How does board independence affect capital structure decisions?

A study on financing decisions in the United States

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Abstract

This research aims to investigate the relationship between board independence and capital structure. This paper takes advantage of the Sarbanes Oxley Act that forced United States listed firms to increase the share of independent directors within the board of directors. The relationship has been analyzed by performing a two-stage least squares (2SLS) regression, including noncompliance with the new regulation as an instrumental variable. By using this method, an exogenous shift in the share of independent directors is used to cope with potential endogeneity issues. The data that is used, is retrieved from Wharton Research Data Services and covers the period 1996-2005.

The results of this study show a significant, positive relationship between the share of independent directors on the board of directors and leverage. This is consistent with the hypothesis that an increase in outside directors increases corporate governance, which lowers the costs of risky financing sources, implying an increase in the amount of leverage a firm takes on.

Key words: Board Independence, Board of Directors, Capital structure, Corporate Governance, Sarbanes Oxley Act, Two-stage Least Squares regression

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1. Introduction

The debate on how managers should finance their organization is still one of the most challenging issues in corporate finance literature, despite the passing of half a century of research effort since the cornerstone of capital structure theory was established by Modigliani and Miller in 1958. Certainly, the fact that capital markets are not perfect, as assumed by Modigliani and Miller (1958), makes it more difficult to determine how investments should be financed, either by debt or by equity. However, it is one of the most important decisions for a manager as an optimal capital structure maximizes firm value by minimization of the cost of capital (Nadarajah, Ali, Liu, & Huang, 2018).

Concerning the maximization of firm value, corporate governance plays an important role. It is found that corporate governance positively affects firm value (Ammann, Oesch, & Schmid, 2011). Therefore, it is important to consider corporate governance in capital structure decisions. After several scandals regarding corporate governance, namely Enron, Tyco and Worldcom, the trust in the financial sector had decreased tremendously. As a result, the Sarbanes Oxley Act (SOX) was introduced. The SOX consisted of a new set of regulations to improve corporate governance within publicly listed US firms, and it would improve the auditing of those companies (Agrawal & Chadha, 2005).

One of the newly introduced rules required all public US firms to have an audit committee consisting of only independent directors, including at least one financial expert. Later, the New York Stock Exchange (NYSE) and NASDAQ introduced an additional set of rules, including the requirement that the majority of the board should consist of independent directors (Duchin, Matsusaka, & Ozbas, 2010).

This new regulation forced many firms to increase the share of independent directors within the board of directors. As it is one of the most important responsibilities of the board of directors to represent the shareholders and prevent the manager from pursuing its own interests, it is important that the board of directors operates independently (Fama & Jensen, 1983). Hence, the introduction of the SOX led to an improvement within the world of corporate governance because it is widely perceived that an increase in outside directors increases corporate governance within a firm. The

reason for this is that outside directors would align the interests of the shareholders more with the managers' interests than an inside director would. Thus, it affects the managerial discretion, which is defined as managements' opportunity to pursue their own interest rather than that of the shareholders in corporate decisions (Hambrick & Finkelstein, 1987).

Hence, corporate governance mechanisms are used to control managers to act in the best interest of shareholders. An example of corporate governance mechanisms is managerial ownership, which should align the interests of managers and shareholders. A second example is ownership concentration which leads to more active shareholders, who can monitor management themselves. A sidenote that should be made is that this only makes sense for shareholders with substantial stakes, since small shareholders do not have the incentive to monitor management. Managerial compensation is a third example of how the interest between management and shareholders could be aligned. Compensation contracts can incentivize management to maximize shareholders' wealth (Florackis, 2008).

Much research has been conducted to estimate the effect of corporate governance mechanisms on firm characteristics, such as performance and capital structure. This research will add to the existing literature of this relation and aims to examine how a more independent board affects the capital structure of a company. The study of capital structure is defined as: *"it attempts to explain the mix of securities and financing sources used by corporations to finance real investment"* (Myers, 2001, p. 81). Several theories are developed to explain the motives behind companies' choices for different financing sources. The pecking order theory and static tradeoff theory are established decades ago, but still are the most prominent theories to explain financing decisions.

In short, the pecking order theory predicts that there is a hierarchy determining whether firms would choose for one financing source over another. It predicts that firms choose internal funds over external funds, but when they must acquire external funds, they prefer safer external funds (read: debt) over riskier external funds (read: equity) (Myers, 2001). The static tradeoff theory assumes that firms have an optimal debt ratio, based on a tradeoff between the costs and benefits of any additional dollar debt, and they aim to reach that at any time (Mostafa & Boregowda, 2015). A third, more recent developed theory assumes that firms try to time the market. Meaning that they

will issue equity once their share price is overvalued and they repurchase equity once their share price is undervalued (Mostafa & Boregowda, 2015). Previous literature shows that it is hard to determine which theory predicts best, after testing both the pecking order theory and the tradeoff theory (Fama & French, 2002).

This paper investigates how board independence, measured by the share of independent directors within the board, affects the capital structure of firms in the United States. Therefore, the research question of this paper will be:

How does board independence affect capital structure decisions in the United States?

The sample of this research consist of publicly listed firms in the United States during a period of 1996-2005. The research will be conducted by executing a two-stage least squares regression. The in 2002 introduced SOX, allows to examine an exogenous shift in the share of independent directors on the board. Noncompliance with the new regulation in 2000, specifically: noncompliance with a totally independent audit committee in 2000, is used as an instrumental variable to measure the effect of a shift in the share of independent directors.

It was expected that board independence positively affects the amount of leverage a firm takes on. This is based on the theory that an increase in outside directors, lowers the information asymmetry and therefore leads to a reduction in the costs of risky sources of financing (Alves, Couto, & Francisco, 2015). In line with the hypothesis, a significant positive relation between the share of independent directors and leverage is found.

This research contributes to the existing literature in two ways. First, unlike other papers, this paper assumes endogeneity issues. For instance, Jiraporn et al. (2012) assume that reversed causality is unlikely to be an issue in their main model. This could cause biased results and should therefore be taken seriously. Consequently, this study uses an exogenous shift in the share of independent directors to measure the effect of board independence on capital structure decisions. Therefore, the results of this paper show a causal relationship. In addition, this paper distinguishes itself from other papers that examine the relationship between board composition and leverage by looking at

United States firms only. After the failures of several prominent companies, as Enron, Tyco and Worldcom, the US governance system caught a lot of attention, which caused the regulators to intervene. Therefore, it is relevant to see how the research question applies to the United States rather than undeveloped countries, as is examined by Sheikh & Wang, 2012; Tarus & Ayabei, 2016; Vu, Tran, Doan, & Le, 2020 and Njuguna & Obwogi , 2015. Thus, the research method in combination with the sample ensures this research to be innovative and a contribution to the existing literature about board independence and capital structure.

The paper is constructed as follows; the next chapter consists of the literature review that describes relevant background theory and previous findings related to this research. Also, the introduction of the SOX that is used in the methodology will be described more extensively. Chapter 3 describes the data construction and methodology. Thereafter, the descriptive statistics and main results of this research will be described followed by the conclusion and a discussion including some suggestions for further research.

2. Literature Review

This literature review provides an overview of the relevant background information with regard to the topic of this paper. First, agency problems are introduced, followed by the theory about the board of directors as they are supposed to mitigate agency problems. Thereafter, three different capital structures will be touched upon to provide an overview of different strategies regarding financial leverage. Fourth, the determinants of capital structure will be discussed to give a complete overview. After that, existing literature with similar research questions will be discussed, followed by a summary of the SOX to provide background information in how this research distinguishes itself from others. Lastly, the hypothesis of this research will be elaborated.

2.1 Agency problems

Within the world of corporate governance, agency problems have evolved. Agency problems are a result of conflicting interests. Therefore, contracts are needed and those are not written nor enforced fully costless (Fama & Jensen, 1983). The focus in this paper will be on the agency problems between hired managers and shareholders, and that of shareholders and debtholders.

One of the most famous agency problems between managers and shareholders is the Free Cash Flow (FCF) problem. It was discovered by Jensen in 1986 and he defines FCF as: "*the cash flow in excess of that required to fund all projects that have positive net present values when discounted at the relevant cost of capital"* (p. 323). The conflict of interest arises as the shareholders prefer to have the excess cash flow paid out as dividend, whereas the managers rather invest that excess cash to grow the company. The agency costs of FCF are that managers will invest in marginal or even negative net present value projects. These projects may be beneficial for the managers in terms of benefits or personal rewards; however, they are detrimental for the shareholders (Chung, Firth, & Kim, 2005).

The second agency problem is between shareholders and debtholders, it is called the asset substitution or risk shifting problem (Mao, 2003). It is described as follows: "*The agency costs associated with the existence of debt, are composed mainly of the value reductions in the firm and monitoring costs caused by the manager's incentive to reallocate wealth from the bondholders to himself by increasing the value of his equity claim"* (Jensen & Meckling, 1976, p. 345). They argue

that equity could be viewed as a call option on the firm. As the value of a call option increases with the volatility of the underlying asset, this incentivizes the equity holders to push management in investing in risky projects (Green & Talmor, 1986).

The last agency problem is, again, between shareholders and debtholders and consists of underinvestment. In short, it states that equity holders have an incentive to do sub-optimal investments, thus underinvest in positive net present value projects. The reason for this is that they face the risk and costs of the investment, but do not fully benefit when the investment is successful, they only benefit partly. The greater benefit is for the creditors (Mao, 2003).

2.2 Board of directors

One solution how to deal with the agency problems described above is the board of directors. The board of directors plays an important role within the firm as it represents the shareholders. Thus, it should act in the best interest of the shareholders and prevent the managers from pursuing their own. Since the role of the board is to hire, fire, monitor and compensate management, it should provide a clear separation of ownership and control. Nevertheless, in practice some independence issues have evolved. For example, in some firms the board of directors consists of more inside directors than outside directors. However, it is more likely that an outside director will stand up against a Chief Executive Officer (CEO) than an inside director, thus inside directors decrease corporate governance within the firm. Also, outside directors are better able to mitigate agency problems (Fama & Jensen, 1983). Another independence concern that can be questioned is that of CEO duality. This happens when the CEO fulfills two roles within the firm: chairman of the board as well as CEO of the company. This raises the question whether the board is independent and could act in the best interest of the shareholders while it has tight connections with management (Fosberg, 2004).

Many studies have been conducted to the question whether board independence harms or favors firm performance. Mixed results have been found, which can partly be explained as follows: companies can increase the number of outside directors, which seems favorable for the shareholders. However, as internal managers choose the outside directors, they can reduce their power in several ways. The insiders may appoint outsiders that have been in passive boards before,

or that have irrelevant background or outsiders that do not have the knowledge to really challenge the executive powers (Fuzi, Halim, & Julizaerma, 2016). This way, an increase in outside board members does not necessarily improve performance. Other research examined whether the theory that independent boards improve corporate governance, and thereby performance, is true. They found that firms with more independent directors on the board do not perform better than other firms (Bhagat & Black, 2002). A study of Duchin et al. (2010) found that the effectiveness of outside directors depends on the cost of information. Thus, whether an increase in outside directors either harms or favors the firm depends on how high or low the costs are to acquire information about the firm. In case of low information costs, it favors the firm. However, in case of high information costs, the effectiveness of outside directors does not outweigh the information costs (Duchin, Matsusaka, & Ozbas, 2010).

2.3 Capital Structure Theories

This research focuses on the effect of board independence on financing decisions. Financing decisions of a firm may be determined based on several theories. Three different theories will be explained. First two theories are the traditional capital structure theories: the pecking order theory and the static trade-off theory. Both theories are based on the cornerstone of modern corporate finance: the irrelevance proposition from Modigliani and Miller, which states that in perfect capital markets, it does not matter how the firm is financed (Modigliani & Miller, 1958). In addition, the third theory is a more recent developed theory and is called the market timing theory.

First theory to be discussed is the pecking order theory, developed by Myers and Majluf in 1984. This theory assumes a financing hierarchy, in which firms prefer internal funding over external funding. When a firm needs to issue external funding, it prefers debt over equity because the information costs are lower when a firm issues debt. Therefore, equity is in the bottom of the hierarchy (Frank & Goyal, 2003). This theory expects that firms take on more debt relative to equity.

On the other hand, the static tradeoff theory is widely known as optimal capital structure theory. It is based on the work of Modigliani and Miller in the 1950s as it assumes that once income tax is added to the model, there appears a benefit for taking on more debt. The static tradeoff theory

predicts that firms base their capital structure on a tradeoff between the costs and benefits of issuing debt. It tries to maximize the benefits, by increasing debt and thereby increasing the tax shields. However, it also considers the costs of financial distress and agency costs. This way, the static tradeoff theory identifies the ideal mix, also known as target debt ratio, for a company regarding their financing decisions (Myers, 2003).

A third, maybe less well-known theory is the market timing theory. According to the market timing theory, firm prefer to issue equity when the costs of equity are relatively low, otherwise they will issue debt. On the other hand, they prefer to issue debt when their perception of the costs of equity is relatively high. Their judgement regarding the height of the costs of equity is based on both their own knowledge and they are following psychological patterns. An important example is based on the prospect theories and means that executives base their ideas on reference points (Huang & Ritter, 2005). Consequently, stock prices volatility influences a firms' capital structure (Luigi & Sorin, 2009).

2.4 Determinants of Capital Structure

Capital structure decisions differ per firm, as all firms are unique and are differently built. However, literature suggests that there are consistent determinants of capital structure, although the effect of those determinants on capital structure may differ per theory. In this section, the different determinants of capital structure will be discussed and how they are expected to affect financing decisions.

Profitability

First, profitability plays an important role in capital structure decisions. The static tradeoff theory expects firms with high profitability to take on more debt than lower profitable firms as they want to reduce tax expenses. Higher profit implies higher cashflows and higher cashflows imply higher tax payments. However, if the firm takes on more debt, it reduces the cashflows and as a result pays less tax. Contrary, according to the pecking order theory, a profitable firm is expected to take on less debt than its counterparts as profitable firms have more earnings and it will use that for financing rather than debt, based on the hierarchy discussed in the pecking order theory (Fauzi, Basyith & Idris, 2013). Concluding, the static tradeoff theory would expect a positive relationship

and the pecking order theory would expect a negative relationship between profitability and leverage (Kayo & Kimura, 2011).

Tangible assets

As most debt requires collateral, to guarantee bondholders, it is likely that the proportion of tangible assets of a firm has its impact on debt decisions (Fauzi , Basyith , & Idris, 2013). As tangible assets serve as collateral, the higher proportion of tangible assets diminishes the risk of the bondholders suffering the agency costs of debt. Also, in case of bankruptcy, tangible assets should retain more value. As a result, literature suggests that the higher fraction of tangible assets on the balance sheet, the more willing bondholders are to supply capital, and thus leverage should be higher (Rajan & Zingales, 1995). However, the impact of tangibility on leverage is particularly important for firms that are financially constrained. Thus, when firms are unconstrained, tangibility plays less of an important role (Almeida & Campello, 2007).

Uniqueness

According to Titman & Wessels (1988) uniqueness is something that should be considered as well within the process of financing. As a firm becomes more unique, thus produces for example unique products, it is harder to find substituting companies in case of liquidation. Therefore, once a unique firm liquidates, the liquidation costs are higher than when a less unique company liquidates. A firm should take these costs into account when it determines its capital structure, as these are the costs it could impose on their clients, workers, and suppliers when it goes bankrupt. Uniqueness is expected to have an inverse relation to leverage (Titman & Wessels, 1988).

Firm size

Previous literature suggests that larger firms are more prominent and therefore can take on more debt relative to smaller firms. The reason for this is that large firms are less likely to go bankrupt, they do have greater debt capacity and might be more transparent (Kayo & Kimura, 2011). However, according to Rajan & Zingales (1995) the relationship between firm size and capital structure is ambiguous. On the one hand, they argue that larger firms are less likely to fail and more diverse and therefore size may be an inverse proxy for the chance of bankruptcy. This would imply that size is positively correlated with leverage. On the other hand, they discuss that size can

be a proxy for the information outside investors have. They assume that information asymmetry is less of a problem for larger firms and therefore they can issue new shares with no reduction in the market value (Rajan & Zingales, 1995). This implies that larger firms would prefer equity over debt. Again, the expected relationship with leverage it controversial. A positive relationship would confirm the diversification theory and a negative relationship would confirm the information asymmetry theory (Kayo & Kimura, 2011).

Growth opportunities

Previous research found a negative relationship between growth opportunities and the amount of leverage a company has. This is based on the theory that equity financing is a mechanism that decreases the issue of underinvestment associated by financing through debt (Padrón, Apolinario, Santana, Martel, & Sales, 2005). In a situation in which management faces high debt levels, high growth opportunities and acts in a way to protect shareholders, management could prefer to do sub-optimal investment projects rather than positive investment projects if the profits will end up in hands of the bondholders. As a result, many studies have found a negative relation between growth opportunities and debt level (Myers, 1977; Murray & Goyal, 2009). On the other hand, according to the pecking order theory, growth opportunities can be positively related to leverage. Companies with good investment opportunities that lack internal fundings, will choose debt over equity in case of information asymmetry. Thus, managers that want to avoid information asymmetry costs, would rather use debt for the investment options than equity. According to Myers and Majluf (1984), managers prefer to issue equity once shares are overvalued, meaning that they will benefit old shareholders. However, new shareholders know this and will therefore require a discount on the share price before they will buy the new shares. As a result, managers do not prefer to issue equity (Myers & Majluf, 1984). Concluding, there are two theories driving the results of the relationship between growth opportunities and leverage. A positive relationship would be in line with the pecking order theory and a negative relationship would be in line with previous discussed agency theory of underinvestment (Kayo & Kimura, 2011).

Market to book value

Market to book value is commonly used as a proxy for the investment opportunities a firm has, which in term means the intangible firm value that has no collateral value. Once a firm is in

financial distress, it is likely that the intangible value will be lost. This implies that the risk of undervaluation is relatively high for firms with high intangible value, as well as the risk for resource diversion (Pandey, 2001). Based on this information, a negative relation between market to book value and leverage would be expected. In addition, previous research also found a negative relationship between the market to book value and leverage (Rajan & Zingales, 1995; Titman & Wessels, 1988)

Tax rate

As tax is deductible for interest payments, but is not for dividend payouts, it creates an incentive for firms to issue debt (Modigliani & Miller, 1963). It therefore seems quite logical that the tax rate has its impact on the amount of debt a firm takes on. Previous literature has struggled finding evidence for this. However, according to Gordon & Lee (2000), there is a strong and significant link between tax rate and debt levels. They found that, holding personal taxes fixed, at a decrease of ten percentage points in corporate tax rate, the fraction of assets financed with debt decreases by 3.5%. However, it is important to control for firm size, as small firms rely more on debt than large firms, yet small firms have lower tax incentives to take on debt (Gordon & Lee, 2001).

Non-debt tax shields

Existing literature argues that non-debt tax shields influence capital structure decisions as well. On the one hand, DeAngelo and Masulis (1980) argue that the larger the ratio of non-debt tax shields to Earnings Before Interest and Taxes (EBIT) gets, leverage should decrease. They suggest that tax deductions for investment tax credits and depreciation are substitutes for the tax benefits of issuing debt, and that firms will select a debt level that has an inverse relation with those available tax shields substitutes for debt (DeAngelo & Masulis, 1980). On the other hand, previous research found a positive relation between non-debt tax shields and leverage (Harris & Raviv, 1991; Lim, 2012).

Industry classification

It is a stylized fact that firms within one industry are more similar than firms in different industries, this also accounts for the leverage ratios of firms within an industry. In addition, industries tend to retain those leverage ratio rankings over the years. Thus, the leverage ratios differ per industry, for

example regulated industries (Electric and Gas utilities, Airlines and Telephone) are on average highly levered (Harris & Raviv, 1991; DeAngelo & Masulis, 1980).

Governance

Corporate governance is necessary to mitigate agency problems caused by the separation of ownership and control. These problems arise as managers pursue their own interest at the expense of that of the shareholders. In the context of capital structure, it could be the case that managers will take on more debt and therefore deviate from the optimal debt ratio. Governance should mitigate those issues. As mentioned in section 2.2, an example is CEO duality, which means that the CEO of the firms holds both the position as CEO and is also the chairman of the board of directors. As the board of directors has an important control function within the firm, it must not be under control of the CEO. It is important that the decision *management* and decision *control* are not influenced by one and the same person. Thus, if there is a dual leadership structure, chair and CEO held by two different persons, the agency problems associated with the separation of ownership and control should be moderated. As a result, firms with a dual leadership structure, should have a more optimal debt ratio than firms with a unitary leadership structure (Fosberg, 2004).

Another aspect in corporate governance is board size. Whether a large board is favorable for a firms' performance is found to be controversial. As the advantages of a large board are more knowledge and different perspectives, several important disadvantages are found as well. For example, the issue of freeriding and slow decision-making (Coles, Daniel, & Naveen, 2008). Regarding the relationship between board size and leverage, that is found to be positive (Ranti, 2013). One explanation given for this, is that larger boards are more entrenched because of effective monitoring and that these companies pursue higher leverage to increase firm value (Ranti, 2013). Thus, a positive relationship between board size and leverage is expected.

2.5 Previous studies on board independence and leverage

Much research has been conducted on this topic. However, the data sample in combination with the methodology in this research has not been examined yet. Contrary to previous literature, this research has been conducted on firms in the United States. Table 1 provides an overview of what

previous papers have found regarding the relationship between board independence and capital structure decisions.

Table 1
Summary of previous literature

Authors	Sample	Main findings
Sheikh & Wang (2012)	Pakistan 2004-2008	A positive relation between the share of outside directors and the total debt ratio as well as the long debt ratio
Tarus & Abayei (2015)	Kenya 2004-2012	A positive relation between directors' independence and leverage. In addition, they found a significant negative relation between CEO duality and leverage.
Vu, Tran, Doan & Le (2020)	Vietnam 2015-2019	No correlation between board independence and capital structure
Njuguna & Obwogi (2015)	East-Africa 2009-2013	A positive relation between board size, independent directors, education diversity and capital structure. Also, a negative relation between CEO duality and capital structure.
Alves, Couto & Francisco (2015)	33 different countries 2006-2010	Firms with more independent directors acquire riskier financing sources.

2.6 Sarbanes-Oxley Act

After some historical accounting scandals, for example the downfall of Enron, the US congress passed the SOX in July 2002. Aiming to restore public trust in financial markets and to enhance the corporate governance, focusing on improving the auditing of US listed companies (Duchin, Matsusaka, & Ozbas, 2010). It included radical changes in corporate governance and regulation for US listed firms. These radical changes consist of better supervision and deeper monitoring. In addition, it imposed penalties for misconduct and aimed to prevent fraud by dealing with potential

conflicts of interest, management misbehavior and misleading financial reporting (Sun, Lan, & Zhenzhong, 2014).

Focusing on the change in the independence of the board after the introduction of SOX, it is notable that the SOX required the total audit committee to be independent. However, after the introduction of the SOX in 2002, the NYSE and Nasdaq went even beyond these changes and required the board to consist of a majority of outside directors. This regulation was approved by the Securities and Exchange Commission (SEC) in 2003. Also, the definition of an independent director was expanded to someone who does not have a material relationship with the company. Thus, not a direct relationship nor as a shareholder, partner or an officer of an organization that is related to the company. In addition, the new regulation required independent board members to participate minimum levels in the compensation and nominating committees (Duchin, Matsusaka, & Ozbas, 2010).

According to Duchin et al. (2010) this new regulation resulted in an increase of firms that had a majority of outside directors on the board. In the period 1996 to 2000, about 72-74% had a board consisting of mostly outside directors. In 2000, this increased to roughly 76% and by 2005 94% of the firms had a board that consisted mostly of independent directors.

2.7 Hypothesis

Based on previous literature, and the theory discussed above, the following hypothesis is stated:

An increase in the share of independent directors has a positive effect on leverage.

It is expected that independent directors act more in the interest of the shareholders and have the task to prevent the manager from pursuing its own interest. In addition, more independent directors would lead to a reduction in information asymmetry between outside investors and managers. The issue of information asymmetry is often explained with an example called the “lemons problem”. In short, it argues that it is hard to evaluate the quality of products sold and as a result, low quality products are sold disguised as high-quality products (Akerlof, 1970). It could also be translated to the capital markets. If managers are promoting their strategy as good strategies (could be due to overconfidence as well), while their strategies are of low quality, it is hard to evaluate for the

investors whether it really is a good quality strategy. This information asymmetry causes financing costs to rise, and this may result in a valuation discount. This discount is referred to as a "lemons discount" (Benner & Zenger, 2016). Thus, a reduction in information asymmetry implies that suppliers are more willing to supply their capital to a firm and more supply means a decrease of the costs of issuing risky sources of finance (Alves, Couto, & Francisco, 2015). Therefore, it is expected that a positive relation between the share of independent directors and the amount of leverage will be found.

3. Methodology

This section will first provide a description of the research method. Then, the research model will be explained followed by an elaboration of the variables that are used in the regression model. Lastly, it is explained how the data is collected and the sample is constructed.

3.1 Research method

To answer the question how board independence affects capital structure decisions, the following research approach is applied. Following the study of Duchin et al. (2010), a two-stage least squares regression is executed. As mentioned before, to mitigate the endogeneity concerns that could arise, a change in regulation is used to observe an exogenous change in the share of independent board members (Duchin, Matsusaka, & Ozbas, 2010). Thus, the strategy of this research is to divide the sample in two different groups: a treatment group and a control group based on their compliance with the new regulation of a totally independent audit committee in the year 2000. This way, noncompliance with the new regulation is used as an instrument to identify an exogenous shift in the share of independent directors.

Endogeneity problems

Potential endogeneity problems could arise and lead to biased or inconsistent results. This could be due to omitted variable bias, measurement errors or reversed causality. The main problem in this case is that by performing a standard Ordinary Least Squares (OLS) regression, the change in share of independent directors might be endogenous. Therefore, in this study an instrumental variable is used to eliminate potential biases. For an instrument to be a valid instrument it is important that the instrumental variable (Z) is correlated with the regressor (X), but uncorrelated with the disturbance term (U) and therefore two conditions should be met:

1. Relevance: $Cov(X, Z) \neq 0$
2. Exogeneity: $Cov(U, Z) = 0$

When using an instrumental variable, a two-stage least squares is performed rather than just an OLS regression. In the first stage, the regressor X is regressed on the instrumental variable Z. Thereafter, in the second stage regression the dependent variable Y will be regressed on the predicted values of X in the first stage (Ketel, 2019).

Noncompliance with the new regulation of a totally independent audit committee in 2000 will be the instrumental variable in this examination. To be a valid instrument, it should fulfill the conditions described above. The first condition can be tested, this will be discussed in section 4.2. The second condition, however, cannot be tested as the disturbance term is unobservable. Nonetheless, it can be argued that the noncompliance with the new regulation only affects the amount of leverage via the share of independent directors and not via other factors, as the regulation aims to increase the number of independent directors within firms. Thus, it is assumed that this does not affect leverage in another way. As it is assumed that the second condition is met, the estimator will be consistent, not necessarily unbiased (Ketel, 2019).

3.2 Research model

The data in this research is panel data, as there are many firms that have observations for several years. The baseline model assumes that leverage is determined as follows:

$$\begin{aligned} Leverage_{it} = {} & \beta_1\, Share\ of\ independent\ directors_{it} + \beta_2\, Profitability_{it} + \beta_3\, Tangible\ assets_{it} \\ & + \beta_4\, Firm\ size_{it} + \beta_5\, Growth\ opportunities_{it} + \beta_6\, Industry_i + \beta_7\, Tax\ rate_{it} \\ & + \beta_8\, Corporate\ Governance_{it} + \beta_9 Market\ to\ book\ ratio_{it} + r_i + s_t + \varepsilon_{it} \end{aligned}$$

$$r_i = firm\ specific\ leverage\ effect$$

$$S_t = year\ specific\ effect$$

However, instead of estimating the model above, first differences are estimated in this research:

$$\begin{aligned} \Delta\, Leverage_i = {} & \beta_1\, \Delta Share\ of\ independent\ directors_i + \beta_2\, Profitability_i + \beta_3\, Tangible\ assets_i \\ & + \beta_4\, Firm\ size_i + \beta_5\, Growth\ opportunities_i + \beta_6\, Industry_i + \beta_7\, Tax\ rate_i \\ & + \beta_8\, Corporate\ Governance_i + \beta_9\, Market\ to\ book\ ratio_i + \Delta s + \Delta\varepsilon_i \end{aligned}$$

$$where\ \Delta X = X_{2005} - X_{2000}$$

By estimating first differences, the firm-specific fixed effects are removed. The constant captures the time-specific effects. In the regression model, the control variables take the value of the year 2000 to control for initial conditions.

Then a two-stage least squares regression will be run. The first stage regression has the change in the share of independent directors between 2000 and 2005 as a dependent variable. The main explanatory variable in this stage is the dummy variable that takes value 1 if a firm did not comply with the new regulation yet in 2000. Thus, if a firm did not have a fully independent audit committee yet. If a firm did comply with the new regulation in 2000, the variable takes value 0. Hence, in this stage, a distinguishment will be made between the treatment group and the control group. In addition, control variables are added to the model. Those variables take the value of the year 2000 to control for initial conditions. The second stage regression has as dependent variable the difference in leverage for each firm in 2005 compared to the year 2000. The main explanatory variable in this regression is the change in the share of independent directors implied by the fitted values from the first stage. Again, the model includes control variables from which the value in the year 2000 is taken.

3.3 Variables

As this research consists of two regressions, there are two regression equations. Both regressions include a dependent variable, a main explanatory variable and control variables. First the dependent variable and main explanatory variable are discussed for both stages. Thereafter, an overview of the control variables is provided.

3.3.1 First stage regression equation

Dependent variable in the first stage:

The dependent variable in the first stage regression is the change in the share of independent directors between 2000 and 2005. The share of independent directors is measured in the following way:

$$\frac{Number\ of\ outside\ directors\ within\ the\ board}{Total\ number\ of\ board\ members}$$

For this research, the change in the share of independent directors between 2000 and 2005 is calculated. Thus, this variable is calculated as follows:

$$Share\ independent\ directors_{2005} - Share\ independent\ directors_{2000}$$

Main independent variable in the first stage:

The main independent variable in the first stage is whether a firm complied with the regulation of a fully independent audit committee in 2000. This variable takes the form of a dummy variable. If a firm had a fully independent audit committee in 2000, it takes value 0. If a firm did not have a fully independent audit committee yet in 2000, it takes value 1.

3.3.2 Second stage regression equation

Dependent variable in the second stage:

The dependent variable in the second stage regression is the change in leverage between 2000 and 2005. Literature suggests that there are several ways to define leverage. There is no clear right or wrong which measure to use. Some argue that it is better to use book leverage, while others prefer market leverage over book leverage (Frank & Goyal, 2009). A reason to prefer book leverage could be since debt is better supported by assets in place than growth opportunities. Also, manager tend to believe that market leverage numbers are not fully reliable as markets fluctuate heavily. On the other hand, authors supporting market leverage argue that the book value of equity is not necessarily a relevant number, but rather a "plug number" used to manage a well-balanced balance sheet. In addition, it is assumed that markets are generally looking forward while the book measure is instead backward looking. Concluding, market leverage and book leverage should not be viewed as the same (Frank & Goyal, 2009).

In this research leverage is defined as the total debt divided by stockholders' equity.

$$\frac{Total\ debt}{Stockholders'\ equity}$$

However, as the change in leverage is used, the variable is constructed as follows:

$$Leverage_{2005} - Leverage_{2000}$$

Main independent variable in the second stage:

The independent variable in the second stage, is the change in the share of independent directors. However, as this is an instrumental variable regression, the fitted values from the first stage regression are used to measure the effect of a change in the share of independent directors. Thus, the main independent variable in the second stage consists of the fitted values from the first stage regression.

3.3.3 Control variables

Several control variables are included in the model to minimize the potential effect of omitted variable bias, meaning that they reduce the variance of the error term. As mentioned in the literature review, leverage is determined based on many aspects. The model should control for these determinants. How these control variables are computed is explained in Table 2.

Table 2
Explanation of the control variables and how they are computed

Variable:	**Measured in the following way:**
Profitability	$\frac{\text{Operating Income before Depreciation}}{\text{Total Assets}}$
Tangible Assets	$\frac{\text{Net Property Plant Equipment}}{\text{Total Assets}}$
Firm size	Logarithm of Total Assets
Growth opportunities	$\frac{\text{Capital Expenditures}}{\text{Total Assets}}$
Market to Book ratio	$\frac{\text{Market Capitalization}}{\text{Book Value of Equity}}$
Tax Rate	$\frac{\text{Total Income Tax}}{\text{Pre} - \text{Tax Income}}$
Industry	Two digits SIC code
Corporate governance	CEO Duality → dummy variable 1 if the CEO is also the chairman, 0 otherwise Board size → number of board members

3.4 Sample & Dataset

The data used for this research is retrieved from Wharton Research Data Services (WRDS) and within WRDS, two different databases are combined. The first database used is the Compustat database. It provides firm specific information and is therefore used to compute variables that include firms' financials. The description of how these variables are computed is provided in Table 2. As this paper focuses on US firms only, Canadian firms are excluded from the sample. To prepare the dataset for merging, the duplicates based on year and company code (CUSIP) are dropped. The second dataset used is the Directors Legacy database within the Institutional Shareholder Services (ISS) database. This database contains director information from 1996 up until 2005. It provides information about the number of directors, their affiliation with the firm, their roles within committees and personal characteristics. Before the Director Legacy dataset was merged with the Compustat dataset, some variables were created. First, board size per firm and year was calculated. After that, the number of independent directors was computed, this was necessary to calculate the share of independent directors within the board. To determine whether a firm complied with the new SOX regulation, the share of independent directors within the audit committee was required. This variable was computed as well. While creating this variable, the conclusion was made that there were firms that did not have an audit committee at all in 2000. As the compliance variable is based on whether a firms' audit committee was fully independent, it was decided that firms without an audit committee did not comply with the SOX regulation in 2000. After the creation of these variables, the duplicates were dropped again, as only one observation per firm per year was needed. This resulted in a panel dataset with 13,215 firm-year observations for the years 1996-2005. Focus of this research is on the period 2000-2005, for which there are 7,721 firm-year observations.

Outliers

Following the creation of the variables, some outliers emerged. Outliers can dramatically affect the results, both the magnitude and the direction of the coefficient sign (Choi, 2009). Therefore, it is important to cope with them properly. Based on the histograms displayed in Appendix 1 the variables leverage, profitability, growth opportunities, tax rate and market to book ratio are winsorized at 1 and 99 percentiles. The histograms after winsorizing show that the distribution of the observations is less prone to outliers.

4. Results

This section will provide the results of this research. First, the descriptive statistics will be evaluated. Then, the assumptions of the instrumental variable and the regression model will be touched upon. Lastly, the regression output will be discussed.

4.1 Descriptive statistics

Table 3 shows the descriptive statistics of the variables used in the regression model over the whole sample period: 1996-2005. The data consist of 13,215 firm-year observations. Table 3 also shows that some variables had missing observations, for example, profitability has only 12,787 observations. The main variable in this research is the share of independent directors which has a mean of 0.647 over the whole sample period. Thus, over the whole sample period, boards consisted for 64.7% of outside directors, on average.

Table 3
Descriptive statistics of the variables over the whole sample period: 1996-2005. Variables are retrieved from IRRC and Compustat Database.

Variable	Obs	Mean	Std. Dev.	Min	Max
Share independent directors	13,215	0.647	0.236	0	1
Boardsize	13,215	7.017	3.413	1	25
Leverage	13,123	0.964	1.797	-3.882	12.398
Profitability	12,787	0.127	0.096	-0.224	0.403
Tangible assets	12,927	0.285	0.234	0	0.97
Firm size	13,184	7.536	1.682	1.835	14.217
Growth opportunities	12,206	0.057	0.051	0	0.28
Tax rate	13,190	0.3	0.253	-1.104	1.286
CEO duality	13,215	0.251	0.434	0	1
Market to book ratio	12,887	3.055	3.25	-5.279	20.622

More fascinating is whether the descriptive statistics are different for the treatment group and the control group, which are reported in Table 4. As mentioned before, this research examines two different groups: firms that complied with the new regulation of a totally independent audit committee in 2000, and firms that did not comply. There were 1,439 observations in the year 2000, from which 519 (approximately 36%) were not in compliance with the new regulation and from which 921 were complying. It is no surprise that the mean share of independent directors is higher for the group compliant firms as the separation of the groups depends on the share of independent

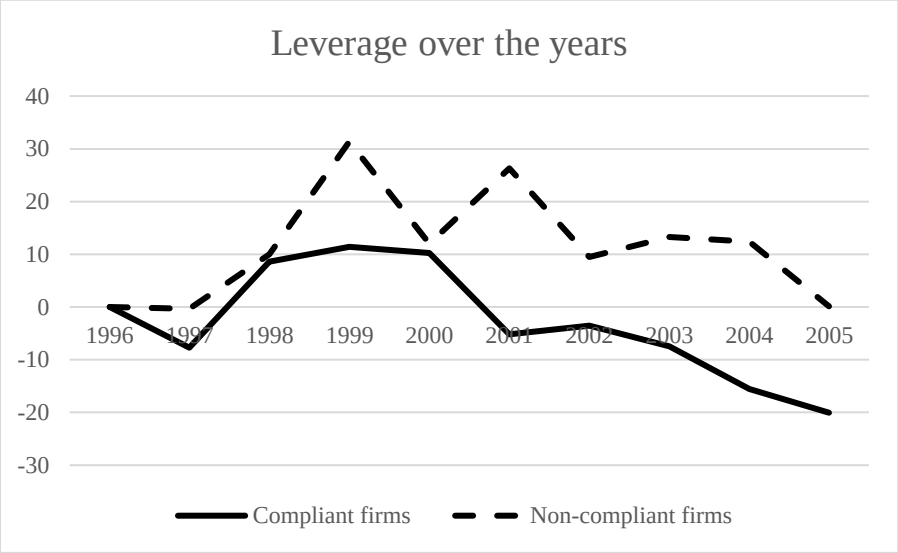
directors (within the audit committee). In addition, it is obvious that the share of independent directors within audit committee was 1 for the firms that were complying. This number is almost halved for the non-compliant firms in 2000. In addition, the groups are slightly different for each variable. Biggest difference can be seen for the market to book ratio: 3.341 versus 3.093.

Table 4
Descriptive statistics of the variables separated by compliance of the new regulation. The data displayed in the table is a comparison for the observations in the year 2000. Compliance is determined based on whether a firm had a fully independent audit committee in 2000.

Descriptive statistics	**Compliant firms**		**Non-Compliant firms**		
Variable	Mean	Std. Dev.	Mean	Std. Dev.	T-statistic for difference
Share independent directors	0.71	0.18	0.47	0.27	20.61
Boardsize	6.76	3.09	6.11	3.76	3.56
Share independent within audit	1	0	0.54	0.24	57.93
Leverage	1.07	1.88	1	2.06	0.67
Profitability	0.13	0.10	0.13	0.11	0.83
Tangible assets	0.27	0.22	0.29	0.24	-1.72
Firm size	7.55	1.59	7.55	1.69	-0.03
Growth opportunities	0.06	0.05	0.07	0.06	-1.71
Tax rate	0.31	0.27	0.30	0.24	0.55
CEO duality	0.29	0.45	0.30	0.46	-0.61
Market to book ratio	3.34	3.96	3.09	3.71	1.15

Whereas there is a treatment group as well as a control group, it is important to analyze whether the two groups were behaving similar prior to the change (read: treatment). This is a so-called parallel trend. Thus, analyzing whether the group that complied with the SOX regulation in 2000 acted similar as the group that did not comply with the SOX regulation in 2000 in terms of leverage. Figure 1 shows that leverage of both groups evolves similarly until the year 2000. This is the start of a sharp break for the compliant firms and an increase for the non-compliant firms. Therefore, it can be concluded that, before the year 2000, firms behaved similarly in terms of leverage and after that year they started behaving in opposite directions.

Figure 1
Parallel trends. The graph displays the leverage levels for the compliant and noncompliant group from 1996 until 2005. The lines represent leverage level relative to 1996.



The last table of the descriptive statistics, Table 5, shows how the share of independent directors evolved over time for the treatment group and the control group. It already indicates that the new regulation introduced by SOX was an incentive for firms to increase the number of independent directors in the board, especially for firms that did not comply before. The numbers show that firms that did not comply increased their share of independent directors on average about 20 percentage points versus an increase of only 1.3 percentage points for compliant firms.

Table 5
Average share of independent directors of the sample over the years separated by compliance

	Share of independent directors	
	Compliant firms	Non-compliant firms
2000	0.712	0.465
2001	0.687	0.543
2002	0.702	0.589
2003	0.712	0.629
2004	0.714	0.663
2005	0.726	0.683

4.2 Assumptions of the instrumental variable

When performing a regression model, it is important to consider the assumptions of the model. As this research makes use of an instrumental variable, it is important to test for endogeneity/instrument validity. First will be checked whether the regressor is indeed endogenous, and an instrumental variable is needed. Testing the exogeneity of the instrument would only be

possible when multiple instruments are existing, this is not the case. And lastly, testing the relevance of the instrument will be done by analyzing the outcome of the first stage regression.

Endogeneity

An endogeneity test is performed to check whether the variable that is thought to be endogenous, in this case change in share of independent directors, indeed is endogenous. The output is shown below, and it can be concluded that the results are significant at 90% confidence level, meaning that the null hypothesis can be rejected and thus the regressor is endogenous.

Tests of endogeneity
H0: Variables are exogenous
Durbin (score) chi2(1) = 3.38893 (p = 0.0656)
Wu-Hausman F(1,704) = 3.10002 (p = 0.0787)

Relevance

As mentioned in the methodology section, an instrumental variable should be relevant. This means that the instrumental variable (Z) should have a significant effect on the actual regressor (X). This can be tested by analyzing the first stage regression. The output below shows that the instrument indeed is highly significant. This means that it is a good and relevant variable to implement in the model.

First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(1,58)	Prob>F
D Share ind. directors	0.230	0.157	0.145	118.739	0.000

(F statistic adjusted for 59 clusters in SIC3)

4.3 Assumptions of the regression model

In addition to the assumptions of the instrumental variable, it is meaningful to check for the assumptions of the two-stage least squares model. This will be done next.

Normality

The first assumption entails that the expected value of all disturbance terms is zero. In addition, the disturbances are assumed to be normally distributed (James & Singh, 1978). This is tested by a Shapiro-Francia W' test. The results are shown below. As the p value is 0.000, the null hypothesis

of normality of the residuals can be rejected. This does imply that the disturbance term is not normally distributed. However, according to Knief & Forstmeier (2021) are the risks of violating the normality assumption limited and manageable.

Shapiro-Francia W' test for normal data

Variable	N.	W'	V'	z	Prob>z
Residuals	773	0.713	152.414	11.338	0.000

Linearity

The second assumption is that the causal effects are linear (James & Singh, 1978). This is tested by plotting the dependent variable of the second stage regression on the independent variables. The graphs of the relationships between the dependent variable and the independent variables can be found in Appendix 2. As shown in the output, in general most variables show signs of a linear relationship. It differs per variable; how clear the linearity is. There is no clear pattern of nonlinearity for most variables. The variable profitability shows signs of a quadratic relationship. On the other hand, the variable tangible assets shows signs of an almost perfect linear relationship. Thus, the variables do not show perfect linearity, but they also do not show perfect nonlinearity.

Outliers

The third assumption focuses on outliers. It states that large outliers are unlikely for all variables (Stock & Watson, 2014). The graphs in Appendix 3 show the results of the checks for outliers. The plots regress each variable against all others (Reyna, 2007). As the output shows, no outliers are observed as the data points seem in range.

Homoskedasticity

Before running the regression model with the instrumental variable, it is important to check for heteroskedasticity. In Appendix 4, a scatterplot of the residuals and linear prediction is displayed. The pattern shows some signals of heteroskedasticity. Therefore, robust standard errors are used to control for the effects of heteroskedasticity.

Multicollinearity

Table 6
Pearson correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1)ΔLeverage	1.000									
(2)ΔShare independent directors	**0.089***	1.000								
(3) Profitability	0.046	**0.057***	1.000							
(4) Tangible Assets	0.017	-0.012	**0.223***	1.000						
(5) Firm size	-0.040	-0.013	**-0.171***	**-0.026***	1.000					
(6) Growth opportunities	0.042	-0.014	**0.288***	**0.589***	**-0.083***	1.000				
(7) Tax rate	-0.053	0.036	**0.206***	**0.044***	**0.075***	**0.029***	1.000			
(8) Market to book ratio	**-0.163***	-0.016	**0.294***	**-0.140***	**0.042***	**0.044***	**0.021***	1.000		
(9) CEO duality	-0.022	-0.048	0.008	**0.081***	**0.130***	**0.030***	**0.024***	**-0.027***	1.000	
(10) Board size	**-0.066***	**-0.109***	**0.078***	0.019	**0.501***	**-0.027***	**0.130***	**0.066***	**0.150***	1.000

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

Multicollinearity occurs when the independent variables are related to each other, meaning that they are not statistically independent. It could lead to unstable estimates of the variables and incorrect variance estimates (Dohoo, Ducrot, Fourichon, Donald, & Hurnik, 1996). According to Dohoo et al. (1996) multicollinearity happens to be an issue when the correlation between the variables is 0.9 or higher. Table 6 displays the correlations between the variables of the regression model. All bold coefficients are statistically significant at a 90% confidence level. The correlations between the variables are not near 0.9, implying no multicollinearity.

4.4 Regression output

Table 7
Output of the performed two-stage least squares regression. First column reports the output of the first stage. Columns 2, 3 and 4 report the second stage regression including a different set of control variables. The dependent variable in the first stage is the change in the share of independent directors between 2000 and 2005. The dependent variable in columns 2, 3 and 4 is the change in leverage between 2000 and 2005. All models include industry dummies, robust standard errors (clustered by industry).

	(1) First stage	(2) Second stage	(3) Second stage	(4) Second stage
VARIABLES	ΔShare independent directors	ΔLeverage	ΔLeverage	ΔLeverage
ΔShare independent directors		1.960**	1.895**	2.222**
		(0.903)	(0.916)	(0.892)
Profitability	0.159*	1.034		1.381*
	(0.0810)	(0.761)		(0.745)
Tangible assets	-0.0617	-0.251	-0.166	0.229
	(0.0525)	(0.710)	(0.713)	(0.513)
Firm size	0.0105**	0.0519	0.0453	0.0244
	(0.00494)	(0.0634)	(0.0605)	(0.0620)
Growth opportunities	-0.200	3.317*	3.843**	
	(0.194)	(1.776)	(1.769)	
Tax rate	0.0195	-0.541*	-0.433	-0.592**
	(0.0293)	(0.286)	(0.284)	(0.277)
Market to book ratio	-0.00150	-0.0910**	-0.0825**	-0.0777**
	(0.00243)	(0.0388)	(0.0356)	(0.0369)
CEO duality	-0.0219	-0.126	-0.130	-0.0640
	(0.0141)	(0.144)	(0.142)	(0.136)
Boardsize	-0.0109***	-0.0133	-0.0147	-0.0109
	(0.00331)	(0.0378)	(0.0370)	(0.0328)
Dummy =1 if firm did not comply with SOX in 2000	0.137***			
	(0.0124)			
Constant	0.00525	0.447	0.541	0.456
	(0.0285)	(0.357)	(0.339)	(0.345)
Observations	780	773	775	835
R-squared	0.230	0.123	0.122	0.099
Industry dummies	Yes	Yes	Yes	Yes

Robust standard errors in parentheses (clustered by industry)
*** p<0.01, ** p<0.05, * p<0.1

Table 7 shows the main results of this research. The first column shows the first stage of the regression. The dependent variable is the change in the share of independent directors from 2000 to 2005. The main independent variable is the dummy that takes value 1 if the firm did not comply

with the new SOX regulation in 2000. In addition, eight control variables as well as industry dummies are included in the model. Column two of Table 7 provides the main outcome of this study, columns three and four are robustness checks to analyze whether including or excluding several control variables affect the results. All three columns have as a dependent variable the change in leverage from 2000 to 2005. The main independent variable in these regressions are the fitted values from the first stage regression, as these columns show the second stage regression. Thus, the fitted values from the first stage regression are used to measure the effect of a change in the share of independent directors on leverage. Like the first column, eight control variables and industry dummies are included in columns 2, 3 and 4. In all models robust standard errors are used, clustered by industry, with the aim to control for heteroskedasticity.

First thing to note, is that consistent with the relevance test in section 4.2, the coefficient representing the instrument is highly significant. Therefore, it can be concluded that the dummy variable for noncompliance has a highly significant, positive effect on the change in the share of independent directors. Firms that did not comply with the SOX regulation in 2000, increased their share of independent directors 13.7% over the sample period. This effect is different from zero at a 1% significance level.

Analyzing the second stage regression, in all three columns the variable representing the change in share of independent directors has a positive and significant effect on leverage. In the three different models, the magnitude is slightly different. As mentioned before, the second model is mostly focused on, so that one will be used for interpretation. The results show that a one unit increase in the share of independent directors will lead to a 1.960 increase in leverage. This effect is different from zero at a 5% significance level.

Regarding the control variables, they differ per model in magnitude and significance. However, most variable show comparable results in the three models. Only the variable ‘tangible assets’ shows a different sign for columns two and three compared to column four. However, in all models the effect is not significant. Profitability shows a positive, and in one model significant, effect on leverage. Firm size also seems to have a positive effect on leverage but is not significant for all three models. The variable growth opportunities has a positive effect on leverage as well, this

variable is significant. On the other hand, tax rate seems to have a negative effect on leverage. In addition, market to book ratio also shows a negative and significant effect on leverage. The variables that account for governance both indicate a negative, unsignificant effect on leverage.

The predictive power of the first stage regression is 23%, meaning that the explanatory variables explain 23% of the variance of the change in the share of independent directors. This indicates how well the regression prediction approximates the real data points. For the second stage regression, the explanatory power differs per model between 9.9% and 12.3%. Thus, the variance of leverage is explained for 12.3% by the independent variables.

4.5 Robustness checks

Next, two robustness checks are reported. The first one is based on a new definition of the variable compliance. The second is based on a bigger sample size.

As mentioned before, whether a firm complied with the new regulation or not, is based on new regulation with regard to independence within the audit committee. A firms' audit committee should consist only of outside directors. However, in 2003, the SEC approved new regulations that went beyond those of a totally independent audit committee. It required firms to have a majority of outside directors on the board. Based on this regulation, compliance is determined as well to see how the results would change. Thus, another regression is run, in which the variable compliance is based on whether a firm had a majority of independent directors on the board in 2000. The regression model contains the same control variables as the main model.

The results can be found in Table 8. The first stage regression again shows a highly significant coefficient for the instrumental variable, which is in this case whether a firm complied with the regulation of a majority of outside directors on the board. Firms that did not have a majority of independent directors in 2000 significantly increased their share of independent directors with 24.2% over the sample period. Then, like in previous regression, the fitted values from the first stage regression are used in the second stage. Again, a positive coefficient is found for the change in the share of independent directors. However, in contrast to the regression in Table 7, the coefficient is not significant. The signs and magnitudes of the control variables are comparable

with the results in Table 7. The R-squared is slightly higher in the latter regression, 14.5% versus 12.3%.

Table 8
Regression output when using a change from 2000 to 2005. First column displays the first stage regression. As a dependent variable it has the change in the share of independent directors between 2000 and 2005. Main explanatory variable is the dummy variable that takes value 1 if a firm did not comply yet with the regulation of a majority of outside directors on the board. Second column shows the second stage regression. Dependent variable in this regression is the change in leverage between 2000 and 2005. Main independent variable is the change in the share of independent directors between 2000 and 2005. Both models include industry dummies. Robust standard errors are used, clustered by industry.

	(1) First stage	(2) Second stage
VARIABLES	ΔShare independent directors	ΔLeverage
ΔShare independent directors		0.322
		(0.606)
Profitability	0.173***	1.291*
	(0.0621)	(0.746)
Tangible assets	-0.0466	-0.318
	(0.0465)	(0.704)
Firm size	0.0133***	0.0695
	(0.00469)	(0.0605)
Growth opportunities	-0.172	3.057*
	(0.165)	(1.827)
Tax rate	0.0187	-0.486*
	(0.0307)	(0.290)
Market to book ratio	-0.00142	-0.0923**
	(0.00227)	(0.0386)
CEO duality	-0.0207*	-0.158
	(0.0120)	(0.140)
Boardsize	-0.00701***	-0.0305
	(0.00252)	(0.0376)
Dummy =1 if firm did not comply with SOX in 2000	0.242***	
	(0.0173)	
Constant	-0.0436*	0.427
	(0.0258)	(0.329)
Observations	780	773
R-squared	0.365	0.145
Industry dummies	Yes	Yes

Robust standard errors in parentheses (clustered by industry)
*** p<0.01, ** p<0.05, * p<0.1

As the sample in the regression output shown before is rather small, another robustness check is performed to see how the results would change with more observations. The main cause of the small amount of observations is because the first differences of leverage and the share of

independent directors are taken to compare the year 2000 with the year 2005. Meaning that only the firms could be included for which an observation for both the year 2000 and the year 2005 was included in the sample. This reduces the number of observations drastically. Also, as mentioned before the control variables take the value of the year 2000. Thus, in addition to the first differences variables, the observation for the year 2000 was required to be included in the sample. This led to a relatively small sample size.

To compare the results with a larger sample size, the initial research model is executed again. However, instead of comparing 2000 with 2005, the year 2000 is now compared with 2004. The results in Table 9 show that the results are similar to Table 7. The first stage regression still shows a highly significant and positive effect of the dummy variable of compliance on the change in share of independent directors, meaning that the instrumental variable is relevant. In the second stage, the variable measuring the effect of a change in the share of independent directors is still positive, however not significant. Moreover, all control variables do have the same sign and similar significance level as column 2 in Table 7.

Table 9

Regression output when using a change between 2000 and 2004. First column displays the first stage regression. As a dependent variable it has the change in the share of independent directors between 2000 and 2004. Main explanatory variable is the dummy variable that takes value 1 if a firm did not comply yet with the regulation of a fully independent audit committee yet in 2000. Second column shows the second stage regression. Dependent variable in this regression is the change in leverage between 2000 and 2004. Main independent variable is the change in the share of independent directors between 2000 and 2004. Both models include industry dummies. Robust standard errors are used, clustered by industry.

	(1)	(2)
	First stage	Second stage
VARIABLES	ΔShare independent directors	ΔLeverage
ΔShare independent directors		0.740
		(1.061)
Profitability	0.115**	0.895
	(0.0528)	(0.608)
Tangible assets	-0.0388	-0.287
	(0.0407)	(0.570)
Firm size	0.00670*	0.00436
	(0.00362)	(0.0539)
Growth opportunities	-0.213	1.100
	(0.130)	(1.720)
Tax rate	0.00679	-0.419**
	(0.0231)	(0.195)
Market to book ratio	0.000436	-0.0419*
	(0.00187)	(0.0244)
CEO duality	-0.0138	-0.122
	(0.0120)	(0.103)
Boardsize	-0.00822***	-0.0134
	(0.00251)	(0.0344)
Dummy =1 if firm did not comply with SOX in 2000	0.106***	
	(0.00877)	
Constant	-0.0427**	0.484
	(0.0208)	(0.296)
Observations	1,604	1,594
R-squared	0.164	0.071
Industry dummies	Yes	Yes

Robust standard errors in parentheses (clustered by industry)

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

5. Conclusion

The aim of this study is to examine the effect of board independence on capital structure. More specific, the effect of the share of independent directors within the board of directors on capital structure. This is done by performing a two-stage least squares regression. The data that is used for this research is retrieved from Wharton Research Data Services. The research is based on a change in regulation regarding corporate governance for publicly listed US firms. The SOX that was introduced forced firms to increase the share of independent directors within the board of directors, which led to an exogenous shift in the share of independent directors within firms. This exogenous shift is used to cope with potential endogeneity issues. Based on previous literature and the theory of agency problems, a positive relation was expected between the share of independent directors and leverage, since more outside directors decreases information asymmetry. This implies a reduction in the costs of risky financing sources, which implies an increase in leverage.

Based on the results, it is first concluded that the instrument used in this model, namely whether firms complied with the new SOX regulation of a totally independent audit committee, is highly relevant. Secondly, it can be concluded that the share of independent directors has a positive effect on leverage. More specific: an increase in the share of independent directors within the board of directors, leads to a higher leverage ratio. This means that evidence is found supporting the hypothesis.

The results are robust to several robustness checks. First, the use of different compositions in control variables is checked for. In total, three different regressions were run with different compositions of control variables. Nonetheless, the results did not change drastically. The conclusion for all three models is the same, namely, board independence positively affects leverage. Secondly, another measure of compliance is controlled for. Thus, instead of looking at the regulation of a totally independent audit committee, the regulation of a majority of outside directors was used. This also led to the same conclusion as in the initial model. However, the results are weaker and insignificant. Lastly, as the sample size was quite small, the same regression was run for a bigger sample. This was possible by comparing the year 2000 with 2004, instead of 2000 with 2005. The results were again similar to the results of the initial model, however, insignificant and smaller.

6. Discussion and suggestions for future research

This section provides an overview of the encountered limitations while conducting this research, followed by some suggestions for future research that exceeded the scope of this paper.

First, the external validity of the results might be low, as the sample size is not very large, and the sample consisted of United States firms only. As discussed in the methodology section, this research used first differences method. Meaning that for the variable share of independent directors and leverage, the differences were calculated between 2000 and 2005. This led to an enormous decrease in the number of observations in the regression model. This could be considered as a disadvantage of the methodology. As a result, the results may be insufficient to generalize for a larger and broader sample size. Therefore, a suggestion for future research could be to examine whether the results hold when a similar shock will be examined in other countries. Since this research focused on a change in the law that affected US firms, it could be interesting to see how exogenous changes in for example Europe would affect leverage.

Another limitation is that the issue of agency problems is more complex than simply: an increase in outside directors would increase governance. There are other considerable aspects that play a role in this issue as well. For example, an important aspect within agency problems and the role of outside directors is information costs. A disadvantage of having more outside directors on the board, is that they have less information than insiders. Therefore, outsiders could bump into problems because they know less, also known as the problem of information asymmetry. However, when one wants to solve this problem of information asymmetry, information costs arise. According to Duchin et al. (2010) the effectiveness of outside directors depends on the level of costs of acquiring information about the firm. Thus, when the costs of acquiring information about the firm are high, it might not be best for the firm to increase the share of independent directors, even though outside directors are independent. On the other hand, when the costs of acquiring information are low, it does improve firm performance (Duchin, Matsusaka, & Ozbas, 2010). Therefore, a limitation for this research might be the exclusion of any information costs in the model, as it is reasonable that it interacts with the effectiveness of the share of independent directors on leverage.

In addition to previous limitation, this research could suffer from omitted variable bias in general. As there were more variables that affect leverage, for instance the non-debt tax shields and uniqueness. Yet, the data for these variables were unreliable and therefore left out of this research. Also, more measures on corporate governance could be included.

Following on the omitted variable bias, a note should be made about the exogenous shock in the share of independent directors. Analyzed is the shift in share of independent directors based on noncompliance with the new regulation. Thus, added directors for other reasons than compliance may give different results (Duchin, Matsusaka, & Ozbas, 2010). Suggestion for future research might be to see how other exogenous shocks, than regulation, in board independence affect leverage.

Also, a limitation is that only one measurement of leverage is assumed, while literature is still inconclusive about the right definition of leverage. Therefore, it might be interesting to see whether the results hold with other definitions of leverage.

Lastly, the data is from about 20 to 25 years ago. Which could question the relevance of the results. However, as an exogenous shock was needed, this was a good example of an exogenous shock in the share of independent directors. It could be insightful to see how the results would be the same if more recent date would have been used.

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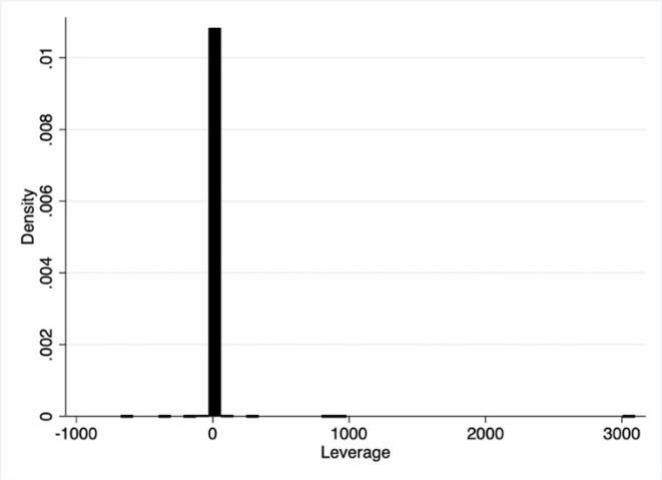
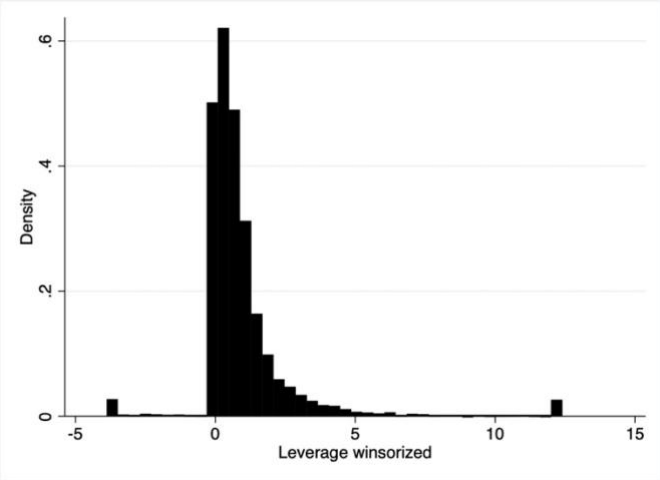
Appendices

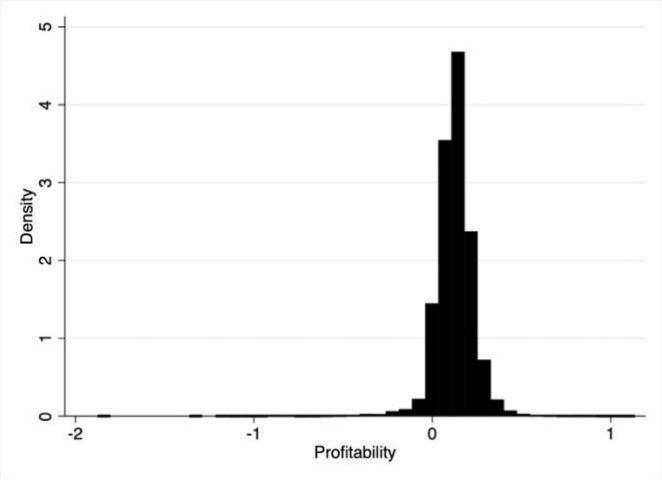
Appendix 1

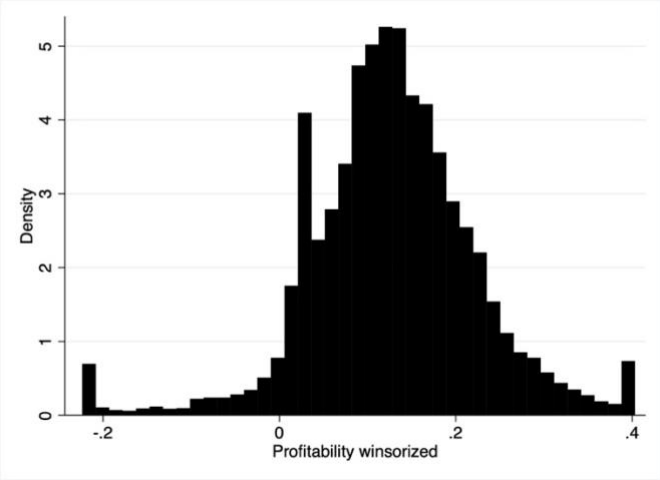
Histogram before and after winsorizing the variable leverage



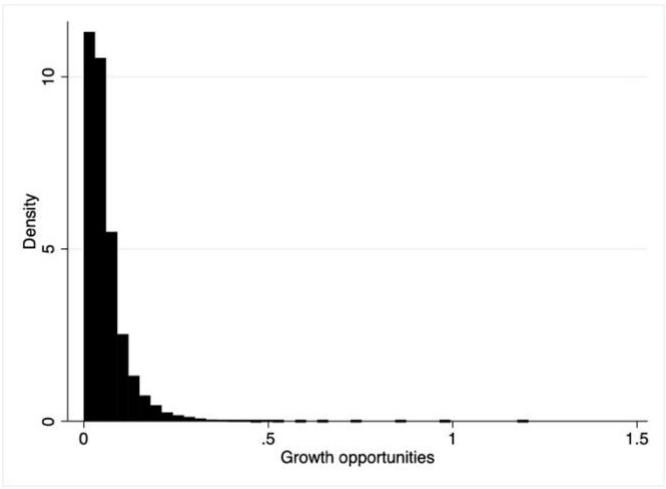


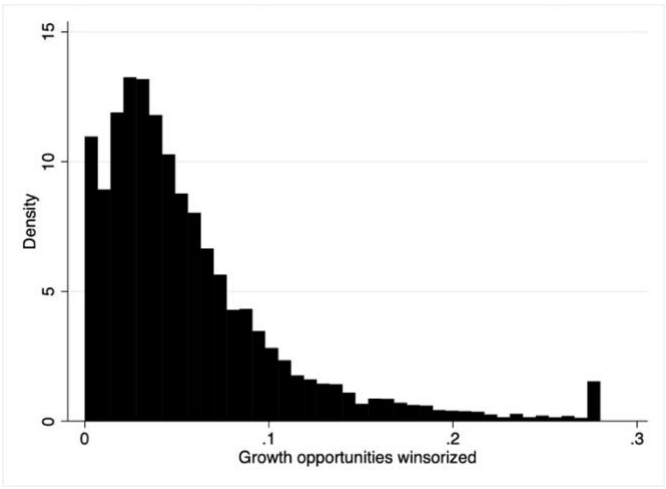
Histogram before and after winsorizing the variable profitability



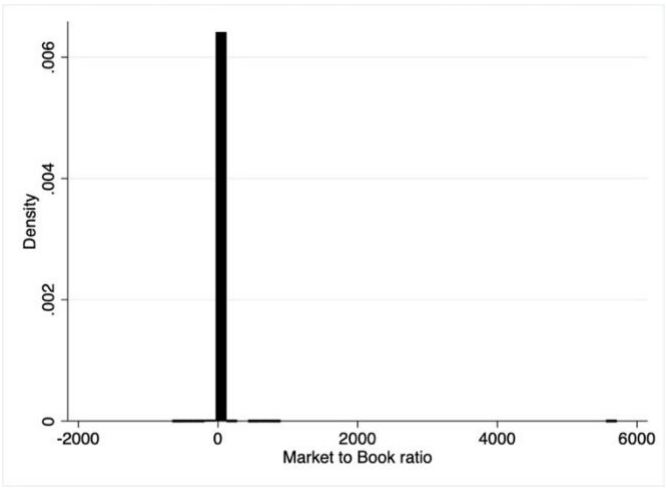


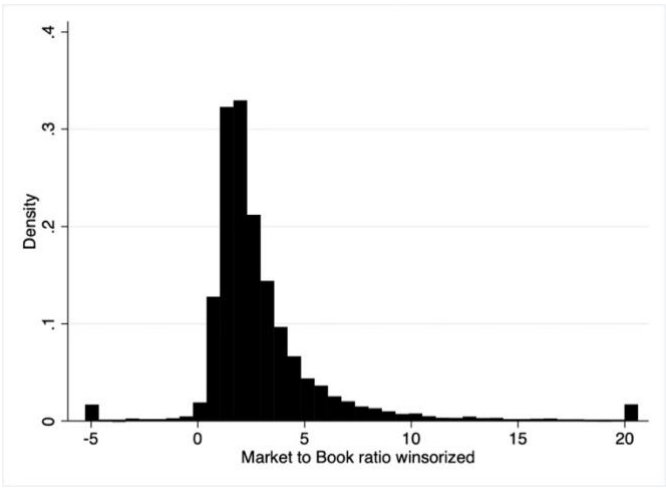
Histogram before and after winsorizing the variable growth opportunities



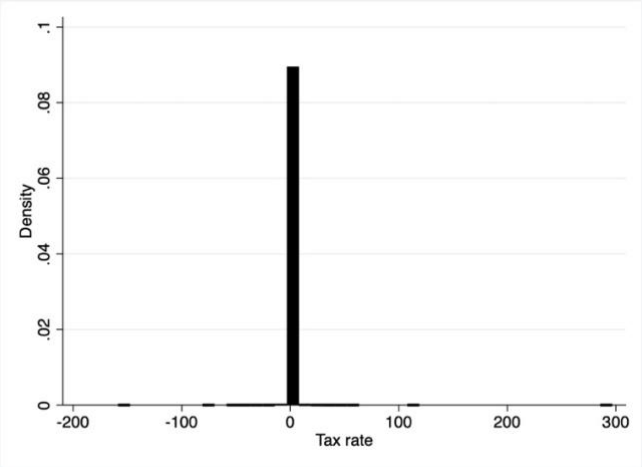


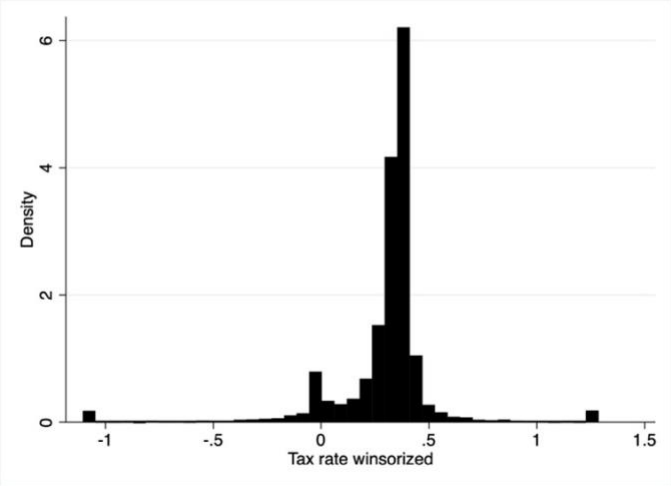
Histogram before and after winsorizing the variable market to book ratio





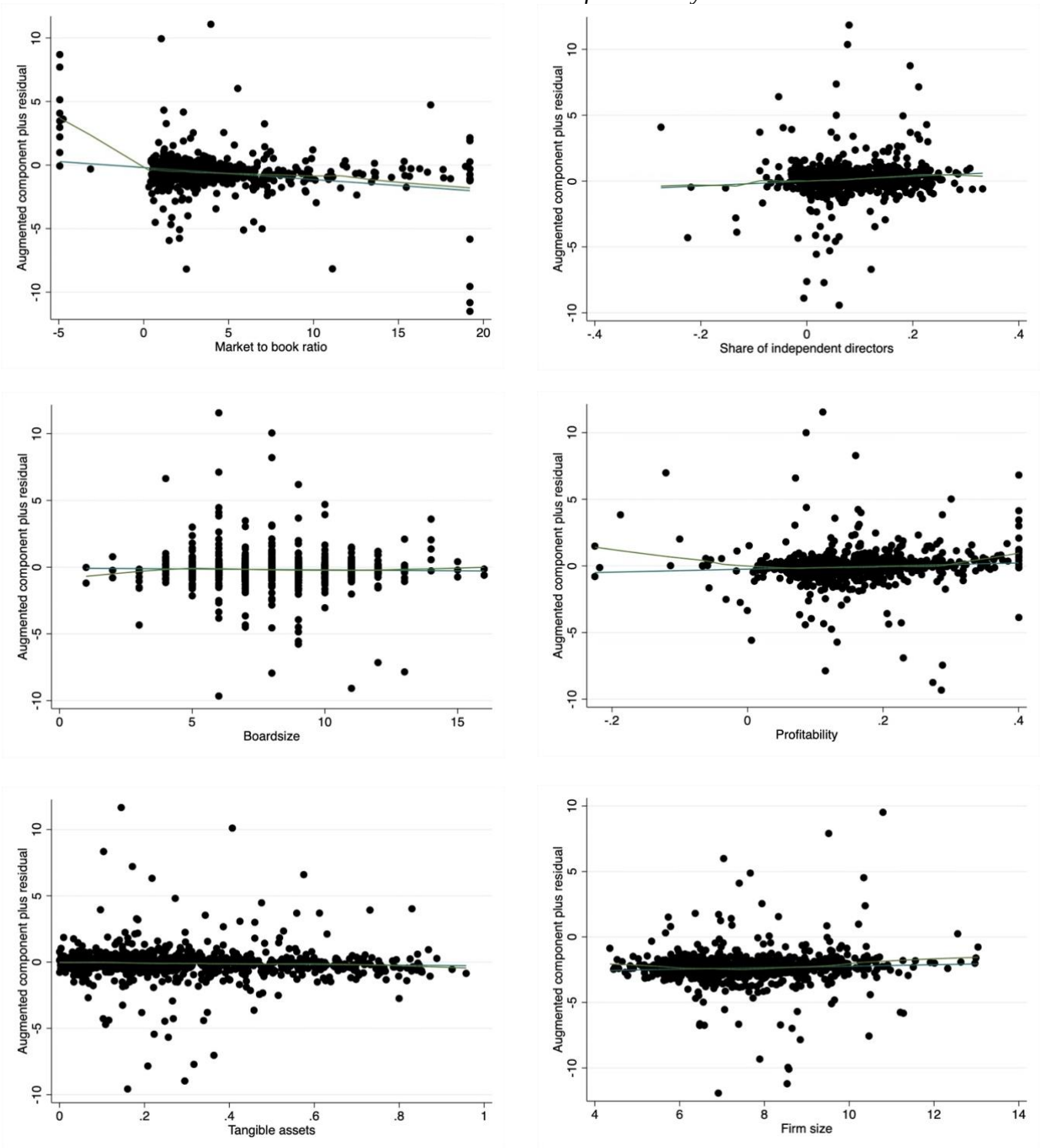
Histogram before and after winsorizing the variable tax rate

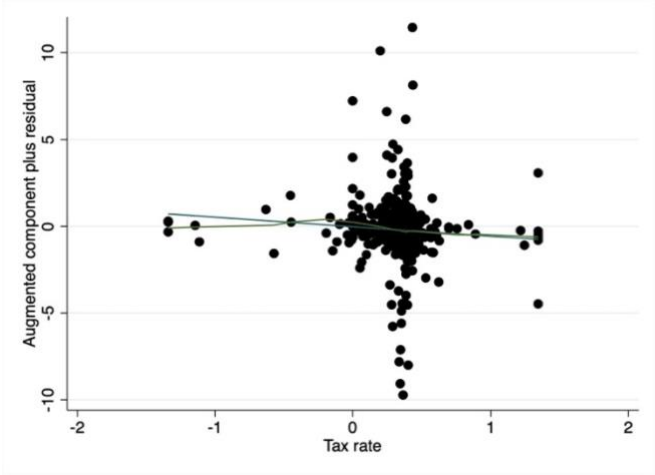


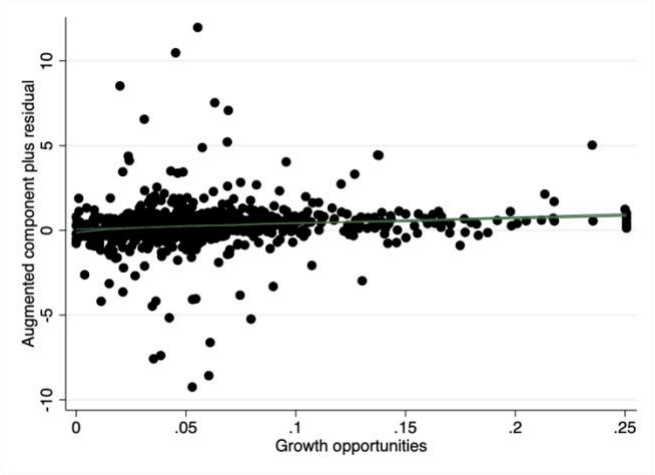


Appendix 2

Scatterplots of the relationship between the dependent variable and independent variables, to check for linearity

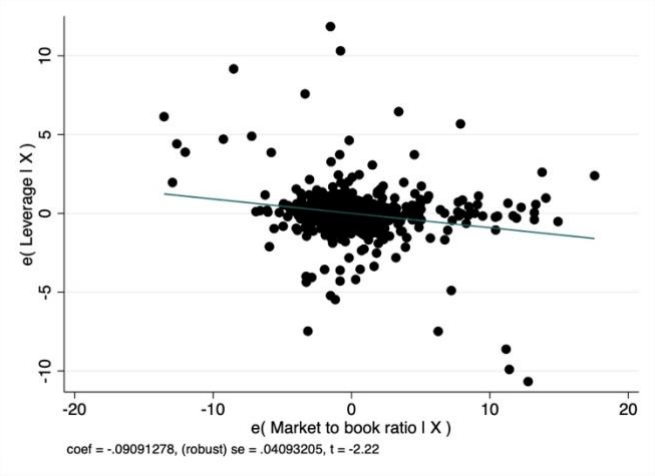


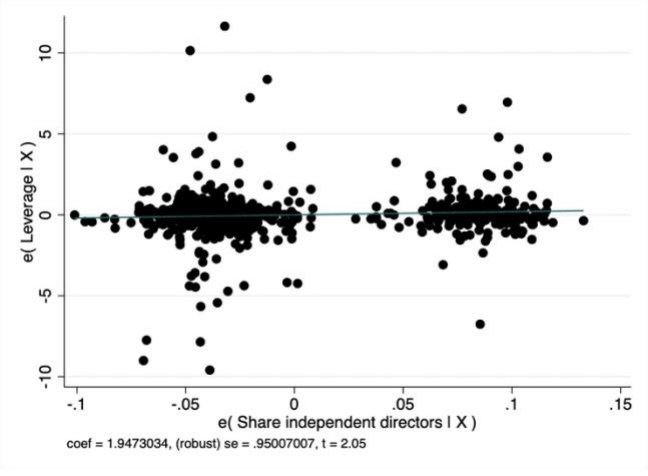


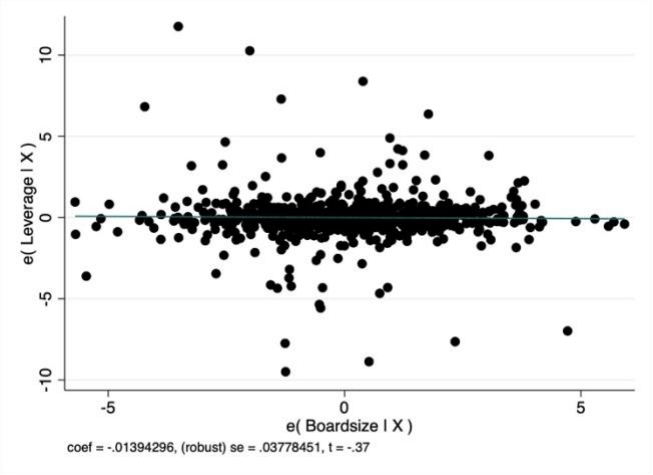


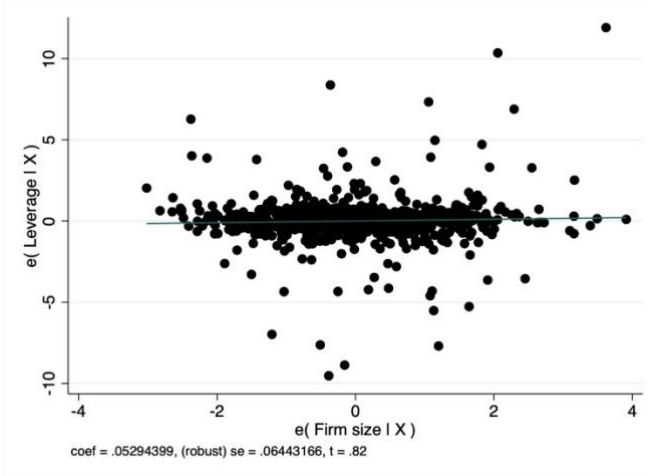
Appendix 3

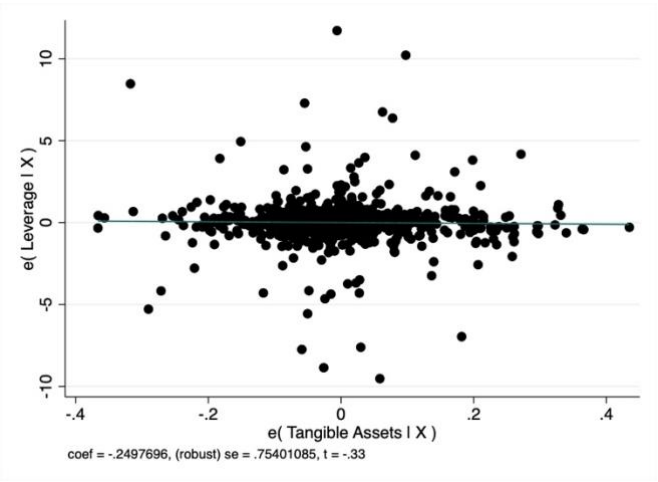
Scatterplots to check for outliers. The plots regress each variable against all others

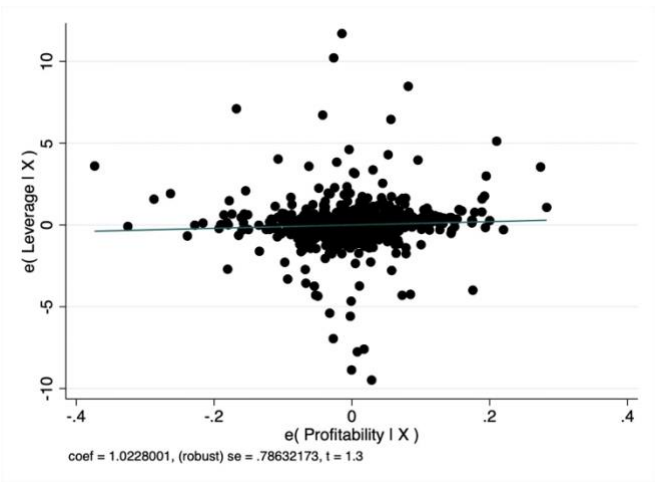


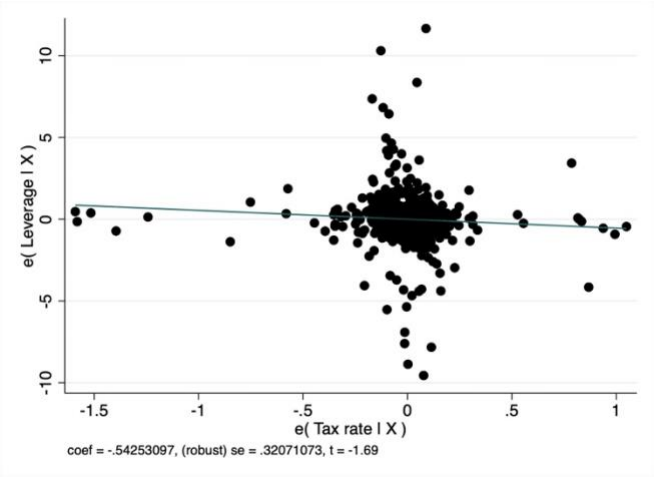


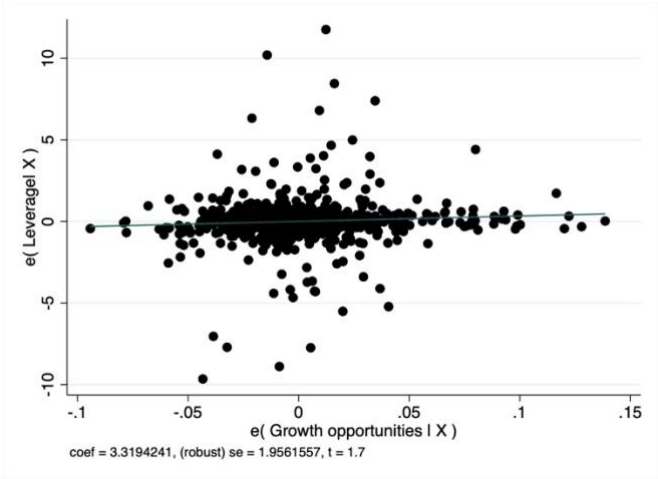





e(Leverage l X)
10
5
0
-5
-10
-.4
-.2
0
.2
.4
e(Tangible Assets l X)
coef = -.2497696, (robust) se = .75401085, t = -.33


e(Leverage l X)
10
5
0
-5
-10
-.4
-.2
0
.2
.4
e(Profitability l X)
coef = 1.0228001, (robust) se = .78632173, t = 1.3


e(Leverage l X)
10
5
0
-5
-10
-1.5
-1
-.5
0
.5
1
e(Tax rate l X)
coef = -.54253097, (robust) se = .32071073, t = -1.69


e(Leverage l X)
10
5
0
-5
-10
-.1
-.05
0
.05
.1
.15
e(Growth opportunities l X)
coef = 3.3194241, (robust) se = 1.9561557, t = 1.7

Appendix 4

Scatterplot of the residuals and linear prediction to check for heteroskedasticity