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THE INFLUENCE OF BOARD DIVERSITY ON FIRM PERFORMANCE: A GEOGRAPHIC APPROACH

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ABSTRACT

This thesis explores the effects of diversity in board of directors on firm performance. In prior literature there is no consensus regarding its influence on firm performance. There are generally endogeneity issues present between board diversity and firm performance. The endogeneity issues are mitigated using an instrumental variable, surrounding diversity. Using an instrumental variable regression, I find different effects of board diversity on firm performance. A radius of 50 kilometer for surrounding diversity gives the most significant results. The effect on ROA and EBITDA-to-Assets is slightly negative. The effect on Tobin's Q is positive. Although prior literature mostly shows a positive effect on firm performance, this thesis shows a mixed result of board diversity on firm performance. This means the relationship is not straightforward and may depend on the context in which diversity is assessed.

Keywords: board diversity, firm performance, endogeneity, instrumental variable regression, surrounding diversity

JEL Classification: C26, G32, G34, L25, J16

CONTENTS

1 INTRODUCTION

Board diversity and its influence on firm performance is a much discussed topic. Especially since the inception of the gender quotas in several European countries. Norway took the pioneering step of implementing mandatory gender quotas for listed companies, and now they are considering extending this commitment further by proposing gender quotas for unlisted companies. Large private companies should also increase their amount of female board directors to 40%. This is because at this rate the gender balance never reaches its goals in the private sector (Reuters, 2022). Although board diversity consists of more than just the gender aspect, this does indicate that this topic is on the agenda. The crucial role diversity has in active policy-making underscores the importance to understand its impact. This thesis will focus on the influence of board diversity on firm performance, exploring the effect of location on board diversity. The effect of board diversity is often contradicting or insignificant. To address this endogeneity issue this thesis will explore the role of location on board diversity.

This problem has been mentioned before by Knyazeva et al. (2013). The best approach to address endogeneity issues involves utilizing a robust instrumental variable. They investigate how board composition is impacted by the supply of corporate directors. The ability to recruit independent directors for firms depends on the local supply of potential independent directors. Suggesting that firms can more easily recruit qualified directors if they can choose from a bigger pool. Therefore, location of the firm's headquarter is important. They use the number of firms within 60 miles of the headquarter as a proxy for the local director supply. Bernile et al. (2018) used this method to develop their instrumental variable. They investigated numerous outcomes of the influence of board diversity. They highlight a positive effect on both social and economic perspective. One of their main proxies for firm performance is profitability. They also emphasize that board diversity does not always have a clear positive or negative effect on profitability. Firms with higher R&D spending are much more influenced by how diverse their boards are. Today, the physical distance of directors to a firm's headquarter is less important. Therefore, they broaden the pool of directors available for for firms. Directors with non-stop flights to their firm's headquarter are also within the talent pool of directors. Expanding the supply of directors to firms within a non-stop flight from their headquarter. Prior researchers also use regulatory changes, such as gender quotas, to capture the causality. Ahern and Dittmar (2012) have researched the influence of Norwegian gender quotas on firm performance. The gender quotas caused a negative effect on firm performance, for both stock

price and Tobin's Q. This method, however, to measure the influence of board diversity is not undisputed. This is because using natural experiments as a basis for causal inferences has shown to have problems. For example, Ferreira (2015) argued that the influence of quotas on firm performance is not clear, because the Norway quota as a natural experiment has too many problems with causal evidence. Adams and Ferreira (2009) were one of the first to conclude that more women on board of directors enhance firm's governance. This is because they are tougher monitors. But gender-diverse board of directors do not improve firm's value. Only when the firm's governance system is weak and there is no board monitoring, female directors have a positive influence on firm's value.

This thesis will use the local supply of directors as instrumental variable to address the endogeneity issue. Different from Bernile et al. (2018) and Knyazeva et al. (2013) the local supply of directors will be based on the average board diversity of firms in their proximity within different ranges. Here, the instrumental variable, surrounding diversity, is defined by computing the average board diversity within a specified radius. A higher average diversity within this radius signifies that firms in proximity serve as a reliable proxy for enhanced access to diverse director candidates within a defined geographic proximity. This means different firms have varying degree of accessibility to potential diverse directors. The underlying rationale is rooted in the notion that a larger pool of potential diverse directors enhances the ease of recruiting such candidates. Consequently, firms with access to a more extensive pool are more likely to have a diverse board. For every firm the closest neighboring firms need to be determined. By determining the proximity of each firm to its neighboring counterparts, we can discern the concentration of nearby firms. Next, the average board diversity of these neighboring firms is calculated, such that every firm has a surrounding diversity metric. This approach acknowledges the substantial differences in the talent pools available to firms situated in city centers versus those in suburban or rural settings. Therefore, using this variable as an instrument to address endogeneity issue between the relation of board diversity and firm performance raises the following research question:

Does board diversity significantly impact firm performance, and to what extent does the use of surrounding diversity as an instrumental variable mitigate endogeneity concerns?

I will study this research question using board director panel data combined with financial firm-level panel data from 2018 to 2023 for 4521 unique North American firms collected

from BoardEx and Compustat. This includes firms located in the United States and Canada with a market cap of at least 250 million. To measure the influence of board diversity instrumented with local director supply on firm performance, I will perform instrumental variable regressions. The dependent variables are proxied by return on assets (ROA), Tobin's Q, and two asset valuation metrics (log asset market-to-book value and EBITDA-to-assets). All regressions include year fixed effects and SIC industry fixed effects, to capture industry and time variation.

The results of this thesis will provide new insights in the effect of board diversity on firm performance. Especially, the new approach to assemble the instrumental variable. This not only clarifies causality, but also gives an insight into the choice of a firm's location. My instrument's variation differs in comparison with the instrument of Knyazeva et al. (2013) in two ways. Measuring the board diversity of firms within their proximity, instead of the number of firms. Moreover, classifying firms in a different way by considering their nearest neighbors gives the opportunity to compare firms in different pools. I expect to find that board diversity has a positive influence on firm performance. This is because, Bernile et al. (2018) has found these results with their non-local director supply instrument. Although their instrument was based on directors who reside not necessarily near their headquarter. They later concluded that the proximity of directors near their headquarter plays an important role. Moreover, previous literature does not always account for endogeneity issues, by means of using an instrumental variable, while this thesis does.

The main findings in this thesis are the effect of board diversity on firm performance and the usage of the instrumental variable. The effect of the instrumented board diversity on firm performance is mixed. This means there is no clear positive or negative effect. The effect on ROA and EBITDA-to-Assets is slightly negative. The effect on Tobin's Q is positive. The instrumental variable, surrounding diversity, turns out to be a valid instrument.

The remainder of this thesis is structured as follows. Section 2 is the Theoretical Framework, which discusses relevant literature and previous research. Section 3 describes the dataset and explains the methodology. Section 4 will include all results of the regression analyses performed. Thereafter, prior literature will be discussed in relation to my findings. Section 6 is the conclusion, where the research questions will be answered an overview will be given of this paper.

2 THEORETICAL FRAMEWORK

This section discusses previous literature of board diversity, its impact on several firm performances and board diversity in combination with an instrumental variable. Based on this prior research, two hypotheses are formulated.

2.1 *Board Diversity*

The study of diversity and its impact has been a recurring theme in academic research due to its wide-ranging implications. Fama and Jensen (1983) refer to the agency problems that can arise within a firm, because of the separation of ownership and firm decisions. Owners depend on the decisions managers make. The board of directors can solve this issue, because they can ensure that managers act in the best interest of the owners. The effectiveness of the board of directors depend heavily on the composition. Diversity is an important aspect of the board of directors. Diversity leads to moderated decisions, as it brings together individuals with varied backgrounds, experiences, and perspectives (Kogan, 1966). Diversity within companies is crucial for their success. The influence of diversity also applies for the board of directors. Robinson and Dechant (1997) found that women and ethnic minorities are more likely to leave the firm, which as a result has negative influences on the firm. This is because more diversity will ensure to attract talent from different backgrounds. Moreover, people with different backgrounds allows for more creativity and problem-solving skills. However, Bantel and Jackson (1989) argue that the more diverse a board is the more conflicts and communication errors arise. Therefore, a diverse board of directors does not have to be beneficiary for the firm. In addition, they show that excessive heterogeneity in the board of directors could even lead to competitive behavior, no information sharing and no group cohesion, because of a missing common language.

To this day there is no clear answer whether board diversity is beneficial or brings extra costs to a firm. Most prior research is focused on firm performance as the primary desirable outcome outcome when assessing the impact of board diversity. Therefore, in the next chapter an overview will be given how board diversity influences firm performance.

2.2 *Board Diversity and its influence on performance*

The board of directors should solve frictions between stakeholders and managers. Increasing the effectiveness of a firm and thus increasing firm value. the diversity of board of directors plays an important role in its functioning. The board diversity can influence the functioning and effectiveness of a firm, and therefore influences a firm's performance (Aggarwal et al., 2019). There is not a perfect diversity metric firms can pursue to achieve the best firm performance. Diversity consists of different characteristics. Each diversity characteristic has its own influence. I summarize the findings prior literature has found on the relationship between board diversity and firm performance.

One of the first and most researched diversity characteristic is the male-female ratio of the board of directors, also known as gender characteristic. The board of directors consists of female or male or a combination of those two. The emphasis has increasingly shifted to a well diversified board of directors regarding a well balanced representation of females and males. An important reason is the introduction of gender quotas in various forms in recent years. Adams and Ferreira (2009) have researched how gender diversity affects firm governance and corporate performance. They have studied the difference of attendance problems between male and female board directors. They found that female directors have less attendance problems than male directors. In addition, more gender diverse boards hold CEO's responsible for poor stock price performance. This makes CEO's more dependent on stock prices. Directors on more gender diverse boards receive more equity-based compensation. However, the influence on firm performance of a more gender diverse board is negative. This is because a gender diverse board of directors can lead to too much monitoring and therefore decrease shareholder value (Adams & Ferreira, 2007). They do notice that gender diversity could increase firm value when the current governance system is weak and there is too little monitoring. Dezsö and Ross (2012) used panel data to examine if female representation in top management enhances firm performance. They used 15 years of data for S&P 1500 firms. They found that female representation ensures that the firm's strategy is more focused on innovation, and therefore has a positive effect on firm performance. Baranchuk and Dybvig (2009) emphasize that for a well functioning board, various aspects of board diversity should be included. The collective impact of diversity components surpass the significance of individual dimensions. This once again shows how important it is to combine these components into one diversity index.

Carter et al. (2003) researched the relationship of board diversity and firm value for Fortune 1000 firms. Board diversity is made up of ethnic race and gender. They find a positive relationship for board diversity and firm value after controlling for firm size and industry. They also highlight that as the size of a company and its board grows, the proportion of women and minorities serving on those boards also tends to increase. The age of board directors is becoming more important. Talavera et al. (2018) study how age diversity influences bank risk and profitability using 97 Chinese banks from 2009 to 2013. They found that age diversity has a negative influence. This is because directors of different age categories do not have the same personal values on the views of risk, prudence and wealth. This leads to ineffective board meetings, where there are difficulties in communications, which can lead to conflicts. Li et al. (2011) also investigated the relationship of age diversity. It turns out age diversity has a positive influence on profitability. Hyoung Ju Song (2020) studied the effect of gender and age diversity on firm performance in the lodging industry. They found a positive and significant effect for gender diversity and an insignificant effect for age diversity. This contradicts previous findings by Adams and Ferreira (2009). They argue that having a more gender diverse board brings more problem solving and creativity. This outweighs the cost of communication problems. Verwijmeren et al. (2018) argue that directors differ in their skill set. This type of diversity between directors is cognitive diversity. In 2009 the United States required public firms to describe their reasons for nominating directors. It is still hard to classify each skill and why this skill should add value to the firm. Therefore, they construct a dictionary with the most common words for each skill firms use in their reports. This way they can create several skill categories. It appears that firms with directors who possess the same skills perform better than more diverse directors. The more the directors differ in their skill set, it becomes harder to coordinate meetings, which influences the decision-making process. Therefore, there is a negative relationship between cognitive diversity and firm performance.

A large part of prior literature is focused on the implementation of gender quotas. Norway introduced a gender quota in 2003, demanding that at least 40% of board seats are held by women. In 2008 this rule applies for all public firms. Ahern and Dittmar (2012) researched the influence of this gender quota on firm performance and governance. They show that the introduction led to a significant drop in firm value, Tobin's Q, and a negative stock price reaction. However, Eckbo et al. (2022) have recently revised the approach of Ahern and Dittmar (2012). They have discovered that the influence on market valuation and operating performance were economically and statistically negligible. At the time of the introduction the supply of

qualified female directors was sufficient to compensate for the shortages. Therefore, there were no negative consequences because of the quota introduction.

The mixed results in prior literature on the relationship between board diversity and firm performance can be explained by the following. Studies differ in how performance is measured, the way in which diversity is composed, different time horizons and omitted variable biases. Positive influences of gender diversity on firm performances are substantiated by Mínguez-Vera (2008), negative effects by Adams and Ferreira (2009) and mixed results by Matsa and Miller (2013). These mixed results are acknowledged by Post (2015). They combine 140 studies to examine whether the results of these studies differ in regulatory and social/cultural contexts. They find a marginal positive effect of the influence of gender diversity on market performance in countries with greater gender parity. For countries with lower gender parity the relationship is negative.

Concluding, I expect that if board diversity increases, this has a positive effect on firm performance. Therefore, my first hypothesis is:

Hypothesis 1: *an increase in board diversity increases the firm performance.*

2.3 *Instrumental Variable*

Knyazeva et al. (2013) have raised concerns regarding the impact of board compositions. They contend that the relationship between board independence, major board decisions, and firm performance is frequently inconclusive or lacks significant evidence. This is because of endogeneity issues. Endogeneity issues in this context refer to the challenge of making a causal relationship between board diversity and firm performance. This means it is difficult to establish whether changes in board diversity lead to changes in firm performance or vice versa. There are two kinds of endogeneity issues recognized in prior literature. Unobserved heterogeneity means that missing variables affect both the dependent and independent variables. Omitting these independent variables could lead to correlations between the independent variable and the error term. Additionally, reverse causality complicates matters further by suggesting that endogeneity may stem from the inherent interplay between board diversity and firm performance, making causal inference challenging.

For instance, high firm performance might attract more diverse directors to join the board, but it's also plausible that having more diverse directors positively influences firm performance. This circular causality makes it challenging to isolate the true impact of board diversity. To mitigate endogeneity problems, researchers often use instrumental variables. The instrumental variable should be correlated with the endogenous variable (board diversity), but should not be correlated with the dependent variable (firm performance). Using a suitable instrumental variable is crucial. Commonly used instruments in corporate governance research include regulatory changes, industry-level variables, or historical factors that may influence board composition but are unlikely to directly affect firm performance. I will discuss instruments used in prior literature, why some gender quotas are not useful for causal inferences and the basis for the instrumental variable which I will use.

The best approach to address endogeneity issues, as highlighted by Knyazeva et al. (2013), involves utilizing a robust instrumental variable. In their research they examined the influence of independent boards on firm performance and shareholder value. They use an instrument which is focused on the local supply of potential directors. The ability to recruit independent directors for firms depends on the local supply of potential independent directors. The local availability of qualified prospective directors plays a crucial role in a firm's board appointment process. There are time constraints for prospective directors, they are often executives at other firms, which makes relocating inefficient. So, firms are dependent on the availability of potential independent directors in their proximity. Knyazeva et al. (2013) therefore describes this local talent pool as a scarce human resource. They use the number of firms within 60 miles as a proxy for the local talent pool.

Prior literature often uses gender quotas in Europeans countries as a natural experiment. This way the increase or decrease in board gender diversity is an exogenous event. This allows for making causal inferences between board diversity and firm performances. Adams and Ferreira (2009) concluded that the introduction of the Norway quota had a negative effect on firm performance. However, Ferreira (2015) argued that this method has a number of disadvantages. The timing of the natural experiment is not clear, the exact date of the "quota shock" is subject to interpretation. Two years were given for the companies to adapt, so there was too much freedom to define the shock. Moreover, the choice for the control group is a problem, because there is no good control group to compare with the treated firms. This is because there are spillover effects, firms outside of Norway are also affected. Kirchmaier and

Adams (2013) showed that in 2006 the gender board diversity changed dramatically in other Scandinavian countries, as a reaction to the Norway quota. And there are other confounding factors, because the event window is very wide. This caused for more reluctance to use quotas.

Bernile et al. (2018) therefore opted for an instrument based on the works of Knyazeva et al. (2013). Expanding on the idea of a local director pool, they designed a non-local director pool. Directors with non-stop flights to the firm's headquarters were considered part of this non-local talent pool. The approach was grounded in the understanding that physical distance, while initially perceived as a barrier, could be mitigated by modern transportation infrastructure. They used the diversity of directors who are within a non-stop flight from their firm's headquarter. Then, they used this non-local director pool as an instrument to capture the effect of board diversity on firm profitability. They acknowledge that physical distance does matter, but becomes increasingly irrelevant as non-stop flights between the headquarter and director's home increases. They found that in counties which are distant, an increase in non-stop flights to the headquarter, increases the frequency of a director-firm match by 25%.

For instance, consider a multinational corporation with operations spanning across continents. In such a scenario, the inclusion of non-local directors provides valuable perspectives influenced by diverse backgrounds. As a result, the board gains access to a broader range of insights and expertise. This innovative approach to measuring the supply of potential directors transcends traditional boundaries.

In this thesis I will use an instrumental variable based on the local director pool. This is the surrounding board diversity for every firm. Building on the idea of using a local director pool as a credible instrumental variable, create the following hypothesis:

Hypothesis 2: *the instrumental variable surrounding board diversity mitigates the endogeneity issue between board diversity and firm performance.*

3 DATA AND METHODOLOGY

The following section describes the data and methodology to answer the main research question. First, the dataset and necessary variables are explained, including the instrumental variable. Thereafter, the descriptive statistics will be discussed and some variables will be transformed. Lastly, the methodology to examine the relationship between board diversity and firm performance is explained.

3.1 *Sample selection*

This thesis utilizes a sample which consists 4521 public North American firms with a market capitalization of at least 250 million for the years 2018 to 2023. The data is retrieved from BoardEx and Compustat via Wharton Research Data Services (WRDS). BoardEx contains all information regarding director characteristics to compute the diversity index. Moreover, it contains basic firm information, such as headquarter address and ISIN code. Compustat contains information regarding firm performances and other financial ratios. Combining the datasets allows us to investigate the effect of board diversity on firm performance. After dropping missing values the final dataset contains 11367 observations.

I proceeded as follows. First North American firms with a market capitalization of at least 250 million are chosen in the BoardEx database from 2018 to 2023. This resulted in 4521 firms in the United States and Canada. Thereafter, company keys are used to select all directors who work or worked at one of these companies from 2018 to 2023. This resulted in 6 years of data for 31802 directors. Next, the director data is used to calculate the board diversity per company per year. Further explanation for board diversity will be explained in the Board Diversity chapter. Subsequently, firm fundamentals for these 4521 firms are added by using the Compustat database. Several variables are missing for certain firms. Transforming and cleaning the data, which will be explained in the following chapters, eventually leads to data for 2611 firms. Python is used as software program to compute and calculate the necessary variables.

3.2 *Data*

3.2.1 *Dependent variable*

In this thesis I examine whether the benefits of board diversity outweigh its cost. To do this, firm performance is used as the dependent variable. Various forms of firm performance have been used in previous literature. It is still not clear what the net impact is of board diversity on firm performance, because there are so many different outcomes (Post, 2015). To examine the influence in this thesis four proxies for firm performance are used: The ratio of EBITDA-to-Assets, Market-to-Book ratio, Tobin's Q and Return on Assets (ROA). This is a combination of valuation metrics and operating firm performances.

To construct these performance metrics, Compustat provides annual data for firm fundamentals, including the variables needed to compute the proxies. Following Bernile et al. (2018), an increase in board diversity should lead to positive effects for firms in form of better profitability and higher valuations. Therefore, using EBITDA-to-Assets and Market-to-Book ratio is justified. In this thesis, two other proxies for firm performance are used to get an even broader picture of board diversity. Tobin's Q is used in prior literature (Ahern & Dittmar, 2012; Mínguez-Vera, 2008). It provides insight into a firm's market value relative to the replacement cost of its assets. Tobin's Q is a proxy for shareholder's value, which is a better metric than stock price returns. ROA has often been used as a performance measure (Knyazeva et al., 2013). ROA is a financial ratio that provides insight into a company's efficiency in utilizing its assets to generate profit. ROA is the ratio of operating income to total assets, expressed as a percent of total assets.

$$[1] \quad \text{EBITDA-to-Assets} = \frac{\text{EBITDA}}{\text{TA}}$$

$$[2] \quad \text{Market-to-Book} = \frac{\text{MVPS}}{\text{BVPS}}$$

$$[3] \quad \text{Tobin's Q} = \frac{\text{MV} + \text{TA} - \text{CEQ}}{\text{TA}}$$

$$[4] \quad \text{ROA} = \frac{\text{NI}}{\text{TA}}$$

EBITDA-to-Assets is calculated through dividing Earnings Before Interest, Tax, Depreciation and Amortization (EBITDA) and Total Assets (TA). For Market-to-Book, the Market Value of Equity Per Share (MVPS) is divided by the Equity Book Value Per Share (BVPS). For Tobin's

Q, the sum of Market Value (MV) plus Total Assets (TA) minus the Book Value of Common Equity (CEQ) is divided by Total Assets (TA). For ROA, Net Income (NI) is divided by Total Assets (TA).

3.2.2 *Explanatory variable: Board Diversity*

To assess the impact of diversity on variables like firm performance or risk, a comprehensive diversity index should incorporate both demographic and cognitive components (Bernile et al., 2018). Demographic diversity involves observable characteristics such as gender, ethnicity and age. Cognitive diversity explores differences in perspectives, knowledge, and problem-solving approaches among individuals. Achieving a balanced mix of characteristics from these two diversity types is essential. The Board Diversity Index, based on prior literature and data availability, integrates two demographic components (gender and age) and two cognitive components (years of experience on the current board and total boards served on). This approach ensures a well-rounded evaluation of diversity.

The Board Diversity Index is composed of four diversity components. First, the gender diversity component is based on the difference between male and female board directors. This is done by calculating the percentage of women per company for every year. This involves a multi-step process. Initially, the data must be grouped by the company identifier via 'CompanyID' or 'Ticker Symbol'. This ensures the data is organized in such a way that company data is grouped together. Subsequently, for every company, the number of female directors can be determined. By dividing this count by the total number of directors for this particular company, the percentage of women per company can be determined.[1] The second diversity component is the director's age. The standard deviation of director's age is calculated per company, using the grouped data. The third diversity component is years of experience. Years of experience are the number of years a director has held his or her board seat. The standard deviation for years of experience per company is calculated. The fourth diversity component is the number of boards a director has sat on. The standard deviation for number of boards per company is calculated. Standard deviation is used for these three components, because this is more convenient than transitioning directors from one bucket to another.

Combining these characteristics is based on the approach of Bernile et al. (2018). In or-

[1] When the data is grouped by company and year it is easy to calculate the percentage of females for every company every year. For example, company XYZ has 12 board members of which 3 are female in 2018. The percentage of women for company XYZ is 3 divided by 12, which is 0.25. So the percentage of women for company XYZ in 2018 is 25%.

der to obtain a single diversity value per company, the diversity components need to be scaled in such a way that they are comparable. Each component is divided by its mean, to get a normalized value. This way the components can be added together to obtain a board diversity value per year for every company. The following formula is used:

$$\text{Normalized Diversity component} = \frac{\text{Standard Dev. Diversity component}}{\text{Mean of Diversity component}}$$

The normalized components can be added together to obtain the Board Diversity Index.[2] This formula calculates the board diversity for every firm every year. The i is the specific firm and t is the specific year. This will be used as main explanatory variable to examine the relation between board diversity and firm performance. The normalized components are indicated with NORM. Moreover, this variable is also used to construct the instrumental variable, which will be discussed in the next chapter.

$$\begin{aligned}\text{Board Diversity Index}_{it} = &\text{Female\_Norm}_{it} + \text{Age\_Norm}_{it} + \\ &\text{Time\_Board\_Norm}_{it} + \\ &\text{Num\_Boards\_Norm}_{it}\end{aligned}$$

3.2.3 *Instrumental variable: Surrounding Diversity*

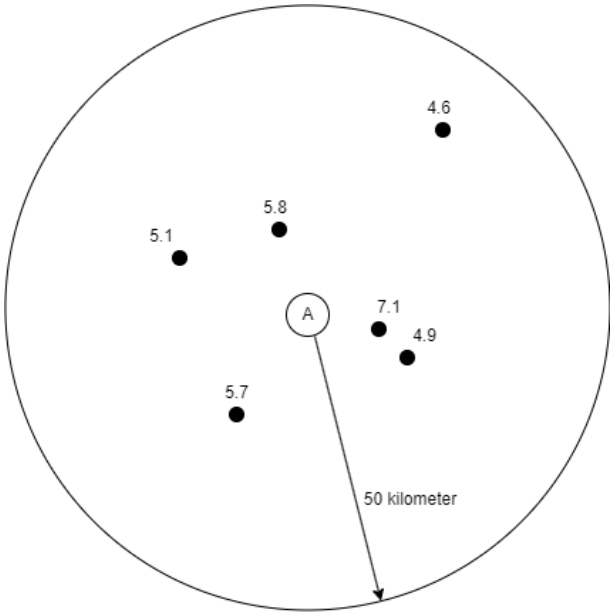
Throughout this thesis, a director supply-based instrumental variable is used to address the issue of endogeneity. This implies that we need to create a variable aiming to capture the accessibility of recruiting diverse directors. The underlying rationale is rooted in the notion that a larger pool of potential diverse directors enhances the ease of recruiting such candidates. Consequently, companies with access to a more extensive pool are more likely to have a diverse board. Moreover, the use of this type of instrumental variable is substantiated by Knyazeva et al. (2013). Geographic location of a firm's headquarter is generally chosen long before this firm goes public and a board of directors is composed. This means the location is unrelated to the demand for building a diverse board. Therefore, firm location and concentration of firms can be seen as exogenous variation. This solves the problems Ferreira (2015) addressed for using gender quotas as causal inference.

For every firm, the concept of surrounding diversity represents a measure that determines the average board diversity of firms within a certain radius. This radius serves as a geographical

[2] The meaning of Board Diversity index is that for every company every year (2018-2023) a single value is calculated. So, company XYZ can have a diversity value of 5.2 in 2018, a value of 5.5 in 2019, etc.

proximity metric. So the surrounding diversity is the average of all board diversities within the radius. Various distances are used for the radius, 25-kilometer, 50-kilometer and 100-kilometer. A problem does arise when comparing firms with varying numbers of neighboring firms within their radius. Consider a scenario where one firm has only one neighboring firm within its proximity, while another has twenty. Simply calculating the average surrounding diversity might lead to an unfair comparison, as the average could be the same for both firms, despite the substantial difference in the number of surrounding firms. More firms within the radius could indicate a bigger pool of local potential directors. To address this issue, a penalty term is incorporated into the surrounding diversity calculation. Specifically, a minimum threshold of ten neighboring firms is set for each radius. If a firm falls short of this threshold, hypothetical firms with a board diversity of zero (indicating no diversity at all) are introduced. This addition ensures that the average surrounding diversity becomes significantly lower for firms with fewer neighboring companies.[3] Figure 1 is an example how to calculate the surrounding diversity.

Figure 1: Surrounding Diversity
The surrounding diversity of firm A is determined by the average of the six black firms plus the four hypothetical firms with a value of zero. So in this case, the surrounding diversity is: (4.6 + 5.8 + 5.1 + 7.1 + 4.9 + 5.7 + 4 * 0) / 10 = 3.32



[3] Note that if a firm has ten or more surrounding firms within its specified radius, no hypothetical firms are introduced in the surrounding diversity calculation. In this scenario, the average board diversity is directly calculated based on the existing surrounding firms. This means that whether a firm has 10 or 50 surrounding firms, the diversity pool considered for the calculation remains the same.

To calculate surrounding diversity, python is used. First, Balltree is used to search for nearest neighbours. This method recursively partitions the dataset into subsets (balls). The algorithm efficiently moves through the tree, sometimes skipping entire branches based on distances, until it reaches a leaf node (decision point). At the leaf node, it examines a localized subset of points to find the nearest neighbour. So, it searches for the nearest neighbour in a subset of points, and therefore is more efficient. When the nearest neighbours are determined, a function calculates the average diversity of those neighbours. If there are less than ten neighbours, the hypothetical neighbours with zero diversity are added to account for the difference. The dataset utilized for assessing surrounding diversity includes board diversities for each firm across the years 2018 to 2023. When identifying neighboring firms for a specific firm, it's crucial to avoid including the same firm in a different year. This ensures that the assessment of surrounding diversity focuses on distinct firms in each respective year, preventing duplication.

The instrumental variable used in this thesis is different from prior literature. Knyazeva et al. (2013) utilized the number of firms within a 60-mile radius for their instrumental variable. This only indicates how many firms are there in their proximity. To better capture the supply potential diverse directors directors, some diversity measure should be incorporated. Bernile et al. (2018) expanded this pool of directors who are a non-stop flight away from their headquarter. However, these directors already work at this specific firm, meaning they are already part of the board of directors. They may not necessarily represent the untapped potential for diversifying the board. The approach in this thesis tries to find potential diverse directors who can join the board of directors. By measuring the board diversity of the specific surrounding firms offers a more refined and and context-aware measure. This surrounding diversity value takes both the number of surrounding firms and their diversity into account. The calculation of surrounding diversity with respect to former instrumental variables is more complicated. Instead of just counting the firms in a radius, these specific surrounding firms need to be remembered for determining their board diversity.

In the process of calculating the surrounding diversity for a particular firm, the diversity of that specific firm itself is included as one of the factors. In essence, the board diversity of the focal firm is considered alongside the diversities of other surrounding firms within the specified radius. This approach ensures that the diversity metric encompasses not only the external board compositions but also incorporates the internal diversity of the firm under examination.

3.2.4 *Control variables*

This thesis will include a number of control variables to capture other determinants that may influence firm performance. The control variables are Number of Directors, Firm size, Leverage, sector, and year.

The first control variable is the number of board directors. Most prior literature has found a negative relationship between board size and firm performance (Carter et al., 2003). Yermack (1996) has researched the influence of board size on Tobin's Q for U.S. companies from 1984 to 1991. A small board does not only positively impacts firm value, but also other financial ratios. So their conclusion is that board size has a negative influence on firm performance. This is because there is a higher chance there are conflicts of interest in a bigger board of directors. More recent studies, such as O'Connell and Cramer (2010), also find a negative relationship for the Irish stock market. Therefore, in this thesis I expect a negative relationship for board size and firm performance. Firm size is the second control variable. This will be done using the natural logarithm of total assets as proxy for firm size. Most prior literature found a positive relation (Adams & Ferreira, 2009; Bernile et al., 2018; Knyazeva et al., 2013). However, some studies Mínguez-Vera (2008) found a negative effect of firm size on firm performance. This is because larger companies tend to be more inefficient than smaller companies. Leverage is the third control variable. This variable is used by Bernile et al. (2018) in different types of regressions. It turns out board diversity has a significant influence on firm's leverages, and could therefore be interesting to add as a control variable. Finally, year fixed effects and industry fixed effects are added. The number of board directors can be extracted from the dataset. Firm size and Leverage need to be calculated. The control variables are:

$$[5] \quad \text{Number of Directors}$$

$$[6] \quad \text{Firm size} = \ln(\text{TA})$$

$$[7] \quad \text{Leverage} = \frac{\text{DLTT} + \text{DLC}}{\text{SEQ}}$$

The natural logarithm of Total Assets (TA) is used as proxy for Firm size. The debt level of a company is measured using the Leverage. This is done by adding long term debt (DLTT) and debt in current liabilities (DLC) divided by the stockholder's equity (SEQ).

3.3 *Descriptive Statistics*

The descriptive statistics are shown in table 1. This is an overview of firm-level time-varying characteristics. A noteworthy observation is the presence of several extreme outliers across numerous variables. These outliers can significantly impact the interpretation of summary measures, therefore in table 2 the variables are transformed. Examining specific variables, both EBITDA and Net Income exhibit negative minimum values. This indicates that not all firms in the dataset are consistently profitable. This influences performance metrics, such as ROA, Tobin's Q, Market-to-Book ratio and EBITDA-to-Assets. The variable ROA appears to have a mean close to zero, suggesting that, on average, the entities in the dataset are not generating substantial returns on their assets. Additionally, Tobin's Q, Market-to-Book ratio, and Leverage exhibit considerable variability, as indicated by their standard deviations.

Board Diversity and Surrounding Diversity display similarities in their characteristics, with comparable mean and standard deviation values. This could suggest that the diversity of both board members and the broader corporate environment are influenced by each other. The Board Diversity of a firm has a value between 0 and 12.79. When the board of directors of a firm is not diverse at all, based on the diversity components, this results in a value of zero. The higher the value the more diverse the board of directors is. It is remarkable that the minimum value of Surrounding Diversity is 0.04, slightly higher than zero. If a firm has no firms in their proximity, this should result in a surrounding diversity of zero. However, when creating the surrounding diversity variable of a certain firm, the diversity of this certain firm is also included. This actually is a better representation of surrounding diversity, because the diversity should be measured by both the surrounding firms and the respective firm.

The following variables are transformed. Total Assets is used as control variable for firm size. Therefore, the natural logarithm for Total Assets is applied. Tobin's Q, used as firm performance measure, has some extreme outliers. Therefore Tobin's Q will be winsorized. Winsorizing uses a technique where all values in the upper or lower tail are replaced with the 1st and 99th percentile respectively. Market-to-book, EBITDA-to-Assets and Leverage also contain very large outliers. These variables are also winsorized. Table 2 shows the descriptive statistics for transformed variables and the untransformed variables.

Compared to other studies such as Bernile et al. (2018), some statistics differ in magnitude.

This is because prior research often uses a different dataset. Prior research is mostly focused on S&P 1500 companies. In this thesis a self made sample of North American companies is used, where the market capitalization is at least 250 million. Much smaller companies are therefore included, which has influence on profitability and revenues.

Table 1: Descriptive Statistics

Variable	Observations	Mean	Std. Dev	Min	Max
Total Assets	11367	18090.58	100664.4	2.08	3169495
EBITDA	11367	806.66	3562.17	-28387	119437
Net Income	11367	487.18	2746.48	-22440	99803
Market Value	11367	12493.91	56517.04	14.64	2324390
ROA	11367	-0.00	0.21	-5.24	5.00
Tobin's Q	11367	2.53	7.69	-18.30	753.07
Market-to-Book	11367	3.64	235.23	-21212.5	7243.39
EBITDA-to-Assets	11367	0.07	0.49	-5.09	19.42
Leverage	11367	0.59	30.31	-2232.71	603.79
Number of Directors	11367	9.20	2.31	3	23
Board Diversity	11367	3.85	1.28	0	12.79
Surrounding Diversity 25km	11367	3.02	1.33	0.04	6.40
Surrounding Diversity 50km	11367	3.29	1.14	0.04	7.61
Surrounding Diversity 50km	11367	3.47	0.93	0.04	7.25

Table 2: Descriptive Statistics - Transformed

Variable	Observations	Mean	Std. Dev	Min	Max
log(Total Assets)	11367	7.98	1.72	0.73	14.97
EBITDA	11367	806.66	3562.17	-28387	119437
Net Income	11367	487.18	2746.48	-22440	99803
Market Value	11367	12493.91	56517.04	14.64	2324390
ROA	11367	-0.00245	0.209	-5.24	5.00
Tobin's Q_w	11367	2.39	2.21	0.64	13.46
Market-to-Book_w	11367	4.30	10.45	-34.32	69.86
EBITDA-to-Assets_w	11367	0.061	0.162	-0.62	0.48
Leverage_w	11367	0.963	2.745	-11.99	15.30
Number of Directors	11367	9.20	2.31	3	23
Board Diversity	11367	3.85	1.28	0	12.79
Surrounding Diversity 25km	11367	3.02	1.33	0.04	6.40
Surrounding Diversity 50km	11367	3.29	1.14	0.04	7.61
Surrounding Diversity 50km	11367	3.47	0.93	0.04	7.25

3.3.1 *Instrumental Variable validation*

Table 4 shows the correlation between dependent, independent, instrumental and some control variables. The instrumental variable, surrounding diversity, exhibits minimal correlation with the dependent variables, such as Tobin's Q, ROA, EBITDA-to-Assets, and Market-to-Book ratio. This suggests that surrounding diversity is not directly influencing firm performance, avoiding potential issues of endogeneity. Moreover, the instrument shows a little correlation with the primary independent variable, board diversity, which is desirable for ensuring that the instrument is not simply a proxy for the main explanatory variable.

There are three instrumental variables. They differ in their radius, 25 kilometer, 50 kilometer and 100 kilometer. To assess the validity of the instruments used in an IV regression, specifically to check for over-identification of the model, a Sargan test is performed. In IV regression, the aim is to estimate the effect of an endogenous variable on an outcome variable while accounting for potential endogeneity issues. This is done by using instrumental variables. When the number of instrumental variables exceeds the number of endogenous regressors, the model becomes overidentified. The Sargan test tests whether the instruments used in my model are valid. The null hypothesis is that the instruments are valid. If the p-value is above the 0.05 level, you fail to reject the null hypothesis. This means based on the Sargan test, there is no indication of overidentification or invalid instruments. Based on the results in table 3 [4], the instruments are not invalid for three performance metrics. The instruments are weak for their effect on ROA. However, the Sargan test may be problematic, because the instrumental variables are quite the same. They only differ in their radius. Kiviet and Kripfganz (2021) argue that the test lacks power if the instruments have unverifiable characteristics or indistinguishable characteristics. Therefore, the Sargan test is not perfect.

Table 3: Sargan statistics
This table shows the Sargan-statistic and p-value for the instruments.

Dependent Variable	Statistic	P-value
ROA	7.254	0.0266
Tobin's Q_w	0.426	0.8082
Market-to-Book_w	1.636	0.4414
EBITDA-to-Assets_w	7.089	0.289

[4] For every firm performance metric, all instruments should be included to determine their validity. There are three instruments for every performance metric.

Table 4: Correlation Matrix
This table shows the correlations between the variables used in the regression analysis.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) ROA	1.00										
(2) Tobin's Q	-0.26	1.00									
(3) market-to-Book	0.02	-0.02	1.00								
(4) EBITDA-to-Assets	0.34	-0.11	0.01	1.00							
(5) Leverage	0.01	-0.01	0.21	0.00	1.00						
(6) Number of directors	0.12	-0.07	-0.01	0.04	-0.00	1.00					
(7) Firm_size	0.28	-0.14	0.02	0.10	0.00	0.57	1.00				
(8) Board_diversity	0.10	-0.02	0.00	0.07	-0.00	0.17	0.20	1.00			
(9) Surrounding diversity_25km	-0.07	0.02	-0.01	-0.02	-0.00	-0.04	-0.00	0.16	1.00		
(10) Surrounding diversity_50km	-0.07	0.02	0.00	-0.02	0.01	-0.05	-0.02	0.15	0.86	1.00	
(11) Surrounding diversity_100km	-0.06	0.03	0.01	-0.02	0.01	-0.04	-0.03	0.12	0.70	0.86	1.00

3.4 *Research Methodology: Regression Analyses*

To analyze the collected data I will perform instrumental variable regressions in the statistical tool STATA.Previous studies have highlighted the challenge of endogeneity in board compositions, wherein variables like board diversity may be influenced by unobserved factors, potentially biasing the results. To mitigate this issue, a two-stage least squares analysis will be performed, known as instrumental variable regression. In the first stage, board diversity levels will be predicted by surrounding diversity, serving as a proxy for the local director pool. This variable reflects the diversity within the vicinity of firms, providing insight into the availability of diverse director candidates. While surrounding diversity influences board diversity it does not impact firm performance directly. The estimated values of board diversity will be based on the instrumental variable. This instrumental variable has three different radii as is mentioned earlier. Regression equations in this first stage show how board diversity is influenced by surrounding diversity and potentially other control variables. Consequently, the regression formulas for the first stage are as follows: [5]

$$[8] \quad BoardDiversity_{it} = \beta_0 + \beta_1\ Surrounding\ Diversity\_25km_{it} + \beta_4\ \textbf{Control Variables}_{it} + \epsilon_{it}$$

$$[9] \quad BoardDiversity_{it} = \beta_0 + \beta_1\ Surrounding\ Diversity\_50km_{it} + \beta_2\ \textbf{Control Variables}_{it} + \epsilon_{it}$$

$$[10] \quad BoardDiversity_{it} = \beta_0 + \beta_1\ Surrounding\ Diversity\_100km_{it} + \beta_2\ \textbf{Control Variables}_{it} + \epsilon_{it}$$

This means Board Diversity will be regressed on surrounding diversity and control variables. The results of this first stage are given in table 6 in Appendix A. This first stage regression also demonstrates the relevance of surrounding diversity on board diversity.

In the second stage firm performances will be regressed on the predicted board diversity and control variables. This stage aims to uncover the relationship between board compositions and various measures of firm performance. There are four different dependent variables, all representing firm performance. To perform this panel approach in STATA, the **xtivreg2** command is used. It could be possible that the local industry clusters might lead to knowledge spillover effects or better access to expertise from industry peers. Therefore, industry fixed effects are used to control for time-invariant heterogeneity. The outcome of the second stage

[5] It is important to note that the data for 2023 is dropped, which means that data from 2018 to 2022 is used. This is because some firms report firm results of the fourth quarter of 2023 only at the end of the first quarter in 2024.

regression is given in the Empirical Results section. Consequently, the following regression functions are formed:

[11] $\textit{Tobin's } Q_{it} = \beta_0 + \beta_1 BoardDiversity_{it} + \beta_2 \textbf{ Control Variables}_{it} + \epsilon_{it}$

[12] $ROA_{it} = \beta_0 + \beta_1 BoardDiversity_{it} + \beta_2 \textbf{ Control Variables}_{it} + \epsilon_{it}$

[13] $\textit{Market-to-Book}_{it} = \beta_0 + \beta_1 BoardDiversity_{it} + \beta_2 \textbf{ Control Variables}_{it} + \epsilon_{it}$

[14] $\textit{EBITDA-to-Assets}_{it} = \beta_0 + \beta_1 BoardDiversity_{it} + \beta_2 \textbf{ Control Variables}_{it} + \epsilon_{it}$

In these formulas board diversity is instrumented with surrounding diversity as is mentioned before. The four different variables for firm performance and control variables are explained in the data chapter.

4 EMPIRICAL RESULTS

This thesis examines the relation between board diversity and firm performance. Specifically, whether board diversity affect firm performances. Three types of instrumental variables are used to counter the endogeneity issues. The instrumental variables differ in their radius. The different types of instrumental variables could function as a robustness check. To this end, I examine the influence of board diversity on firm performance. The following section shows the results of this relationship.

4.1 *Interpretation*

The model used is an instrumental variable regression. Board Diversity is instrumented with surrounding diversity. There are three control variables, firm size, leverage and number of directors. Interpreting the coefficients of the regressions depends on the construction of board diversity. Given that board diversity is constructed using normalized diversity components, a "one unit increase" in the board diversity index refers to an increase of one standard deviation in the combined diversity measure.

4.2 *Findings*

The first stage regression estimates are shown in table 6 in Appendix A. The estimates show that there is a significant positive effect between surrounding diversity and board diversity. Each column represent the first stage regression between the dependent variable board diversity and independent variable surrounding diversity with a certain radius. The F-statistic is greater than 10, which means it is not a weak instrument.

The second stage regression is displayed in table 5. This table shows the regression results where board diversity is instrumented with one of the three surrounding diversities. The surrounding diversities differ in their radius. The firm performances are indicated in the four columns. [6] Three regressions are performed with the same dataset, only the instrumental variable is changing across these regressions. Thereafter, regression results are showed without the control variables in table 7.

[6] Bernile et al. (2018) only used two performance metrics Market-to-Book and EBITDA-to-Assets.

Table 5: Regression results with different surrounding diversities as instruments. There are four dependent variables: ROA, Tobins's Q, Market-to-Book and EBITDA-to-Assets. Board diversity is instrumented with one of the surrounding diversities. The sample consists of North American firms for the period 2018 to 2022, collected from BoardEx and Compustat. The independent variable is Board Diversity. The t-statistics (standard errors) are stated in parentheses. All models include year fixed effects and standard errors are clustered at the firm level to account for the second stage estimation. The stars indicate the significance level.

	ROA	TobinQ	Market-to-Book	EBITDA-to-Assets
Surrounding Diversity of 25 kilometer				
Board_diversity	-0.0352*	0.1188	-0.0186	-0.0154*
	(0.0188)	(0.0747)	(0.4328)	(0.0056)
Firm_size	0.1258***	-0.7554***	-1.4302***	0.0506***
	(0.0365)	(0.1056)	(0.6249)	(0.0069)
Leverage_w	-0.0023***	-0.0101	2.6477***	-0.0014***
	(0.0007)	(0.0071)	(0.1216)	(0.0005)
Number of directors	-0.0035*	-0.0154	-0.0747	-0.0021*
	(0.0018)	(0.0150)	(0.1009)	(0.0010)
Constant	-0.8379***	8.1172***	13.8864***	-0.2632***
	(0.2267)	(0.6996)	(3.9113)	(0.0452)
Observations	11,024	11,024	11,024	11,024
Overall R-squared	0.0535	0.0499	0.5290	0.0368
Surrounding Diversity of 50 kilometer				
Board_diversity	-0.0443**	0.1210*	0.2655	-0.0227***
	(0.0198)	(0.0711)	(0.4589)	(0.0055)
Firm_size	0.1301***	-0.7565***	-1.5640**	0.0540***
	(0.0370)	(0.1059)	(0.6379)	(0.0070)
Leverage_w	-0.0023***	-0.0101	2.6479***	-0.0014***
	(0.0007)	(0.0071)	(0.1215)	(0.0005)
Number of directors	-0.0028	-0.0156	-0.0968	-0.0015
	(0.0019)	(0.0151)	(0.1042)	(0.0010)
Constant	-0.8436***	8.1186***	14.0671***	-0.2679***
	(0.2278)	(0.7010)	(3.9317)	(0.0457)
Observations	11,024	11,024	11,024	11,024
Overall R-squared	0.0689	0.1037	0.3404	0.0600

Continued on next page

Table 5 (Continued): Regression Results with Different Surrounding Diversities as Instruments.

	ROA	TobinQ	Market-to-Book	EBITDA-to-Assets
Surrounding Diversity of 100 kilometer				
Board_diversity	-0.0527**	0.0994	0.1459	-0.0233***
	(0.0201)	(0.0702)	(0.4500)	(0.0051)
Firm_size	0.1341***	-0.7463***	-1.5076*	0.0543***
	(0.0376)	(0.1067)	(0.6362)	(0.0071)
Leverage_w	-0.0023***	-0.0101	2.6478***	-0.0014***
	(0.0007)	(0.0071)	(0.1215)	(0.0005)
Number of directors	-0.0022	-0.0139	-0.0875	-0.0015
	(0.0018)	(0.0151)	(0.1024)	(0.0010)
Constant	-0.8490***	8.1048***	13.9910***	-0.2683***
	(0.2291)	(0.7036)	(3.9277)	(0.0459)
Observations	11,024	11,024	11,024	11,024
Overall R-squared	0.0663	0.1037	0.3405	0.0595

The outcomes for firm performance vary significantly across all three regressions when considering the instrumented board diversity. Specifically, a negative association is observed with ROA, where the coefficients of the instrumented board diversities are -0.0352, -0.0443 and -0.0527. All these coefficients are significant at the 10% or 5% level. This means for every unit change in board diversity (using the 25 kilometer surrounding diversity), the ROA decreases with 0.0352 holding all other variables constant. There is also a negative association between the instrumented board diversity and EBITDA-to-Assets. The coefficients are -0.0154, -0.0227 and -0.0233. Again these coefficients are significant, indicated with the stars. There is a positive association between the instrumented board diversity and Tobin's Q. However, just one coefficient is significant. The effect on Market-to-Book is both positive and negative. This depends on which instrument is used. The coefficients for Market-to-Book are all insignificant. The effects on ROA and EBITDA-to-Assets are most significant and therefore best to use.

The control variables exhibit different magnitudes and directions of impact. Firm size stands out as a robust predictor, demonstrating statistical significance across all performance metrics. On the other hand, the number of directors is insignificant for almost all performance metrics.

The effect of the instrumented board diversity on the performance metrics are very low. The coefficients are all close to zero, which could mean limited influence of board diversity on the examined firm performance metrics. The R-squared is also low, but this does not have to be a problem. The significance of the coefficients in my regression analysis is more critical than the overall fit of the model. In many earnings regressions a low R-squared is considered valid. The R-squared for Tobin's Q and Market-to-Book are much higher. This suggests the proportion of variance for those two performance variables can be better explained by the independent variables. Generally, a higher R-squared suggest that a larger proportion of the variance in the dependent variables is explained by the independent variables, indicating better model performance. In this case, we can see that as the radius of surrounding diversity increases, the overall R-squared tend to decrease, suggesting a potentially weaker explanatory power of the model.

Table 7 in Appendix B shows the results when control variables are removed. The results are much more significant than before. However, the effects of board diversity on the performance metrics are very different than the effects including the control variables. There is a positive effect on ROA and EBITDA-to-Assets. There is a negative effect on Tobin's Q. The effect on Market-to-Book is both positive and negative, this depends on the use of the instrumental variable. The R-squared for all these regressions are very low. This is because the control variables also explain some variation in our dependent variables.

In summary, the coefficients of board diversity are the most significant using a radius of 50 kilometer for surrounding diversity. The effect on ROA, Tobin's Q and EBITDA-to-Assets are all significant. This would argue in favor of using the 50 kilometer radius as instrumental variable. The coefficients of board diversity using a 25 or 100 kilometer radius are significant for ROA and EBITDA-to-Assets. There are mixed results regarding the impact of board diversity on firm performance. Given these mixed results, I find only partial support for hypothesis 1, which stated that board diversity will have a positive effect on firm performance. While the effect on Tobin's Q is positive, the effect on ROA and EBITDA-to-Assets is slightly negative. Moreover, the effect on Tobin's Q is only significant using the 50 kilometer radius for surrounding diversity. The second hypothesis stated that the instrumental variable, surrounding diversity, mitigates the endogeneity issue between board diversity and firm performance. Table 6 tests this whether the the surrounding diversity influences the board diversity. The results suggest a positive and significant effect. Therefore, board diversity is dependent on

the surrounding diversity. This in combination with a F-statistic greater than 10 indicates the instrumental variable is relevant. So, we can assume that surrounding diversity mitigates endogeneity issues.

5 DISCUSSION

The main question is whether the instrumented board diversity influences the firm performance. The first hypothesis stated that board diversity has a positive influence on firm performance. However, the results suggest there is no clear impact of board diversity on firm performance. This depends on the radius of the instrumental variable and the different firm performances. This is different than prior research, which mainly find a positive relationship between board diversity and firm performance such as Bernile et al. (2018), Carter et al. (2003), Hyoung Ju Song (2020), and Li et al. (2011). The instrumental variable with a radius of 50 kilometer provides the most significant outcomes. The outcomes for this regression are a slightly negative effect on ROA and EBITDA-to-Assets and a positive effect on Tobin's Q. The effect on Market-to-Book is insignificant. The different outcomes can be explained. Board diversity constructed in this thesis is not the same as in other studies. In fact, almost all research focused on this subject have different board diversities. Although, certain components are the same, such as gender, age and board experience, the exact combination of those components is new. Adams and Ferreira (2009) only focused on one diversity component. Bernile et al. (2018) also included ethnicity as diversity component. This could influence the overall diversity of the board of directors and eventually affect the firm performance. Moreover, the kind of firms included in my dataset is different than most prior research. Instead of using all firms in the S&P 500 or S&P 1500, I have chosen for a larger dataset. All firms with a market of 250 million or higher in North America are used. Including these smaller firms creates a larger dataset, but also influences the overall profitability. Smaller firms are often less profitable and are more focused on growth than larger firms. The performance metrics are for a large part based on profitability, which mean smaller firms score worse. However, there is a positive effect of board diversity on Tobin's Q. This is because Tobin's Q is not a profitability, but a valuation metric. This positive effect is consistent with prior literature (Knyazeva et al., 2013).

The second hypothesis stated that surrounding board diversity mitigates the endogeneity problems. It turns out surrounding diversity emerges as a robust instrument for capturing the multidimensional nature of board diversity and its impact on firm performance. A number of arguments and tests are given to validate the instrumental variable. The Sargan test identifies if the model is overidentified. This occurs when the number of instrumental variables exceeds the number of endogenous regressors in an IV regression model. The Sargan test shows that there is no indication of overidentification. However, the Sargan test may not be the best way

to determine this, because the instruments are almost the same. The instruments are calculated slightly different, based on their radius. Kiviet and Kripfganz (2021) also highlight that the Sargan test lacks power to identify a valid instrument if the instruments have unverifiable characteristics. In my case the instruments have almost no different characteristics, except for their radius. However, they also highlight that to qualify as an effective external instrument, the instrument should be correlated with the endogenous variable and should not be correlated with the dependent variable. This is the case with all three instrumental variables in this thesis. Finally, the first stage regression also shows that surrounding diversity has a significant effect on board diversity. This and the fact that this instrumental variable is built on the ideas of Bernile et al. (2018) and Knyazeva et al. (2013) should make it a reliable instrumental variable.

This thesis contributes to existing literature in various ways. First, my findings of the influence of board diversity on firm performance add to existing studies, there is not a obvious positive effect. Moreover, a new method to calculate the instrumental variable is used. Because the composition of board of directors often has endogeneity issues (Hermalin & Weisbach, 1998), researchers often use regulatory changes or gender quotas (Ahern & Dittmar, 2012). However, these methods are not optimal (Ferreira, 2015; Kirchmaier & Adams, 2013). Therefore, surrounding diversity is measured for each firm to use as an instrumental variable.

There are a couple of limitations. Despite the use of the instrumental variable to address endogeneity issues, residual confounding factors may still exist. Unobserved variables or omitted variable bias could influence the results, leading to potential biases in the estimated effects of board diversity on firm performance. A second limitation is the data availability. This study uses data from 2018 to 2023, which is a short period. To capture the effect of firm performance longer time frames are essential. Although this time frame has data of more than 4000 firms, for many firms there is data missing for their board members, which is essential for measuring the board diversity. Future work should therefore focus on a larger sample.

6 CONCLUSION

This thesis delves into the intricate relationship between board diversity and firm performance, aiming to address the ongoing debate regarding its impact. There is no consensus about whether the effect of board diversity on firm performance is positive or negative. Moreover, inconsistent and insignificant results in prior research suggest that research designs are missing factors for causal inferences. Therefore, I propose an instrumental variable, surrounding diversity, to address for these issues. The research question is: *Does board diversity significantly impact firm performance, and to what extent does the use of surrounding diversity as an instrumental variable mitigate endogeneity concerns?*

To answer this research question I have analyzed the board diversity across firms over a specified time period. Board diversity is constructed based on four diversity components: gender, age, experience and number of boards served on. Board diversity is measured for all firms from 2018 to 2023. Then, the influence of board diversity on firm performance can be determined via an instrumental variable regression. The instrumental variable, surrounding diversity, is measured by setting a radius for each firm and determining the average board diversity in this radius. There are four measures for firm performance, ROA, Tobin's Q, Market-to-Book and EBITDA-to-Assets.

This study provides valuable insights into the dynamics of the diversity of board of directors and its implications for a firm's success. The effect on these firm performances varies. Using a radius of 50 kilometer as instrumental variable generates the most significant results. The results indicate there is no clear outcome whether there is a positive or negative effect. The effect on ROA and EBITDA-to-Assets, both profitability metrics, are slightly negative. The effect on Tobin's Q, a valuation metric, is positive. Several reasons are given in the Discussion section for this disparate result. Surrounding diversity tends to be a reliable instrumental variable in this thesis. Surrounding diversity has an effect on board diversity but not directly on firm performance, this is ideal to solve the endogeneity issues.

This study concludes, that although prior literature shows a positive effect on firm performance, a higher or better board diversity not always translates into a higher firm performance. The findings of this thesis hold implications for investors and society. Investors should consider the specific context and objectives of their investment when evaluating the importance of board

diversity. The positive influence of board diversity on valuation metrics, such as Tobin's Q, suggests that investors perceive diverse boards as indicative of a company's potential for future growth and innovation. On the other hand, the slightly negative effect of board diversity on profitability metrics like ROA and EBITDA-to-Assets implies that they might encounter initial challenges or inefficiencies in optimizing short-term profitability.

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A APPENDIX A

Table 6: First Stage Regression Results.
Board diversity is regressed on surrounding diversity and control variables. Each column is a regression result where the independent variable is one of the surrounding diversities. So the coefficient of surrounding diversity of 25 kilometer on board diversity is 0.157.

Variable Surrounding Diversity	**For 25km**	**For 50km**	**For 100km**
	(1)	(2)	(3)
Surrounding Diversity	0.157***	0.171***	0.181***
	(0.008)	(0.010)	(0.013)
Leverage_w	-0.006***	-0.006***	-0.006
	(0.004)	(0.004)	(0.004)
Firm Size	0.104***	0.106***	0.108***
	(0.008)	(0.008)	(0.008)
Number of Directors	0.055***	0.055***	0.053***
	(0.006)	(0.006)	(0.006)
Model Statistics			
R-squared	0.0699	0.0667	0.0608
Observations	11,024	11,024	11,024
F-statistic	212.97	202.55	183.58

Standard errors in parentheses. * p<0.05, ** p<0.01, *** p<0.001

B APPENDIX B

Table 7: Regression Results without Control Variables using Different Surrounding Diversities.

	ROA	Tobin's Q	Market-to-Book	EBITDA-to-Assets
Board_Diversity (25km)	0.0333***	-0.3225***	0.1068	0.0116***
	(0.0084)	(0.0618)	(0.4053)	(0.0042)
Constant	-0.1307***	3.6282***	4.7071**	0.0164
	(0.0321)	(0.2367)	(1.5537)	(0.0162)
Overall R-squared	0.0095	0.0005	0.0012	0.0147
Board_Diversity (50km)	0.0307***	-0.3422***	0.0590*	0.0081*
	(0.0086)	(0.0585)	(0.4182)	(0.0040)
Constant	-0.1209***	3.7037***	4.0714	0.0299
	(0.0330)	(0.2242)	(1.6032)	(0.0154)
Overall R-squared	0.0042	0.0005	0.0001	0.0028
Board_Diversity (100km)	0.0273***	-0.3676***	-0.1830	0.0086*
	(0.0076)	(0.0575)	(0.4192)	(0.0038)
Constant	-0.1076***	3.8013***	4.9991**	0.0278*
	(0.0291)	(0.2206)	(1.6070)	(0.0146)
Overall R-squared	0.0095	0.0005	0.0012	0.0147
Observations	11,024	11,024	11,024	11,024

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01