship. Profitability experiences the same behavior: if return on assets increases by 1%, the debt-to-equity ratio would decrease by approximately 1.1%. Finally, tangibility shows the same relationship to the dependent variable as expected. An increase in tangibility of 5% will lead to an increase in debt-to-market ratio of 2.5%. These results are aligned with Heider and Ljungqvist (2015) as well as Frank and Goyal's (2009) findings.

In addition to the first model which is built upon covariates found to determine leverage in previous research, an additional control variable is included: an estimation of whether a firm is overleveraged or not. The results of these regressions can, again, be found in table 8, regression (2). As expected, overleveraged firms display approximately 34.1% higher debt levels than firms not above proxied optimal capital structure. When adding overleveraged the resulting difference in the control group between 2017 and 2018 remains robust. While the estimated ATE now increases somewhat in absolute terms, meaning that the effect is larger, the standard errors are essentially unchanged. So, even with the inclusion of Overleveraged, the ATE remains insignificant. However, by including overleveraged in the regression the post-treatment difference in debt levels between the treated and control group displayed both economical and statistical significance. The coefficient associated with Treated decreased by 0.7 and displayed

a significance at the 5% level, which suggests that before the tax decrease firms within the debt ratios of firms within the U.S. were 21.5 % lower than the debt ratios of foreign firms. Thus, when the model controls for the fact that some firms are above their optimal capital structure, the difference in debt-ratio between domestic and foreign firms is both economically and statistically more significant prior to the tax reduction. The strong post-treatment effect on debt-ratios contradicts the findings from previous research which suggest that U.S. firms are significantly underlevered (Graham 2010; Korteweg, 2010; Molina 2005; Glover 2016). Though, it is important to state that the fact that these results contradict the findings of Graham (2000) and others does not imply that the findings are aligned with those of Blouin, Core and Guay (2010). Rather, while the results indicate that firms do not actively trade the tax benefits of debt against the costs of debt, they do not address the underlying cause of this inaction.

In a final difference-in-differences model, shareholder distribution is added as a control variable, see table 8 regression (3). Firms with a higher shareholder distribution have on average lower debt-ratios. An increase of 1% in shareholder distribution is shown to be associated with a debt-ratio that is 24.8% lower. There is a chance that this effect is a consequence of increases in market value following the increased distribution of funds to shareholders; as such, risk shifting-like behavior cannot be excluded with certainty. Unlike previously, the effect of YEAR no longer remains consistent; instead, the trend found in the control group is at an average of 20.1%. This is an indication that in the absence of the treatment, firms in the U.S. would also be expected to significantly increase their levels of leverage. The magnitude and significance of Treated on the other hand decreased, suggesting that the pre-treatment differences between the U.S. and non-U.S. firms were not as large as originally anticipated.

In terms of the ATE, the magnitude almost doubled, now at approximately –13.9%. Not only does the ATE display a large magnitude, but now also displays statistical significance on the 10% level. Like the results of Faulkender and Smith (2016) and Givoly et al. (1992) who find support for trade-off theory, these results are additional support for the hypothesis that firms do trade-off the costs of debt with its tax benefits following tax reductions. The fact that this significance level is reached only after including controls for agency-related costs indicates that the complete trade-off theories of Stulz (1990) and Morellec (2003) in which all costs of debt arising from market imperfections are included, are relevant.

7.2.2 Robustness test for Large-, Mid-, and Small Capitalization

The fact that Frank and Goyal (2003) argue that larger firms are more inclined to alter their capital structure is reason to believe that firms of different sizes may respond differently. A test on each capitalization class separately is thus also undertaken to assess whether differences between the sample indices exist. In doing so, the satisfaction of parallel trends presumably increases due to the higher degree of similarity in companies within an index. Additionally, it also ensures that the statistically significant findings are not simple the consequence of one capitalization class alone.

Table 9. Robustness test per capitalization class

VARIABLES	Large Cap Debt-to-equity	Mid Cap Debt-to-equity	Small Cap Debt-to-equity
Year	0.0702***	0.3244**	0.3679*
	(0.0254)	(0.1340)	(0.2161)
Treated	0.0089	-0.1071	-0.2758
	(0.0345)	(0.1470)	(0.2412)
Treated x Year	-0.0378	-0.2666**	-0.2978
	(0.0274)	(0.1346)	(0.2159)
Market-to-book	-0.0379***	0.0059	-0.0085
	(0.0102)	(0.0044)	(0.0155)
Tangibility	0.1387**	0.2914**	0.2442**
	(0.0609)	(0.1168)	(0.1216)
Size	0.0410**	0.2545***	0.2798***
	(0.0166)	(0.0475)	(0.0451)
Return On Assets	-0.2869	-0.1924	-0.4473**
	(0.2002)	(0.1830)	(0.2141)
Overleveraged	0.1636***	0.1930***	0.3860***
	(0.0251)	(0.0416)	(0.0545)
Shareholder distribution	-0.3156*	0.1392	-0.1067
	(0.1656)	(0.1231)	(0.1431)
Constant	-0.1091	-1.7552***	-1.4296***
	(0.1662)	(0.4203)	(0.3693)
Observations	742	545	838
R-squared	0.3342	0.4030	0.4503

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results of difference-in-differences estimations divided by capitalization group (large-, mid-, and small-capitalization) can be found in table 9. Unlike the main difference-in-differences regression, the coefficient for Treated suggests that U.S. large cap firms have slightly higher pre-treatment debt-to-equity ratios than non-U.S. large cap firms. Like in the

main regression, though, U.S. ratios are slightly smaller in the mid- and small-capitalization segments. However, none of these results are statistically significant.

Whereas the effect of Year, i.e. the difference in the control group is a lot smaller in the large capitalization segment than in the main difference-in-difference model, the differences in the mid-capitalization and small-capitalization segments are both significantly higher. All these results are statistically significant. This suggest that in the absence of the tax reduction firms in the large-capitalization segment would be expected to increase their leverage the least, while firms in the mid-capitalization and small-capitalization segments would increase their debt-to-equity ratios far more. This is interesting while observing the ATE from Treated x Year, as the magnitudes of the decreases in debt-to-equity ratios following the tax reduction are far larger in the mid-capitalization and small-capitalization segment, on average declining by 26.7% and 29.8% respectively. This can be contrasted to the large-capitalization firms, in which debt-to-equity only declines by 3.8%. This is an indication that whereas non-U.S. mid- and small-capitalization firms significantly increase their leverage ratios between 2017 and 2018, U.S. equivalents are not observed to do the same. However, since statistical significance is only displayed for the mid-capitalization segment, it is only in this segment that strong support for the hypothesis is found. Since the robustness test indicates that the results of the main difference-in-differences regression are neither found in the largest nor the smallest capitalization classes, these findings contradict the argument of Frank and Goyal (2003) who argue that capital structure management is more common in larger firms.

7.2.3 Robustness test to control for the tax changes in the control group

Table 10. Robustness test to control for tax changes in the control group
In the regression below, debt-to-equity is the dependent variable. This model is the main difference-in-differences regression, but with firms from France and Luxembourg excluded.

VARIABLES	Debt-to-equity
Year	0.2000**
	(0.0797)
Treated	-0.1651*
	(0.0937)
Treated x Year	-0.1380*
	(0.0800)
Market-to-book	-0.0191**
	(0.0081)
Tangibility	0.3639***
	(0.0710)
Size	0.0161**
	(0.0080)
Return On Assets	-0.8002***
	(0.1397)
Overleveraged	0.3425***
	(0.0304)
Shareholder distribution	-0.2481*
	(0.1334)
Constant	0.2727**
	(0.1191)
Observations	2,121
R-squared	0.2753

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In table 10, a final additional robustness test of the difference-in-differences estimation is conducted. Here, two foreign firms from France and Luxembourg that received tax reductions in the same period were excluded. As can be seen in table 1, at 10% and 1.1% respectively, these tax reductions were smaller than the one enjoyed because of the TCJA. As such, it should come to no surprise that the exclusion of these firms does not materially change the results, which instead remain robust.

7.2.4 Results of the Matching

The validity of the difference-in-differences estimation is, as previously mentioned, contingent on the assumption that there is a parallel trend between the treatment and the control group. The robustness test in which the model is re-estimated in each capitalization class increases the resemblance of the groups and should enhance the satisfaction of the assumption. Still, as

outlined in the methodology section, there is reason to be suspicious of whether parallel trends are truly fulfilled or not. The fact that the results of the robustness test between capitalization classes show that only mid-capitalization firms have a significant effect, without theoretical intuition for why that would be the case, is further indication of a potential violation of the parallel trends assumption. It should be stressed that Roberts and Whited (2013) acknowledge that it is not possible to test whether the assumption is violated; consequently, a matched treatment and control ATE estimation is also made in order to ensure robustness.

Table 11. Average Treatment Effects

The matched ATE is tested in a sequence of four steps. In the first estimation, matching is done on firm size and industry. In the second estimation, tangibility and return on assets are added as matching criteria. In the third estimation, overleveraged and shareholder distribution are also added. Finally, in the fourth estimation, all variables that had no match within a 50% caliper were removed - in total, 226 observations.

	(1)	(2)	(3)	(4)
VARIABLES	Debt-to-Equity	Debt-to-Equity	Debt-to-Equity	Debt-to-Equity
ATE	-0.0251	-0.0260	-0.0519	-0.0275
	(0.1428)	(0.1271)	(0.1893)	(0.1487)
Observations	2,195	2,195	2,193	1,967
R-squared	0.0178	0.0171	0.0321	0.0155

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The results of the first matched ATE estimation can be found in table 11, estimation (1), where matching is conducted by size and industry. At –2.51%, the ATE is now considerably smaller than what was the case in the difference-in-difference estimation. While as predicted still negative, the effect is not statistically significant. These results are similar to the initial difference-in-differences model that only controls for variables from existing literature. So, when the treated and control groups are matched based on firm size and industry, no convincing support for the hypothesis is found. In estimation (2), the remaining covariates of the first base model with the exception of market-to-book ratio are included. The exclusion of the latter is motivated by a likely violation of the matching assumptions; a consequence of the market value likely being affected by the exogenous shock. Still, the results remain strikingly similar to estimation (1), indicative of the fact that the trends assumption was as satisfied when matching only on size and industry. In estimation (3), the final covariates of the full difference-in-differences model are included, namely overleveraged and shareholder distribution. While the inclusion of these variables led to a statistically significant treatment effect in the difference-in-differences model, no such effect can be observed in the matched treatment-control estimation. Though, it should be noted that the ATE increases in magnitude. If the assumptions underlying the matching procedure are fulfilled, the matched estimation is likely the more valid

result, considering that a violation of the parallel trends assumption of the difference-in-differences is probable.

As such, the results of the matched treatment-control estimation indicate that the difference-in-differences estimation is in fact not robust to a greater extent of comparability between the groups. To confirm this, a final matching procedure is carried out in model (4). Here, a caliper matching at the 50% level is executed, leading to the exclusion of 452 observations that have no close matches. While such a procedure leads to a smaller sample considered in its estimation, the increased similarity provides a useful test for robustness. With an ATE still at –2.75%, the initial matched models still prove robust, and the test fails to find support for the hypothesis that firms lower their debt-to-equity ratios following a significant tax reduction.

7.2.4 Discussion

The results of the main difference-in-differences regression support the formulated hypothesis. The treatment effect of U.S. firms receiving the tax reduction is shown to be 13.9% on average. Interestingly, the support is first displayed after controlling for the firm tendency to not be concerned with capital structure optimization through the variable overleveraged, and the potential tendency to enrich equity holders at the expense of debtholders measured in the shareholder distribution variable. As initially expected, the inclusion of those variables affects the observed change in debt-to-equity.

The implied support of trade-off theory is aligned with Givoly et al. (1992), Faulkender and Smith (2016), Frank and Goyal (2003) and Faccio and Xu (2015), but contradicts the findings of Shyam and Myers (1999) and Fama and French (2005). Although Heider and Ljungqvist (2015) find that firms do not alter their capital structure due to tax decreases, they argue that this may be attributable to the magnitude of the studied tax reductions; a claim derived from the dynamic trade-off theory, in which firms are argued to have an optimal capital structure range, only adjusting leverage when the savings of doing so justify paying the transaction costs. Since the tax reduction from the TCJA is substantially larger than the state tax reductions utilized by Heider and Ljungqvist (2015), the initial difference-in-differences model strengthens their claim. Worth noting, is that the model in this paper expands on theirs in terms of the inclusion of shareholder distribution and an estimate of firms being overleveraged. However, the strength of the assumption of the tax burden is likely stronger in Heider and Ljungqvist (2015), since they approximate the tax burden by the number of subsidiaries in different states. Also, similarity between states is likely larger than between countries. Thus,

they likely reach a truer estimate about where taxes are actually paid. Still, the added accuracy is likely of small benefit considering the fact that the repatriation taxes are still charged to U.S. firms with foreign income.

To further increase the probability of underlying methodology assumptions not being violated, an additional robustness test is carried out by estimating the difference-in-difference model on different capitalization indices. Inter-capitalization differences are found: primarily, mid-capitalization firms are proven to decrease their leverage. In relation to large-capitalization firms, this is not in line with Frank and Goyal's (2003) conclusion that larger firms are more likely to engage in capital structure engineering. On the other hand, the fact that small-capitalization firms simultaneously are not proven to decrease their is supportive of their claim. Since the parallel trends assumptions are likely stronger when debt-to-equity ratios are regressed separately per capitalization class rather than on the sample in its entirety, the failure to find support for the hypothesis in large- and small-capitalization firms makes generalizing the finding of the main regression problematic.

Consequently, a final robustness test is done. Based on similarity in covariates, firms within the treatment group are matched to firms in the control group, ensuring a greater comparability and a greater probability of parallel trends between the groups. The results of this robustness test, which should have the greatest likelihood of satisfied assumptions, indicate that firms did in fact not respond to the TCJA by decreasing their debt-to-equity ratio. Following this development, the hypothesis is no longer supported. This finally positions this paper alongside Heider and Ljungqvist (2015), whose U.S. state-based treatment and control groups allow for a convincing causal interpretation. Contrarily, as the more robust methodology is used, the results are no longer in line with the multinational approach of Faulkender and Smith (2016); perhaps a sign of warning of potentially weaker parallel trends in their estimation. Likewise, the results also differ from Givoly et al. (1992), who utilize only a treatment group; a choice which impairs their ability to make causal interpretations. On the other hand, by enhancing the satisfaction of the parallel trend assumption no support is found for the notion by Heider and Ljungqvist (2015) that by the predictions of dynamic trade-off theory, a larger tax decrease would cause firms to be more inclined to decrease their debt-to-equity ratios. However, a word of caution is warranted even against the matched ATE approach. Since the controlled and treated in our sample still are incorporated in different countries, institutional differences are impossible to overcome. Subsequently, if the critique against the difference-in-differences approach is metaphorically illustrated as a comparison between apples and pineapples, there is

still a risk that the matching approach is insufficient – and that the final result, while better than the alternative, is still a comparison between apples and oranges.

8. Conclusion and further research

This chapter presents the paper's final conclusion as well as a discussion on potential future research.

Despite the possibility of deducting interest payments from taxes, there is no academic consensus on the degree to which taxes affect capital structure. A major issue in such research is to ensure a causal interpretation, e.g. through the utilization of an exogenous event. In the context of this study, the TCJA is used to enable such a causal interpretation. The initial significant results associated with the difference-in-differences estimation suggest that Heider and Ljungqvist's (2015) argument that a large enough tax reduction may lead firms to respond to tax cuts is true. However, the fact that support for trade-off theory was found in a difference-in-differences estimation but was rejected in a more granular matching procedure is interesting in the sense that it casts a shadow of doubt upon some earlier findings. This is potentially also interesting from a tax policy perspective: if true that firm leverage is unresponsive to tax reductions, firm leverage considerations in policy setting are redundant.

In future research, with the usage of larger datasets and perhaps additional tax reductions, the same methodology could perhaps be used in an attempt to draw additional conclusions about the impact of taxes on capital structure with greater precision. Also, whereas previous work that considered state taxes faced a higher degree of institutional similarity, the inclusion of a matching procedure when investigating state tax impact could yield more precise results. Factors such as debt maturity profiles may also potentially have influenced the results of this paper, which due to the little time elapsed since the TCJA is by necessity short-term in its nature. Future research could utilize a longer timeframe which may lead to different results. Additionally, if the sizes of treated and control would be more similar a higher precision in matching could be attained; though, these settings are rare to find in the context of research of tax effects on capital structure. Needless to say, there are countless opportunities for future research to draw advantage of this exogenous shock; after sufficient time has passed, the event will surely be used to draw new conclusions on a variety of themes.

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Appendix A. Computation of marginal costs and benefits of debt

The computation of marginal cost

Van Binsbergen, Graham and Yang (2010) present the following formula to compute the alpha used in their equation.

$$a = 0.117 - 0.039\ Collateral\ assets + 0.015 Log(Total\ Assets) - 0.018\ Book\ to\ Market - 0.024\ Intangility + 0.080\ Cash\ Flow + 0.063\ Dividend$$

They state that (1) COLLATERAL ASSETS is the ratio between fixed assets and inventories to the book value of assets, (2) LOG OF TOTAL ASSETS is the log of assets (book value), (3) BOOK-TO-MARKET is the book-to-market value of equity, (4) INTANGIBILITY the ratio of intangible assets to total assets (book value), (5) CASH FLOW is the cash flows over total assets (book value), (6) DIVIDEND is a dummy variable for a firm paying dividends. Finally, they state that B is a constant with the value of 4.733. Per their recommendations, the values are standardized by subtracting the sample mean from their original sample, and then dividing by the standard deviation of the original sample.

The computation of probability of default

Ohlson (1980) presents the following formula to compute his O-Score:

$$O = -1.32 - 0.41 \ln(V)/GDPP) + 6.03\frac{BL}{V} - 1.43\frac{WC}{V} + 0.08\frac{CL}{CA} + 2.37\frac{NI}{V} - 1.83\frac{FFO}{BL} + 0.285\ INTWO - 17.2\ OENEG - 0.52\ CHIN$$

Here, he claims that (1) ln(V)/ GDPP is the logarithm of assets at book value divided by the nominal GDP, (2) BL is the book value of total liabilities, (3) WC/V is the ratio between working capital and the book value of total assets, (4) CL/CA the ratio between book value of current liabilities to book value of current assets, (6) NI/V the ratio between net income and book value of assets, (7) FFO/BL the ratio between funds from operations (EBT + depreciation and amortization) and book value of liabilities, (8) INTWO a dummy taking the value of 1 if the sum of net income for the past two years is negative, (9) OENEG a dummy taking the value of 1 if the book value of equity is negative, (10) CHIN the ratio between the delta of net income the past two years to the delta of absolute values of net income the past two years.